

FUGRO TECHNICAL SERVICES LIMITED

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Report No.: 0041/17/ED/0117H

Methodology for Water Quality Monitoring

Client : Drainage Services Department

Project : CM 14/2016 - Operational Environmental Monitoring and
Audit for Siu Ho Wan Sewage Treatment Works

Prepared by: Andy K. H. Choi

Reviewed by: Cyrus C. Y. Lai

Certified by:

A handwritten signature in black ink, appearing to be "C. Yung", written over a horizontal line.

Colin K. L. Yung
Environmental Team Leader
Fugro Technical Services Limited



Our Ref: 1458/18-0006

8 January 2018

By Post and E-mail

Drainage Services Department
Projects and Development Branch
Consultants Management Division
42/F, Revenue Tower,
5 Gloucester Road,
Wan Chai, Hong Kong

Attn: Mr. CHUNG Ching Hong, Romeo (E/CM9)

Dear Sir,

RE: CONTRACT NO. CM 13/2016
INDEPENDENT ENVIRONMENTAL CHECKER FOR OPERATIONAL ENVIRONMENTAL
MONITORING AND AUDIT FOR SIU HO WAN SEWAGE TREATMENT WORKS (SHWSTW)
METHODOLOGY FOR WATER QUALITY MONITORING

Reference is made to the comments from Agricultural, Fisheries and Conservation Department (AFCD) and Environmental Protection Department (EPD) forwarded by Drainage Services Department (DSD) via email dated 11 December 2017, and the revised *Methodology for Water Quality Monitoring (MWQM)* (Report No.: 0041/17/ED/0117G) submitted by Environmental Team (ET) of the captioned Project, Messrs. Fugro Technical Services Limited, via email dated 8 January 2018.

In comparison with the previous submission of MWQM (Report No.: 0041/17/ED/0117E), the following updates are noted in the revised MWQM:

- 1) For the alternative monitoring methods that are not specified on the Operational Environmental Monitoring and Audit (OEM&A) Plan (e.g. tidal condition of the sampling exercise, number of replicate per sample, etc.), it is noted that the Baseline EM&A Report (November 2004) of the Project has been reviewed by the ET and are summarised in Table 3.1;
- 2) Duplicate samples are proposed to be collected from each independent sampling event for all parameters as presented in Table 3.1 and Section 3.5.2.

Based on the above, we have no adverse comment on the revised MWQM in principle and hereby verify the same. Please be reminded that approval of the MWQM should be obtained from EPD prior to commencing the monitoring.

Notwithstanding, the ET should be reminded to take note of the comment from AFCD and apply for a permit in accordance with Section 17 of Marine Parks and Marine Reserve Regulation (Cap. 476A) to collect water samples within The Brothers Marine Park. It is also suggested the ET to review the information presented on the OEM&A Plan of the Project and check if any update is required.



Should you have any queries, please feel free to contact the undersigned, or our Mr. Rodney IP at 2815 7028.

Yours faithfully,

For and on behalf of
Allied Environmental Consultants Ltd.

A handwritten signature in black ink, appearing to read 'Grace Kwok', with a stylized flourish at the end.

Grace KWOK
Independent Environmental Checker

GK/ri/rc

c.c. Fugro Technical Services (ET Leader)
AECOM

Attn: Mr. Colin YUNG
Attn: Ms. Joanne TSOI

(by E-mail)
(by E-mail)

