Works if the imported fill requirement is 300,000m^3 or more. The proposed reclamation areas in the SEKD would be reclaimed using public fill. These technical circulars are considered relevant to the present study.

4.2 Description of the Environment

4.2.1 *General*

4.2.1.1 The revised scheme of SEKD covers the disused Kai Tak Airport apron and runway, reclamation in Hoi Sham, reclamation in the Kai Tak Approach Channel (KTAC)/Kwun Tong Typhoon Shelter (KTTS), and other areas. According to the Study Brief, the "Assessment Area" for inland water quality impact assessment includes all areas within and 300m beyond the boundary. The Assessment Area for marine water quality has been expanded to include the Victoria Harbour WCZ and its adjacent WCZs including the Western Buffer and Eastern Buffer WCZs.

4.2.2 *Water Quality in the WCZs*

4.2.2.1 The proposed SEKD is located within the Victoria Harbour (Phase 2) WCZ. The areas covered by this WCZ include Sham Shui Po, Yau Ma Tei, Tsim Sha Tsui, Mong Kok, Kowloon City and Wong Tai Sin. There are in total 10 EPD's water quality sampling stations (VM1, VM2, VM4 to VM8, VM14 and VM15) in the whole Victoria Harbour WCZ. **Drawing No. 22936/EN/190** shows the locations of the stations. The 1999 monitoring results indicated that the dissolved oxygen WQO compliance rate in the Victoria Harbour WCZ was low (30%) and the concentration was decreased by about 10% at all these stations. While the total inorganic nitrogen WQO compliance rate increased to 50% when compared to the compliance rate in 1998. No exceedance of the unionised ammonia level was recorded. However, increasing trends of *E. coli* and temperature were recorded in the waters. **Table 4.4** summarises the water quality parameters measured at selected EPD's water sampling stations. The long-term monitoring results of dissolved oxygen, total inorganic nitrogen, *E. coli* and temperature at these stations are presented graphically in **Drawing No. 22936/EN/013** to **Drawing No. 22936/EN/016** respectively.

Table 4.4 Selected Water Quality Parameters Measured in Victoria Harbour WCZ in 1999

Determinant	Monitoring Stations							
	VM1	VM2	VM4	VM5	VM6	VM7	VM14	VM15
Temperature (°C)	23.1	23.3	23.2	23.3	23.5	23.6	23.6	23.5
Salinity (ppt)	32.1	31.8	31.8	31.5	31.3	31.3	29.2	31.3
Dissolved Oxygen (mg/L)	4.7 (4.8)	4.4 (4.5)	4.1 (4.1)	4.1 (4.0)	4.3 (4.2)	4.5 (4.3)	5.2 (4.9)	4.4 (4.2)
pH (pH value)	8.0	8.0	7.9	7.9	7.9	7.9	8.0	7.9
Suspended Solids (mg/L)	5.8	4.7	5.5	4.9	5.5	6.3	8.7	8.0
5-day Biochemical Oxygen Demand (mg/L)	0.7	0.9	0.8	1.1	0.8	0.7	1.1	0.6
Ammoniacal Nitrogen (mg/L)	0.19	0.23	0.24	0.27	0.26	0.25	0.18	0.26
Total Inorganic Nitrogen (mg/L)	0.30	0.35	0.37	0.41	0.42	0.42	0.45	0.42
Total Kjeldahl Nitrogen (mg/L)	0.48	0.53	0.54	0.58	0.57	0.54	0.41	0.54
Total Nitrogen (mg/L)	0.59	0.65	0.67	0.72	0.72	0.71	0.68	0.70
Chlorophyll-a (µg/L)	2.6	2.3	2.1	1.9	2.0	1.9	3.1	2.3
E. coil (cfu/100mL)	8900	11000	6200	7500	4800	3500	3000	3500
No. of Samples	12	12	12	12	12	12	12	12

Notes:
1. All data are depth-averaged data;
2. Figures in brackets represent the data measured at bottom layer;
3. All data are annual arithmetic means except for *E. coli* data, which are geometric means;
4. Ranges of the data are not included.

Source: Marine Water Quality in Hong Kong in 1999 by EPD.

4.2.2.2 The sampling stations VM1, VM2 and VM4 are nearest to the SEKD. The temperature and salinity levels recorded between 1990 and 1999 in these three stations were quite stable, illustrating normal seasonal variations. In 1999, the temperature recorded in the stations ranged from about 17.1 ^{o}C to 27.3 ^{o}C while salinity ranged from 30.2 to 33.9 ppt. Generally, temperature in the whole of Victoria Harbour WCZ showed an average rise of about 1 ^{o}C in the past ten years.

