4 WATER QUALITY

4.1 Background Water Quality

4.1.1 The main influence on water quality inshore near R9 is poor flushing capacity of the Rambler Channel and high pollution loading from sewage and industry in the hinterland. There is consequently some difficulty in achieving the Water Quality Objectives for the Water Control Zone. Suspended solids, bacterial counts and nutrients are particularly high.

4.1.2 Since the completion of the WKRPUDS the container terminal CT8 has closed off the channel between Stonecutters Island and the mainland, further affecting flushing capacity in nearby stretches of water. The completion of North West Kowloon Interceptor Sewer has diverted flows from north west Kowloon to Stonecutters Island for treatment.

4.2 Legislative Controls

4.2.1 Tables 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7 outline and summarise all Technical Memorandum standards applicable for effluent discharge into marine and inshore waters of the study site.

Table 4.1 : Standards for Effluents Discharged into the Marine Waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zone

(All units in mg/L unless otherwise stated, all figures are upper limits unless otherwise indicated)

Flow rate (m□/day) Determinand	£10	>10 and £200	>200 and £400	>400 and £600	>600 and £800	>800 and £1000	>1000 and £1500	>1500 and £2000	>2000 and £3000	>3000 and £4000	>4000 and £5000	>5000 and £6000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (oC)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) (25mm cell length)	4	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	500	500	500	300	200	200	100	100	50	50	40	30
BOD	500	500	500	300	200	200	100	100	50	50	40	30
COD	1000	1000	1000	700	500	400	300	200	150	100	80	80
Oil & Grease	50	50	50	30	25	20	20	20	20	20	20	20
Iron	20	15	13	10	7	6	4	3	2	1.5	1.2	1
Boron	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Barium	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Mercury	0.1	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	2	1.5	1.2	0.8	0.6	0.5	0.32	0.24	0.16	0.12	0.1	0.1
Total toxic metals	4	3	2.4	1.6	1.2	1	0.64	0.48	0.32	0.24	0.2	0.14
Cyanide	1	0.5	0.5	0.5	0.4	0.3	0.2	0.15	0.1	0.08	0.06	0.04
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.13	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	50
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	30	20	20	20	15	15	15	15	15	15	15	15
E.coli (count/100ml)	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

Table 4.2 : Standards for effluents discharged into the Marine Waters of Victoria Harbour Water Control Zone

(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

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

Table 4.3 : Standards for effluents discharged into the Inshore Waters of Victoria Harbour Water Control Zone

(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m□/day) Determinand	**£10**	**>10 and £200**	**>200 and £400**	**>400 and £600**	**>600 and £800**	**>800 and £1000**	**>1000 and £1500**	**>1500 and £2000**	**>2000 and £3000**	**>3000 and £4000**	**>4000 and £5000**	**>5000 and £6000**
pH (pH units)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (℃)	40	40	40	40	40	40	40	40	40	40	40	40
Colour	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	20
Iron	15	10	10	7	5	4	2.7	2	1.3	1	1.8	0.6
Boron	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.25	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.5	0.4	0.3	0.2	0.14	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.13	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	100	100	100	100	80	80	50	50	50	50
Total phosphorus	10	10	10	10	10	10	8	8	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E.coli//100ml	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000

Table 4.4 : Standards for effluents discharged into the Inshore Waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zone

(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m□/day) Determinand	**£10**	**>10 and £200**	**>200 and £400**	**>400 and £600**	**>600 and £800**	**>800 and £1000**	**>1000 and £1500**	**>1500 and £2000**	**>2000 and £3000**	**>3000 and £4000**	**>4000 and £5000**	**>5000 and £6000**
pH (pH units)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (oC)	40	40	40	40	40	40	40	40	40	40	40	40
Colour	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	20
Iron	15	10	10	7	5	4	2.7	2	1.3	1	1.8	0.6
Boron	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2.7	2	1.6	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.25	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	30
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E.coli//100ml	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Table 4.5 : Standards for effluents discharged into the Group D Inland Waters