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1. Introduction

- 1.1 The Project "Upgrading of Siu Ho Wan Sewage Treatment Works" is to upgrade the Siu Ho Wan Sewage Treatment Works (STW) from the preliminary treatment level to chemically enhanced primary treatment (CEPT) level with UV disinfection facilities. The Project is required to comply with Environmental Permit in respect of the construction and operation phases of the Plant.
- 1.2 Under the Environmental Impact Assessment Ordinance, the Project was classified as "Designated Project". The Environmental Impact Assessment (EIA) study was completed in September 1997 with the EIA Report of Register No. EIAR-124BC and Environmental Monitoring and Audit (EM&A) Manual, and the Environmental Permit (EP) of No. EP-076/2000 was issued in August 2000 to Drainage Services Department (DSD).
- 1.3 The CEPT part has been completed and was put into operation in March 2005. The UV disinfection works were substantially completed in December 2006. It is considered that the operation of the Project shall be deemed to start when the UV disinfection facilities have been completely installed and tested.
- 1.4 The project proponent was Drainage Services Department (DSD). AECOM was commissioned by DSD as the Engineer for the Project. Allied Environmental Consultants Limited (AEC) was commissioned by DSD as the Independent Environmental Checker (IEC) in the operation phase of the Project. Fugro Technical Services Limited (FTS) was appointed as the Environmental Team (ET) by DSD to implement the EM&A programme for the operation phase of the Project.
- 1.5 In this document, methodology of the proposed water quality monitoring programme is presented, which shall be followed in accordance with the approved Operational EM&A plan.

2. Objectives

- 2.1 The objective of the water quality monitoring programme is to:
 - collect data for future reference.
- 2.2 In accordance with Section 5 of the EM&A Plan, water quality monitoring should be carried out at 8 designated monitoring locations (2 impact stations and 6 control stations) during the first five years of the operational phase of the Project. The proposed monitoring locations shall be the same monitoring locations that were used for the baseline monitoring programme, subject to the approval of the Director of Environmental Protection. The coordinates of the monitoring location is shown in **Table 2.1**. The monitoring locations of water quality monitoring are also shown in **Figure 1**.

Table 2.1 Location of Water Quality Monitoring

Sampling Location		Easting	Northing
A	The Brothers, Control Station	816 100	822 500
B	The Brothers, Control Station	816 680	822 440
C	Siu Ho Wan Outfall, Impact Station	816 800	820 180
D	Siu Ho Wan Outfall, Impact Station	817 160	820 360
E	Cheung Sok, Control Station	819 817	821 655
F	Cheung Sok, Control Station	820 158	821 922
G	Tai Ching Chau, Control Station	822 214	822 692
H	Tai Ching Chau, Control Station	822 494	822 939

3. Methodology of Water Quality Monitoring

- 3.1 This methodology is proposed in accordance with the Section 5.1 to 5.4 from the approved Operational EM&A plan. As the tidal condition, sampling depth and number of samples to be collected of each sampling event was not specified in the OEM&A plan, thus they are proposed to be referenced from the baseline monitoring report (November 2004) in this methodology. The proposed frequency of methodology of Water Quality Monitoring as referenced in baseline monitoring report (November 2004) was summarized in **Table 3.1**. Details of reference sections in the previous baseline monitoring report (November 2004) are attached in **Appendix D**.



Table 3.1 Summary of Proposed Monitoring Frequency Referenced from Previous Baseline Monitoring Report

Monitoring Parameter	Sampling Frequency		Relevant Sections in Baseline Monitoring Report for November 2004	Reasons
	Requirements need to be approved	Proposed method		
In-situ measurement	Tidal Condition of Each Sampling	Two tides: - Mid-ebb - Mid-flood	i) APPENDIX A - EGS FIELD SURVEY REPORTS	<ol style="list-style-type: none"> The requirement of tidal condition of each sampling is not specified in the OEM&A plan section 5.4 – Other Monitoring Requirements. With reference to baseline monitoring report (November 2004) APPENDIX A, water sampling was carried out at dual tide. Thus sampling at two tides (mid-ebb & mid-flood) at each sampling event is proposed in this methodology.
Laboratory Analysis	Sampling Depth	3 depths: -surface: 1 m below water -middle: mid-depth -bottom: 1m above the seabed	i) APPENDIX A - EGS FIELD SURVEY REPORTS	<ol style="list-style-type: none"> The requirement of sampling depth, tidal condition of each sampling and no. of samples to be collected is not specified in the OEM&A plan section 5.4 – Other Monitoring Requirements. With reference to baseline monitoring report (November 2004) APPENDIX A, duplicate samples were collected at each of the 3 sampling depths (surface, middle & bottom) at each location during each sampling event, which include sampling on both mid-ebb and mid-flood tides. Thus the same sampling methodology is proposed to be adopted.
	Tidal Condition of Each Sampling	Two tides: - Mid-ebb - Mid-flood		
	No. of Samples to Be Collected at Each Monitoring Location	duplicate samples		