4.2.2.3 The sampling stations VM1, VM2 and VM4 showed increasing trends in *E. coli* levels, reflecting a rise in faecal pollution in the vicinity of the SEKD. The increase in *E. coli* levels could be explained by the discharges from the outfalls located close to VM2.

4.2.2.4 5-day biochemical oxygen demand (BOD), an indication of organic pollution, showed decreasing trends in recent years at the three sampling stations. However, as indicated in the *Marine Water Quality in Hong Kong in 1999*, there was a widespread increase in BOD levels within Victoria Harbour WCZ in 1999.

4.2.2.5 Concentrations of total inorganic nitrogen (TIN) were high in 1998 but were decreased in 1999. There were general rises in TIN levels in the 1990-1998 period except for the sampling station VM1. The TIN levels were then decreased in 1999. All stations had large portions of samples exceeded the WQO for TIN.

4.2.2.6 In 1999, none of the three stations, in terms of dissolved oxygen (DO) levels, complied with the WQO and there were a number of occasions at which the depth-averaged DO concentrations fell below 4 mg/L. In addition, there was a decreasing trend in DO concentrations at these stations.

4.2.2.7 The Eastern Buffer WCZ, located to the east of Victoria Harbour, includes Shau Kei Wan, Chai Wan and Siu Sai Wan. There are three marine water quality sampling stations (EM1, EM2 and EM3) in this WCZ. Locations of these stations are shown in **Drawing No. 22936/EN/190**. The depth-averaged DO levels measured at the three stations could not meet the WQO for year 1999. The TIN and unionised ammonia levels were in full compliance with the WQO values. The past ten-year monitoring data indicated an increasing trend in water temperature and a decreasing trend in pH within the Eastern Buffer WCZ. The monitoring station closest to the Victoria Harbour WCZ also revealed increasing trends in depth-averaged ammoniacal nitrogen and *E. coli* levels. The total volatile solids and DO levels showed decreasing trends.

4.2.2.8 The Western Buffer WCZ is located to the west of Victoria Harbour. The areas covered by this WCZ include north west Tsuen Wan, Tsing Lung Tau to the north, Aberdeen, Ap Lei Chau and Pok Fu Lam to the south. A mariculture zone is located to the west of Ma Wan within the Western Buffer WCZ. EPD carries out routine water quality monitoring at four stations (WM1, WM2, WM3 and WM4) as shown in **Drawing No. 22936/EN/190**. In 1999, 90% of the samples for depth-averaged DO could meet the WQO whilst 100% of the samples for TIN and unionised ammonia (UIA) were in compliance with the WQO values. The monitoring results for the past ten years indicated that *E. coli*, chlorophyll-a and surface water temperature in the water body of the Western Buffer WCZ were significantly increased. The total volatile solids and DO levels showed decreasing trends.

4.2.3 *Water Quality in Typhoon Shelters*

4.2.3.1 There are 14 typhoon shelters in Hong Kong. The typhoon shelters covered by the three WCZs of interest include Kwun Tong, To Kwa Wan, Causeway Bay, Sam Ka Tsuen, Rambler Channel, Aldrich Bay, Yau Ma Tei, Chai Wan and Aberdeen. Kwun Tong Typhoon Shelter (KTTS) and To Kwa Wan Typhoon Shelter (TKWTS) are in the close vicinity of the SEKD and would be potentially affected by the development.

4.2.3.2 KTTS is semi-enclosed by the Kai Tak Airport runway and the existing breakwaters. The water quality in this typhoon shelter was one of the poorest amongst all the typhoon shelters in Hong Kong due to the low exchange rate of tidal flow. The water quality of TKWTS, which is situated in Kowloon Bay, is comparatively better. The EPD's water quality monitoring results collected at KTTS (VT4) and TKWTS (VT11) are presented in **Table 4.5**.

4.2.3.3 The suspended solids (SS) and BOD levels at KTTS and TKWTS in 1999 were higher than those recorded in 1998. These two typhoon shelters showed a decrease in TIN levels. However, the TIN levels were well above the WQO. The total nitrogen levels at KTTS were exceptionally high in 1997-1998 and were much higher than those recorded at TKWTS. The levels of total nitrogen dropped in 1999.

4.2.3.4 The levels of *E. coli* at KTTS were the highest amongst all typhoon shelters in Hong Kong with average concentration over twenty-two thousands per 100mL. There was an increasing trend in *E. coli* at TKWTS.