(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m□/day) Determinand	£200	>200 and £400	>400 and £600	>600 and £800	>800 and £1000	>1000 and £1500	>1500 and £2000	>2000 and £3000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (oC)	30	30	30	30	30	30	30	30
Colour	1	1	1	1	1	1	1	1
Suspended solids	30	30	30	30	30	30	30	30
BOD	20	20	20	20	20	20	20	20
COD	80	80	80	80	80	80	80	80
Oil & Grease	10	10	10	10	10	10	10	10
Iron	10	8	7	5	4	2.7	2	1.3
Boron	5	4	3.5	2.5	2	1.5	1	0.7
Barium	5	4	3.5	2.5	2	1.5	1	0.7
Mercury	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.8	0.5	0.5	0.2	0.2
Total toxic metals	2	2	1.6	1.6	1	1	0.5	0.4
Cyanide	0.4	0.4	0.3	0.3	0.2	0.1	0.1	0.05
Phenols	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1
Sulphide	1	1	1	1	1	1	1	1
Sulphate	800	600	600	600	600	400	400	400
Chloride	1000	800	800	800	600	600	400	400
Fluoride	10	8	8	8	5	5	3	3
Ammonia nitrogen	20	20	20	20	20	20	20	10
Total phosphorus	10	10	10	8	8	8	5	5
Nitrate/nitride	50	50	50	30	30	30	30	20
Surfactants (total)	15	15	15	15	15	15	15	15
E.coli//100ml	1000	1000	1000	1000	1000	1000	1000	1000

Table 4.6 : Water Quality Objectives (WQOs) for Victoria Harbour

Water Quality Objective	Part or Parts of Zone
A. AESTHETIC APPEARANCE	
There should be no objectionable odours of discolouration of the water.	Whole zone
Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
There should be no recognizable sewage-derived debris.	Whole zone
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
The water should not contain substances which settle to form objectionable deposits.	Whole zone
B. BACTERIA	
The level of Escherichia coli should not exceed 1 000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Inland waters
C. COLOUR	
Human activity should not cause the colour of water to exceed 50 Hazen units.	Inland waters
D. DISSOLVED OXYGEN	
The level of dissolved oxygen should not fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as the annual water column average (see Note). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters
The level of dissolved oxygen should not be less than 4 mg per litre.	Inland waters
E. pH	
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.	Marine waters
Human activity should not cause the pH of the water to exceed the range of 6.0-9.0 units.	Inland waters
F. TEMPERATURE	
Human activity should not cause the daily temperature range to change by more than 2.0 oC.	Whole zone
G. SALINITY	
Human activity should not cause the salinity level to change by more than 10%.	Whole zone
H. SUSPENDED SOLIDS	
Human activity should neither cause the suspended solids concentration to be raised more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
Human activity should not cause the annual median of suspended solids to exceed 25 mg per litre.	Inland waters
I. AMMONIA	
The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J. NUTRIENTS	
Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
Without limiting the generally of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg per litre, expressed as annual water column average (see Note).	Marine waters
K. 5-DAY BIOCHEMICAL OXYGEN DEMAND	
The 5-day biochemical oxygen demand should exceed 5 mg per litre.	Inland waters
L. CHEMICAL OXYGEN DEMAND	
The chemical oxygen demand should not exceed 30 mg per litre.	Inland waters
M. TOXIC SUBSTANCES	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.	Whole zone

Note: Expressed normally as the arithmetic mean of at least 3 measurements at 1 m below surface, mid depth and 1 m above the seabed. However in water of a depth of 5 m or less the mean shall be that of 2 measurements (1 m below surface and 1 m above seabed), and in water of less than 3 m the 1 m below surface sample only shall apply.