3.2 Monitoring Parameter

3.2.1 The monitoring parameters for water quality monitoring are summarized in **Table 3.2**.



Table 3.2 Parameters for Water Quality Monitoring

Monitoring Parameters	
In-situ Measurement	Laboratory Analysis
Dissolved oxygen (mg/L)	<i>E. coli</i> (cfu/100ml)
Temperature (degree Celsius)	5-day BOD (mg/l)
pH value	Suspended Solids (mg/l)
Water depth (m)	Ammonia as N (mg/l)
Salinity (ppt)	Nitrate as N (mg/l)
Turbidity (NTU)	Nitrite as N (mg/l)
Current Speed (m/s)	Total inorganic nitrogen (mg/l)
Current Direction (degree magnetic)	Total phosphorus (soluble and particulate) (mg/l)

- 3.2.2 The template of data logsheet of the in-situ measurement for water quality monitoring is provided in **Appendix A**.
- 3.2.3 Apart from the parameters listed in the **Table 3.2**, other relevant supplementary information such as monitoring location, time, weather conditions and any special phenomena shall be also recorded.
- 3.2.4 The tidal data will be obtained from the tide gauge installed in Ma Wan Marine Traffic Station, managed by the Hydrographic Office of Marine Department. Location of the tide gauge and sample of the tidal data can be demonstrated in **Figure 2** and **Appendix C** respectively.



3.3 Monitoring Equipment

3.3.1 A multifunctional meter (YSI 6920 V2) was used to measure dissolved oxygen (DO), concentration, DO saturation, temperature, salinity, pH and turbidity, simultaneously at the same location and water depth. An Acoustic Doppler Current Profiler (ADCP) which integrated with echo sounder function was used to measure water depth, current velocity (speed and direction). The measured data by ADCP will then be downloaded on site to computer on board. The measured water depth data by ADCP shall be electronically logged and available for output. All measurement data from the multiparameter monitoring device and ADCP will be integrated with the GPS data from the DGPS logging device, so that data collected at a specific time and location can be shown. The water sampler shall be tied with the multiparameter monitoring device (with water depth probe to determine the exact sampling depth at which a sample is collected). The equipment employed for the monitoring and sampling and their specifications are presented in **Table 3.3**.

Table 3.3 Water Quality Monitoring and Sampling Equipment

Parameter	Equipment	Model	Range	Equipment Accuracy
Temperature, Dissolved Oxygen, salinity, pH, Turbidity, Sampling Depth	Water Quality Monitoring Device	YSI 6920V2-2-M Sonde	Temp: -5 to 50°C DO: 0-50mg/L DO%: 0-500% Sal: 0 to 70 ppt pH: 0 to 14 pH units Turb: 0-1000NTU Depth: 0-61 meters	Temp: ±0.15°C DO: ±0.1mg/L or 1% (whichever greater) for 0-20mg/L; ±15% for 20-50mg/L (with correction for salinity and temperature) Sal: ±1% or 0.1ppt (whichever greater) pH: ±0.2 units Turb: ±2% or 0.3NTU (whichever greater) Depth: ±0.12m
Water Depth, Current Speed, Current Direction	Acoustic Doppler Current Profiler	RiverSurveyor M9	Water Depth: 0-80m	Water Depth: 1% Current speed: ±0.25% of measured velocity or ±0.2cm/s Current direction: ±2degree magnetic
Positioning	DGPS	Simrad MX521B Smart Antenna with Simrad MX610 CDU	NA	GPS: ±1m
Water Sampling	Water Sampler	Aquatic Research Transparent PC Vertical Water Sampler 2.2L / 3L / 5L	NA	NA