4.2.3.5 In 1999, the dissolved oxygen concentrations recorded at KTTS did not meet the WQO, having a number of samples fell below 4mg/L. The DO levels recorded at TKWTS were in compliance with the WQO. KTTS had the lowest depth-averaged DO levels with samples having concentration below 1 mg/L. However, there has been a significant rise in depth-averaged DO concentrations from 1997 onwards.

Table 4.5 Summary of Water Quality Monitoring Results for Kwun Tong and To Kwa Wan Typhoon Shelters in 1999

Parameters	Kwun Tong Typhoon Shelter - EPD's Monitoring Station VT4	To Kwa Wan Typhoon Shelter – EPD's Monitoring Station VT11
Temperature (°C)	23.7	23.6
pH	7.9	8.0
Salinity (ppt)	30.7	31.6
Dissolved Oxygen (mg/L)	3.2 (2.3)	4.6 (4.5)
BOD (mg/L)	2.5	1.4
E coli (no./100mL)	22000	2600
Total Nitrogen (mg/L)	1.6	0.76
Ammoniacal Nitrogen (mg/L)	1.01	0.27
Total Inorganic Nitrogen (mg/L)	1.19	0.41
Total Phosphorus (mg/L)	0.22	0.08
Suspended Solids (mg/L)	5.4	13.4

Notes:
1. Except as specified, data presented in the table are depth-averaged data;
2. Data presented are annual arithmetic means except for E. coli data, which are geometric means; and
3. Data enclosed in brackets represent the data measured at bottom layer.

Source: Marine Water Quality in Hong Kong in 1999Table E3 by EPD.

4.2.4 *Water Quality in Nullahs/Channel*

4.2.4.1 Kai Tak Nullah collects storm water from San Po Kong, Diamond Hill, Tsz Wan Shan, Wong Tai Sin, Wang Tau Hom, Lok Fu and Kowloon City and discharges into the Kai Tak Approach Channel. There are six monitoring stations (KN1 to KN5 and KN7) to monitor the water quality in the nullah. Pollutants from illegal connections and overflows of surcharged sewers entered the nullah causing water pollution in the past. The situation has improved as a result

of the enforcement of the *WPCO, Waste Disposal (Chemical Waste) (General) Regulations*, and implementation of the East Kowloon Sewerage Master Plan.

4.2.4.2 After the completion of the Tolo Harbour Effluent Export Scheme (THEES) Stage I works, treated effluent from the Sha Tin Sewage Treatment Works has been pumped into the upstream location of Kai Tak Nullah since 1995. Effluent from the Tai Po Sewage Treatment Works was also exported to the nullah after the completion of the Stage II works of the scheme. The general conditions in terms of odour and flushing in the typhoon shelter have been improved.

4.2.4.3 Improvement works including reduction in overflows from a dry weather flow interceptor, renovation of the sewage pumping station and regular desilting were carried out to upgrade the water quality in the nullah. According to the *River Water Quality in Hong Kong* issued by EPD, the Water Quality Index (WQI) of the nullah at the downstream station KN1 was still "bad" in 1999. The WQI grading at stations KN2, KN3, KN4 and KN5 (lower and middle parts of the Kai Tak Nullah) was upgraded to "fair". The upper most station KN7 recorded the WQI grading as "fair".

4.2.4.4 Nutrient and *E. coli* levels in the nullah were high under the influence of the THEES. The SS and chemical oxygen demand (COD) levels showed decreasing trends along the nullah as reported by EPD based on the monitoring results from 1986 to 1999. The long-term monitoring results also indicated that the levels of BOD, total Kjeldahl nitrogen, ammoniacal nitrogen, total phosphorus and some metals at a number of stations have decreased. **Table 4.6** gives a summary of the water quality monitoring results for the Kai Tak Nullah in 1999.

4.2.4.5 Tsui Ping Nullah is not included in the river quality monitoring programme of EPD. In the *Feasibility Study for Nullah Decking and Associated Environmental Improvements*, water quality in Tsui Ping Nullah along Tsui Ping Road and King Yip Road was examined. WQI was "fair" in the upper section along Tsui Ping Road and was "very bad" in the lower section along King Yip Road.