Table 4.7 : Summary of the Water Quality Objectives (WQOs) for the Western Buffer Zone WQZ

Water Quality Objective	Part or Parts of Zone
The annual geometric mean level of Escherichia coli should not exceed 610 per 100 ml	Secondary contact Recreation subzone Fish culture subzone
Within 2m of the bottom, the level of dissolved oxygen should not fall below 2 mg per litre for 90% of samples.	Marine waters
Depth averaged dissolved oxygen should not fall below 4 mg per litre for 90% of samples.	Marine waters, except fish culture subzone
Depth averaged dissolved oxygen should not fall below 5 mg per litre for 90% of samples.	Fish culture subzone
The pH of the water should be within the range of 6.5-8.5 units and waste discharge should not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters, except bathing beach subzone
Discharge should not cause the temperature to change by more than 2.0 °C.	Whole zone
Salinity level should not change by more than 10% of the natural ambient level.	Whole zone
Waste discharge should not raise the ambient natural suspended solids concentration more than 30% nor give rise to accumulation of suspended solids, which may adversely affect aquatic communities.	Marine waters
The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
Nutrients should not be present in quantities sufficient to cause excessive growth of algae	Marine waters
The level of inorganic nitrogen should not exceed 0.4 mg per litre, expressed as annual water column average.	Marine waters
Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

4.3 Impacts

4.3.1 Water quality sensitive receivers are identified as the receiving waters of Victoria Harbour and the Western Buffer Zone. It is not possible to locate any future seawater pumping stations and cooling water intakes along the Rambler Channel. There are no identified sensitive receivers (in accordance with Annex 14, Section 3.1 of the EIA TM) in the Study Area, with the exception of the stream course near the eastern portal. This will require diversion as part of this project

4.3.2 The EIA TM requires identification of impact causing factors and specifically refers to chemical spills. As Route 9 connects to CT9 and the PHIs on Tsing Yi, it is likely that dangerous goods will be carried on this road. Spillage of oil of chemicals could occur as a result of accident or negligence, this could have consequent impacts on the environment. Road drainage leads to the surface water drainage system and is not treated before discharge. Spillages on a road of this extent would be difficult to contain without extensive infrastructure provision, or diversion of run-off to the foul sewers. As this is not current practice to divert road drainage to the foul sewerage system, this recommendation is not made as there are policy implications. In general terms, spillages should be contained wherever possible and the materials removed rather than dispersed into the environment. The methods employed would be determined by the emergency services with the emphasis on reducing risk to life. These methods would be dependent on the types of equipment available. The process for minimising environmental damage from spillage should follow:

- Avoidance through enforcement of the Dangerous Goods Ordinance relating to conveyance and labelling of dangerous materials
- Containment

- In-situ treatment and/or removed of spill materials
- For materials reaching the environment rapid dispersion to prevent damage

4.3.3 Surface run-off from roads can contain materials such oils, tyre rubber, grit and metals. The 'first-flush' run-off from a storm may have potential to cause impacts, particularly after a dry period. After the first-flush, the run-off will become diluted. There is little work on this subject in Hong Kong. International work by the OEDC (1994), 'Environmental Impact Assessment of Roads, 1994', highlights that there is no practical way to predict road runoff contamination as this is dependent on storm characteristics (duration, intensity, periods between storms), and in addition the characteristics of the vehicles using the road. The conclusion is that the 'observed [pollutant] concentrations at any site can be treated as random variables having a lognormal probability distribution'. The other significant point is that the pollutant concentration arriving in the receiving water body is proportional to the total runoff volume in the catchment area. The size of the whole water catchment area will be large in comparison to the area of Route 9, indicating that would be considerable dilution of the road runoff.

4.3.4 Within the framework of the Route 9 project it is not possible to conclude that the runoff should be treated. However, consideration will be given to location of discharge points away from any sensitive locations identified in the future and there will be provision of grit traps. Tunnel discharges will be fitted with oil traps. Discharges should avoid the diverted stream at the eastern portal.

4.4 Summary

4.4.1 There will be possible pollutant runoff, however this is not quantifiable. There will be considerable dilution of road runoff because the catchment area draining into the Rambler Channel will be significant in comparison with the area of Route 9.

4.4.2 Spillages could result in environmental impacts, however these are not quantifiable.