3.3.2 Apart from the equipment mentioned in Section 3.2.1, a Class III commercially licensed vessel was used as survey vessel. DGPS logging device with accuracy $\pm 1\text{m}$ at 95% confidence level shall be installed on the survey vessel to ascertain that measurement can be made accurately on the specific transects. All GPS data collected during the whole survey shall be automatically and electronically logged. Powered winch shall be used on-board the Survey Vessel to assist the monitoring. Experienced supervisor was present throughout the monitoring exercise on the Survey Vessel.

3.3.3 Water samples were collected by water sampler and stored in high density polythene bottles and sterilized glass bottles (for bacterial analysis), packed in ice (cooled to 4°C without being frozen), and delivered to the laboratory on the same day of collection for analysis. All sampling bottles were pre-rinsed with the same water samples. The sampling bottles were then taken to a HOKLAS accredited laboratory for analysis of *E. coli*, BOD_5 , Suspended Solids, $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-N}$, $\text{NO}_2\text{-N}$, Total inorganic nitrogen, Total phosphorus (soluble and particulate).

3.4 Laboratory Measurement and Analysis

3.4.1 ALS Technichem (HK) Pty Ltd (HOKLAS Reg. No. 066), is appointed to be the laboratory for analysis of water samples. The methods adopted by the laboratories and the reporting limits are detailed in **Table 3.4**.

Table 3.4 Laboratory Measurement/Analysis Methods and Reporting Limits

Analysis Description	Method	Reporting limits
<i>E. coli</i>	DoE Section 7.8, 7.9.4.2& 7.9.4.4 plus in situ urease test	1 cfu/100mL
5-day Biochemical Oxygen Demand	APHA 5210B	1 mg/L
Total Suspended Solid	APHA 2540D	0.5 mg/L
Ammonia as N	APHA 4500 NH3: G	0.005 mg/L
Nitrate as N	APHA 4500 NO3: I	0.005 mg/L
Nitrite as N	APHA 4500 NO2 B&H	0.005 mg/L
Total Inorganic Nitrogen	By Calculation	0.01 mg/L
Total phosphorus (soluble and particulate)	APHA 4500 P: J	0.01 mg/L

3.5 Monitoring Frequency and Duration

3.5.1 The water quality monitoring programmed shall be carried out once per two months for a period of five years of the operational phase of the Project.



3.5.2 Water quality monitoring for two tides at 8 designated locations will be carried out for each monitoring event. For each location at each tide, duplicate samples for in-situ parameter and laboratory analysis at 3 designated water depths (1 m below water surface, mid-depth and 1 m above the seabed) will be taken and analyzed.

3.6 Quality Assurance / Quality Control

3.6.1 The equipment is in compliance with the requirements set out in the EM&A plan. All in-situ monitoring instruments were calibrated by a HOKLAS-accredited laboratory or by standard solutions. Calibration of temperature, DO, salinity, pH and turbidity is conducted in three month interval, Copies of calibration certificates for the water quality monitoring equipment are attached in **Appendix B**.

3.6.2 During the measurements of DO concentration, DO saturation, salinity, turbidity, pH and temperature, duplicate readings were taken. If the difference between the first and second readings of DO or turbidity was more than 25% of the value of the first reading, the reading was discarded and further readings were taken.

3.6.3 The laboratory incorporates a variety of QA/QC monitoring programme into their testing system. Where applicable or available, the quality of the analysis will be monitored by conducting the following QC analysis:

For each batch of 20 samples:

- A minimal of 1 laboratory method blank will be analyzed;
- A minimal of 1 sample duplicate will be analyzed;
- A minimal of 1 sample matrix spike will be analyzed.