Table 4.6 Summary of Water Quality Monitoring Results for the Kai Tak Nullah in 1999

Parameter	Sampling Station					
	KN1	KN2	KN3	KN4	KN5	KN7
Dissolved oxygen (mg/L)	4.7 (2.7 – 6.5)	6.5 (2.6 – 7.4)	7.7 (4.1 – 8.2)	7.5 (2.9 – 8.3)	7.6 (6.4 – 8.9)	7.5 (6.3 – 8.0)
pH	7.3 (7.2 – 7.4)	7.5 (7.1 – 7.7)	7.4 (7.1 – 7.5)	7.3 (6.7 – 7.6)	7.5 (7.4 – 7.8)	7.3 (7.2 – 7.9)
Suspended solids (mg/L)	12 (5 – 58)	13 (10 – 57)	26 (8 – 110)	23 (10 – 200)	19 (9 – 30)	17 (4 – 17)
5-day Biochemical Oxygen Demand (mg/L)	19 (8 – 85)	20 (6 – 40)	31 (6 – 57)	16 (6 – 150)	15 (6 – 18)	13 (6 – 20)
Chemical Oxygen Demand (mg/L)	41 (33 – 95)	44 (36 – 56)	56 (26 – 75)	42 (28 – 170)	34 (28 – 40)	40 (23 – 53)
Oil & grease (mg/L)	1.3 (0.5 – 1.7)	1.0 (0.5 – 1.3)	1.0 (0.5 – 5.7)	0.6 (0.5 – 19.0)	0.7 (0.5 – 1.1)	0.5 (0.5 – 2.5)
Faecal coliforms (cfu/100mL)	4,230,000 (490,000 – 9,900,000)	288,000 (110,000 – 1,100,000)	765,000 (220,000 – 7,400,000)	423,000 (79,000 – 12,000,000)	348,000 (110,000 – 2,900,000)	208,000 (90,000 – 520,000)
E. coli (cfu/100mL)	1,530,000 (140,000 – 7,200,000)	288,000 (110,000 – 1,100,000)	235,000 (56,000 – 1,900,000)	129,000 (32,000 - 3,200,000)	105,000 (30,000 – 750,000)	90,500 (36,000 – 400,000)
Ammonia-nitrogen (mg/L)	8.3 (3.40 – 14.00)	3.35 (0.56 – 10.00)	5.35 (0.49 – 10.00)	4.75 (0.37 – 17.00)	5.50 (0.49 – 11.00)	3.25 (0.36 – 16.00)
Nitrate-nitrogen (mg/L)	1.63 (0.02 – 3.00)	1.64 (0.02 – 3.90)	1.80 (0.02 – 3.80)	3.30 (0.01 – 5.20)	2.15 (2.0 –3.8)	3.00 (1.80 – 4.60)
Total Kjeldahl nitrogen	10.50	5.50	8.10	7.05	7.25	4.45

Parameter	Sampling Station					
	KN1	KN2	KN3	KN4	KN5	KN7
(mg/L), Soluble and particulate fractions	(4.80 – 17.00)	(1.60 – 13.00)	(1.60 – 13.00)	(1.60 – 20.00)	(1.80 – 14.00)	(1.60 – 17.00)
Ortho-phosphate (mg/L)	1.30 (0.66 – 1.40)	0.94 (0.24 – 1.40)	1.00 (0.36 – 1.40)	1.20 (0.30 – 3.00)	0.83 (0.32 - 1.40)	0.99 (0.23 – 2.60)
Total phosphorus (mg/L), Soluble and particulate fractions	1.50 (1.4 – 1.8)	1.30 (0.64 – 1.60)	1.50 (1.00 – 1.80)	1.70 (1.00 – 3.30)	1.30 (0.58 –1.70)	1.50 (0.37 – 2.80)
Sulphide (mg/L), Soluble and particulate fractions	0.53 (0.03 – 8.50)	0.02 (0.02 – 7.60)	0.03 (0.02 – 12.00)	0.02 (0.02 – 1.80)	0.02 (0.02 –0.02)	0.02 (0.02 – 0.03)
Aluminium (μg/L)	75 (50 – 160)	100 (50 – 560)	130 (50 – 550)	50 (50 – 300)	75 (70 – 170)	50 (50 – 150)
Cadmium (μg/L)	0.10 (0.10 – 0.10)	0.20 (0.10 – 0.40)	0.20 (0.10 – 0.40)	0.15 (0.10 – 0.30)	0.10 (0.10 –0.10)	0.10 (0.10 – 0.70)
Chromium (μg/L)	2.0 (1.0 – 4.0)	2.0 (1.0 – 3.0)	2.0 (1.0 – 3.0)	1.0 (1.0 – 6.0)	1.0 (1.0 – 1.0)	1.5 (1.0 – 8.0)
Copper (μg/L)	2.5 (2.0 – 7.0)	5.0 (3.0 – 12.0)	3.0 (1.0 – 10.0)	3.5 (1.0 – 10.0)	3.5 (1.0 – 6.0)	3.0 (1.0 – 6.0)
Lead (μg/L)	1.0 (1.0 – 3.0)	2.0 (1.0 – 12.0)	2.0 (1.0 – 11.0)	2.0 (1.0 – 7.0)	1.5 (1.0 – 3.0)	1.0 (1.0 – 4.0)
Zinc (μg/L)	30 (20 – 40)	50 (30 – 110)	35 (20 – 120)	40 (20 – 140)	30 (20 – 30)	30 (20 – 70)
Flow (L/s)	NM	NM	NM	NM	NM	NM

