

Appendix 3

DETAILS OF WATER QUALITY AND SEDIMENT MONITORING PROGRAMME

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A3.1 General and Scope of Works

The water quality and sediment testing programme aimed to quantify ambient environmental conditions in Tai O Bay. Monitoring included the following:

- *in situ* water testing;
- collection and chemical analysis of sediment samples; and
- collection and chemical analysis of water samples.

The monitoring programme was carried out on 13 - 14 February 1999.

A3.2 Sediment Sample Collection

Surface sediment samples were collected from four locations (Stations 2, 3, 4 and 6 - refer to **Figure 4.4**) using grab sampling techniques. Sampling locations were positioned using an approved Global Positioning System (GPS) accurate to within 1m. Sediment samples collected were of at least 2kg in weight.

Following collection, sediment samples were labelled to show the following:

- site name;
- sample location reference number;
- date and time of sample collection;
- sample description.

A3.3 Sediment Sample Analysis

Samples were delivered to the ALS Technichem (HK) Pty Ltd for the chemical analysis as indicated in **Table A3.1**, achieving the detection limits as show.

Table A3.1: Sediment Testing Parameters and Detection Limits (mg/kg unless specified).

Parameter	Detection Limit
Moisture content	0.1%
Ammonia nitrogen	0.4
Total Kjeldahl nitrogen	2
Total nitrogen	0.8
Total phosphorus	0.04
Total silica	1
pH	0.1
Total sulphides	1
Acid volatile sulphides	0.5
Total organic carbon	1
Total inorganic carbon	1

Methods used for sediment analysis were American Public Health Association (APHA, i.e. 1992, 1995), Annual Book of America Society for Testing and Materials Standards (ASTM), United States Environmental Protection Agency (USEPA i.e. 1986) or similar methods. Sediment analyte concentrations were reported on a dry weight basis.

A3.4 *In-Situ* Water Quality Monitoring

In situ parameters (water depth, flow velocity/direction, turbidity, salinity, temperature, dissolved oxygen, pH) were monitored concurrently on a continual basis for a complete tidal cycle at 2 selected monitoring stations (i.e. Monitoring Stations 5 and 6 - refer to **Figure 4.4**). At one selected location (Station 8), salinity/conductivity and tidal range was monitored on a continual basis, whilst at one location (Station 9) tidal variation only was monitored on a continual basis. The *in situ* monitoring programme is detailed in **Table A3.2**.

Table A3.2: Continuous *In-Situ* Water Monitoring Programme (refer to Figure 4.4 for locations).

Parameter	Monitoring Location			
	5	6	8	9
Water depth (24hrs)	✓	✓	-	-
pH (24hrs)	✓	✓	-	-
Salinity/conductivity (24hrs)	✓	✓	✓	-
Temperature (24hrs)	✓	✓	-	-
DO & % saturated DO (24hrs)	✓	✓	-	-
Turbidity (24hrs)	✓	✓	-	-
Flow direction (24hrs)	✓	✓	-	-
Flow velocity (24hrs)	✓	✓	-	-
Tidal range (24hrs) (mPD)	✓	✓	✓	✓

In situ parameters were monitored at the mid-water depth on meter decent to the sea-bed and again on ascent. If the difference between the corresponding readings at any given depth was greater than 25%, the measurement were repeated.

In situ parameters (water depth, flow velocity/direction, turbidity, salinity, temperature, dissolved oxygen, pH) were monitored during each water quality sampling event as described in below (i.e. sampling at Stations 1 - 7 and 10 during high and low tidal conditions - refer to **Figure 5.3** for sampling locations). The *in situ* monitoring undertaken during the water sampling programme is summarised in **Table A3.3**.

Table A3.3: Monitoring Requirements for *In-Situ* Water Testing during the Water Sampling Programme (refer to Figure 5.3 for locations).

Parameter	Monitoring Location							
	1	2	3	4	5	6	7	10
Water depth (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
pH (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
Salinity/conductivity (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
Temperature (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
DO & % saturated DO (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
Turbidity (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
Flow direction (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓
Flow velocity (HT/LT)	✓	✓	✓	✓	✓	✓	✓	✓

HT - high tide
 LT - low tide

Water testing equipment had the following accuracy:

Depth	± 0.1 m
Turbidity	± 1 NTU
Salinity	± 0.1%
Temperature	± 0.5°C
Dissolved oxygen	± 2% or 0.1 ppm
pH	± 0.1 pH units

DO and temperature was monitored *in situ* using a YSI model 58 DO meter, capable of measuring DO in the range 0 - 15 mg l⁻¹ and 0 - 200% saturation, as well as 0 - 45°C. Prior to sampling, the DO meter was calibrated with respect to the ambient salinity of the seawater. *In situ* turbidity readings were undertaken using a portable, weatherproof turbidity meter capable of reading turbidities of 0 - 200 NTU with a photoelectric sensor (Hach 2100P turbidimeter). Prior to sampling, the monitoring equipment was calibrated and checked. Ambient temperatures were monitored using a standard calibrated thermometer. Salinity/conductivity was monitored using a YSI model 33.5.C.T or other similar equipment approved by EPD, while other *in situ* parameters (pH) were monitored using laboratory supplied calibrated meters.

During water quality testing/sampling, a recording tide gauge was set up in Tai O Bay. The current direction and water flow at each sampling position was noted using a portable weatherproof calibrated flow meter.

A3.5 Water Quality Sampling and Laboratory Chemical Analysis

Water samples were collected at Stations 1 - 7 (refer to **Figure 5.3**) under high and low tidal conditions. For the purposes of quality assurance, approximately 2 replicate water samples were taken. Water samples were collected using a Niskin (Nansen bottle-type) 2 L water sampler or similar. Due to restricted water depths in Tai O Bay, water samples were taken from the mid water depth.

Following collection, samples were labelled showing site name, sample location reference number, sample depth, date and time of sample collection. Water samples were preserved in accordance with recommendations from the testing laboratory, kept cool (4°C or less) and stored in the dark. At the testing laboratory, water samples were allowed to settle for 16 hours prior to analysis, although samples for *E.coli*, suspended solids and total volatile solids analysis were analysed without settlement. Samples for *E.coli* analysis were analysed within 24 hours of collection. Water depths were recorded using a portable battery-operated echo sounder.

Collected water samples were analysed for the parameters detailed in **Table A3.4**, achieving the detection limits as specified.

Table A3.4: Testing Parameters and Detection Limits for Water Samples (mg/L unless specified).

Parameter	Detection Limit	Parameter	Detection Limit
Copper	5 ppb	Total phosphorus	0.04
Chromium	5 ppb	Nitrite nitrogen	0.01
Cadmium	1 ppb	Nitrate nitrogen	0.01
Lead	5 ppb	Ammonia nitrogen	0.01
Nickel	5 ppb	Total inorganic nitrogen	0.15
Zinc	5 ppb	Total nitrogen	0.1
Mercury	0.5 ppb	Total carbon	1
Biochemical oxygen demand	1	Total organic carbon	1
Chemical oxygen demand	1	Total inorganic carbon	1
Oil and grease	5	Suspended solids	1
<i>E. Coli</i>	1 org/100 ml	Total volatile solids	1

ppb parts per billion

All water chemical analysis was carried out by ALS Technichem (HK) Pty Ltd. Methods used for water analysis were American Public Health Association (APHA), Annual Book of America Society for Testing and Materials Standards (ASTM), United States Environmental Protection Agency or similar methods specified in the TMES.