4. Event and Action Plan

4.1.1 Since the purpose of the water quality monitoring is to collect data for future propose, no specific event and action has to be followed.

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Figure 1 Monitoring Location of Water Quality Monitoring



816000E

818000E

820000E

822000E

822000N

大小磨刀
BROTHERS

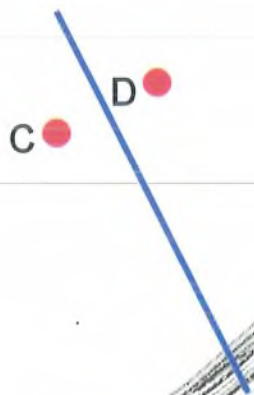
820000N

CO-ORDINATES OF CONTROL STATIONS :

CONTROL STATION No.	CO-ORDINATES	
	NORTHING	EASTING
A	822500	816100
B	822440	816680
E	821655	819817
F	821922	820158
G	822692	822214
H	822939	822494

CO-ORDINATES OF IMPACT STATIONS :

IMPACT STATION No.	CO-ORDINATES	
	NORTHING	EASTING
C	820180	816800
D	820360	817160

圖例
LEGEND :

- IMPACT STATION
- ⊕ CONTROL STATION
- SUBMARINE OUTFALL

圖則名稱 drawing title

UPGRADING OF SIU HO WAN SEWAGE TREATMENT PLANT
BASELINE MONITORING - LOCATION OF MONITORING STATIONS

繪畫 drawn

H.K. LAI

日期 date

06-02-2004

核對 checked

C.K. LAM

日期 date

04-03-2004

批核 approved

S.K. WONG

日期 date

04-03-2004

部門 office

顧問工程管理部

CONSULTANTS MANAGEMENT DIVISION

圖則編號 drawing no.

DCM/2004/002

比例 scale

N.T.S.

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DRAINAGE SERVICES DEPARTMENT
GOVERNMENT OF THE
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Figure 2 Location of the Tide Gauge

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Figure 2 - Location of the Tide Gauge

Source: Google Maps

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Appendix A

Template of Data Logsheet of the In-situ Measurement for Water Quality Monitoring

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Data Record Sheet for Water Quality Monitoring

Client: Drainage Services Department
Project: Contract No. CM 14/2016 Environmental Team for Operational Environmental Monitoring and Audit for Siu Ho Wan Sewage Treatment Works

Date:													Tide Mode: Ebb / Flood											
Weather:	Fine / Cloudy / Rainy / Hazy / Windy / Stormy																							
Sea Condition:	Calm / Smooth / Moderate / Rough / Very Rough																							
Monitoring Location:																								
Water Depth (m):																								
Time:																								
Monitoring Level / (m):	S /	m	M /	m	B /	m	S /	m	M /	m	B /	m	S /	m	M /	m	B /	m	S /	m	M /	m	B /	m
Replicate:	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
DO Saturation (%):																								
DO (mg/L):																								
Temperature (°C):																								
pH																								
Salinity (ppt):																								
Turbidity (NTU):																								
Current Speed (m/s):																								
Current Direction:																								
Remarks:																								

Note: If the difference between 1st and 2nd measurement of DO or turbidity is more than 25% of the 1st reading, discard reading and measure again

Recorded by: _____
Date: _____

Checked by: _____
Date: _____

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Appendix B

Copies of Calibration Certificates for the Water Quality Monitoring Equipment

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Materialab

Report No. : 142626WA171883



Page 1 of 3

Report on Calibration of YSI 69201V2-M Multi-parameter Water Quality Meter

Information Supplied by Client

Client : Materialab Consultants Limited

Client's address : Rm. 23, 25, 7/F, Profit Industrial Building, No. 1-15,
Kwai Fung Crescent, Kwai Chung, N.T.