Remarks: (1) All data are in annual medians of monthly samples except those for faecal coliforms and *E. coli* which are in annual geometric means; (2) figures in brackets are annual ranges; (3) NM - **N**o **M**easurement; cfu – **c**olony **f**orming **u**nit; and (4) equal values for the annual medians and ranges indicate that all data are the same to or are all below the laboratory reporting limits.

Source: River Water Quality in Hong Kong in 1999 by Environmental Protection Department

4.2.5 *Sensitive Receivers*

4.2.5.1 The Assessment Area for this study includes the water bodies traversing the Study Area and the water body covered by the Victoria Harbour, Eastern Buffer and Western Buffer WCZs. The SEKD may affect the water quality in these WCZs during the construction and operational phases. **Drawing No. 22936/EN/033** shows the locations of the existing potential water quality sensitive receivers. These include:

Seawater Intakes for Cooling and Flushing Purposes

- Tsuen Wan (A1);
- Tsing Yi (A2);
- Kennedy Town (A3);
- Cheung Sha Wan (A4);
- Yau Ma Tei (A5);
- Central Water Front (A6);
- Tsim Sha Tsui (A7);
- Wan Chai (A8);
- Tsim Sha Tsui East (A9);
- Tai Wan (A10);
- North Point (A11);
- Quarry Bay (A12);
- Sai Wan Ho (A13);
- Cha Kwo Ling (A14);
- Yau Tong (A15)
- Chai Wan (A16);
- Ap Lei Chau (A17); and
- Tsing Yi Power Station (D1).

Enclosed Water Bodies - Typhoon Shelters

- Rambler Channel (B1);
- Yau Ma Tei (B2);
- Causeway Bay (B3);
- To Kwa Wan (B4);
- Kwun Tong (B5);
- Aldrich Bay (B6);
- Sam Ka Tsuen (B7);
- Chai Wan (B8); and
- Aberdeen (B9).

Mariculture Zones

- Ma Wan (C1); and
- Tung Lung Chau (C2).

Gazetted Beaches

- Tung Wan (E1); and
- Ting Kau (E2 and E3).

4.2.5.2 After the completion of the SEKD, the existing TKWTS will no longer exist and a new marina will be built in Hoi Sham. The existing KTTS will be shifted towards the existing breakwaters at the typhoon shelter outlet. A portion of the new KTTS would be located in front of the end section of the disused airport runway. The new marina and KTTS are the water quality sensitive receivers for the 2016 scenario.

4.2.5.3 The reclamation affects the Kai Tak Nullah and Tsui Ping Nullah. The extended sections of these two nullahs will be built for flow diversion. These two nullahs are sensitive to the water quality changes due to the reclamation and the water quality in the nullahs has been assessed in this report.

4.2.5.4 The water quality changes in the SEKD area may have a direct impact on the seawater intake of the District Cooling System (DCS) for the SEKD. This seawater intake has been included as a water quality sensitive receiver when the SEKD is in place. **Drawing No. 22936/EN/191** shows the locations of these new sensitive receivers.

4.3 Assessment Methodology

4.3.1 *Introduction*

4.3.1.1 To assess the water quality impacts due to the SEKD, coastline configuration in year 2002 has been used as the baseline. Coastline configuration in year 2016 with and without the SEKD has been used for operational phase assessment. **Drawing Nos. 22936/EN/187** and **188** shows the 2002 and 2016 coastline configurations. Major reclamation and marine developments included in the modelling are indicated in the drawings. Comparisons of water quality have been made for the following scenarios:

- Between year 2016 without the project and year 2002;
- Between year 2016 with the project and year 2002; and
- Between year 2016 with the project and year 2016 without the project.

4.3.1.2 The flows and loads discharging into the Victoria Harbour would influence the water quality in the harbour. Implementation of the SSDS Stages II, III/IV or use of decentralised water treatment plants to reduce the pollution loads in the harbour is still uncertain at this stage. However, no matter which approach would be adopted, reduction in flows and loads entering the harbour is expected. In deriving the flow and load data for the 2016 scenario, the pollution load inventory compiled under the *Cumulative Impact Study* was used as the basis. It was