Project : CV/2013/04 – Providing Sufficient Water Depth for
Kwai Tsing Container Basin and its Approach Channel

Sample description : One YSI 69201V2-M Multi-parameter Water Quality Meter

Client sample ID : Serial No. 14E102239

Test required : Calibration of the YSI 69201V2-M Multi-parameter Water Quality
Meter

Laboratory Information

Lab. sample ID : WA171883/1

Date sample received : 22/11/2017

Date of calibration : 22/11/2017

Next calibration date : 21/02/2018

Test method used : In-house comparison method

Note : This report refers only to the sample(s) tested.

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MaterialLab

Report No. : 142626WA171883

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Results :**A. pH calibration**

pH reading at 20°C for Q.C. solution(6.86) and at 25°C for Q.C. solution(9.18)		
Theoretical	Measured	Deviation
9.18	9.19	+0.01
6.86	6.85	-0.01

B. Salinity calibration

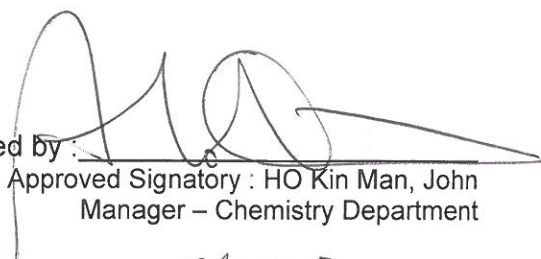
Salinity, ppt			
Theoretical	Measured	Deviation	Maximum acceptable Deviation
10	10.02	+0.02	± 0.5
20	20.04	+0.04	± 1.0
30	30.13	+0.13	± 1.5
40	40.05	+0.05	± 2.0

C. Dissolved Oxygen calibration

Trial No.	Dissolved oxygen content, mg/L	
	By Titration	By D.O. meter
1	8.35	8.52
2	8.43	8.53
3	8.51	8.46
Average	8.43	8.50

Differences of D.O. Content between Wrinkler Titration and D.O. meter should be less than 0.4 mg/L

Supervised by : Y. M. Chung

Certified by : 
Approved Signatory : HO Kin Man, John
Manager – Chemistry Department

Date : 28/11/2007

Note : This report refers only to the sample(s) tested.

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Page 3 of 3

Results :

D. Temperature calibration

Thermometer reading, °C	Meter reading, °C
22.1	21.00

E. Turbidity calibration

Turbidity, N.T.U.			
Theoretical	Measured	Deviation	Maximum acceptable Deviation
0	0.0	0.0	± 0.5
4	4.0	0.0	± 0.6
8	7.8	-0.2	± 0.8
40	40.1	+0.1	± 3.0
80	79.6	-0.4	± 4.0

Supervised by : Y. M. Chung

Certified by : 

Approved Signatory : HO Kin Man, John
Manager – Chemistry Department

Date : 28/11/2017

** End of Report **

Note : This report refers only to the sample(s) tested.

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Appendix C Sample of Tidal Data

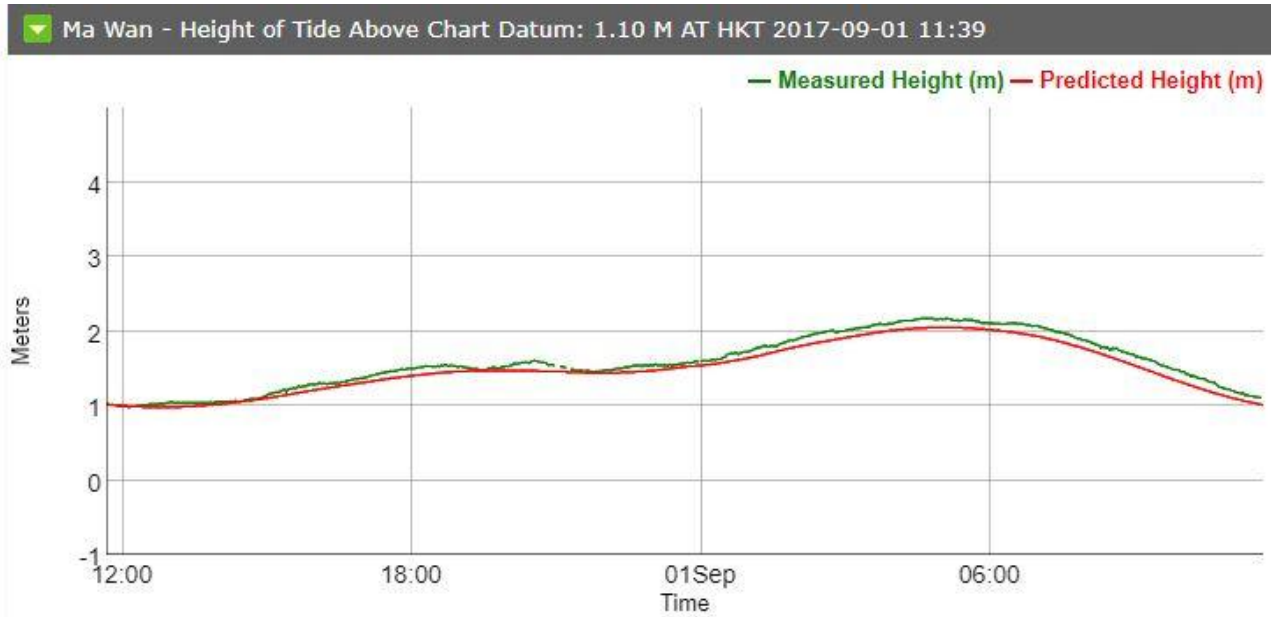
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Source: Tidal Data is obtained from the tide gauge of Hydrographic Office of Marine Department

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Appendix D Reference Sections of the Previous Baseline Monitoring Report

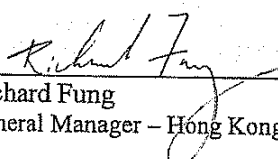


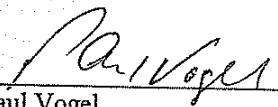
**CONTRACT CM/2004/01
UPGRADING OF
SIU HO WAN TREATMENT PLANT
WATER QUALITY MONITORING
SEDIMENT QUALITY MONITORING
AND BENTHIC SURVEY**

FINAL REPORT (NOVEMBER 2004)

ALS Technichem (HK) Pty Ltd.
11/F, Chung Shun Knitting Centre
Wing Yip Street, Kwai Chung
NT, Hong Kong

On behalf of ALS Technichem (HK) Pty Ltd, we certify that this report is complete:


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APPENDIX A
EGS FIELD SURVEY REPORTS

**CONTRACT CM/2004/01
UPGRADING OF
SIU HO WAN SEWAGE TREATMENT PLANT
WATER QUALITY MONITORING
SEDIMENT QUALITY MONITORING
AND BENTHIC SURVEY**

FIELD WORK REPORT FOR DRY SEASON

HK186604

APRIL 2004

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Plate 6 Sieving samples on deck



4.2.3 Water Sampling

Water samples were collected using the General Oceanics 12-bottle rosette sampler (Plate 8). 2 replicates of water samples were collected at three depths from each station for laboratory testing during both high water and low water survey period on 27 march 2004.

TYPE	NUMBER OF BOTTLES	PLATES	SAMPLES TAKEN	SAMPLE DEPTH
Water column profiling	4 (or 6) × 3	7, 8, 9	Glass bottles and plastic bottles	Three depths: Top, Middle and bottom

Samples were then treated as follows:

Water from each rosette sampler was extracted using the fitted tap on each bottle, directly into 2 (or 3) plastic sample bottles and 2 (or 3) glass sample bottles (Plate 9).

These sample bottles were then placed in an ice box for transportation to the laboratory for testing.

Plate 7 Water Quality Measurement Recording System

