Appendix E

Performance Review Proposal
for Stone Column Installation

Performance Review for Stone Column Installation

1 Introduction

Stone column is required within the reclamation to accelerate the settlement and improve the strength of the marine deposit inside the cellular seawall and foundations of sloping seawall. The performance reviews will be carried out by the Environmental Team (ET).

Before the commencement of the monitoring works, this Performance Review Proposal shall be reviewed and updated by ET, taking account of the Contractor's proposed actual locations of his initial period of installation.

The proposed monitoring details are presented in the following sections.

2 Monitoring Equipment

2.1 Dissolved Oxygen and Temperature Measuring Equipment

Dissolved oxygen (DO) measurements should be salinity compensated. DO and temperature measuring equipment shall be provided as follows:

a. The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument completed with cable & sensor and use a DC power source. It shall be capable of measuring:
   - a dissolved oxygen level in the range of 0-20 mg/l and 0-200% saturation; and
   - a temperature of 0-45 degree Celsius.

b. It shall have a membrane electrode with automatic temperature compensation complete with a cable (e.g. YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument). Sufficient stocks of spare electrodes and cables shall be available for replacement where necessary.

c. Should salinity compensation not be integrated in the DO equipment, onsite / in-situ salinity shall be measured to calibrate the DO equipment prior to each DO measurement.

2.2 Turbidity Measurement Instrument

The instrument shall be a portable, weatherproof turbidity-measuring instrument complete with comprehensive operation manual. The equipment shall use a DC power source. It shall have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU (e.g. Hach model 2100P or an approved similar instrument).

2.3 Suspended Solids

The equipment for measuring suspended solids shall be provided as follows:

a. A water sampler comprising a transparent PVC cylinder with a capacity of not less than 2 litres and which can be effectively sealed with latex cups at both ends. The sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (e.g. Kahlsico Water Sampler or an approved similar instrument).

b. Water samples for suspended solids measurement shall be stored in high density polythene bottles, packed in ice (cooled to 4^{o}C without being frozen) and delivered to the testing laboratory within 24 hour of collection.

2.4 Water Depth

A portable, battery-operated echo sounder shall be used for the determination of water depth at each designated monitoring station. This unit can either be handheld or affixed to the bottom of the work boat, if the same vessel is to be used throughout the monitoring programme.

2.5 Salinity

A portable salinometer capable of measuring salinity in the range of 0-40 PSC (practical salinity scale) shall be provided for measuring salinity and, if necessary, setting salinity compensation on the Dissolved Oxygen Meter.

2.6 pH Measuring Equipment

A portable pH meter capable of measuring a range between 0.0 and 14.0 shall be provided to measure pH under the specified conditions (eg. Orion Model 250A or an approved similar instrument).

2.7 Location of the Monitoring Sites

A hand-held or boat-fixed type differential Global Positioning System (dGPS) or other equivalent instrument of similar accuracy shall be provided and used during monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

2.8 Current Velocity and Direction

A Valeport 108 MKIII current meter, or the approved equivalent, shall be provided for in-situ measurement of current velocity and direction. Real-time data shall be provided for settling out the monitoring stations.

3 Calibration of Equipment

All on site / in-situ monitoring instrument shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated regularly, as per the manufacturer specification, the standard methods or the recommendation of the accredited calibration laboratory throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with certified standard solutions before each use. Wet bulb calibration for the DO meter shall be carried out before measurement at each monitoring location.

For the on-site calibration of field equipment, the BS 1427:1993, "Guide to Field and on-site test methods for the analysis of waters" shall be observed.

4 Back-up Equipment and Vessels

Sufficient stocks of spare parts shall be maintained for replacements when necessary. Back-up monitoring equipment shall also be available so that monitoring can proceed uninterrupted even when some equipment is under maintenance, calibration, etc.

The Water Quality Monitoring will involve a large number of monitoring stations and measurements should be conducted within the prescribed tidal conditions in order to ensure the measurement/samples are representative. A multi-probe monitoring equipment set integrated with water sampler(s) is highly recommended to improve the monitoring efficiency. It is, also, likely that more than one field survey vessels will be required simultaneously to ensure the monitoring are conducted within the acceptable monitoring windows. The monitoring team shall also consider the use of unattended automatic sampling/monitoring devices at fixed stations where monitoring are required throughout the period. The use of such unattended automatic devices, however, shall be subject to the approval from IEC and EPD.

5 Measurement and Analysis

5.1 Baseline Monitoring

The baseline monitoring data from the existing EM&A programme will be adopted. Should these data be not available before the Performance Review, the ET will propose additional baseline monitoring and obtained approval from IEC and EPD.

5.2 Impact Monitoring

5.2.1 In-situ Measurement

During monitoring, duplicate measurements of DO concentration (mg/l), DO saturation (%), turbidity, pH, salinity and water samples shall be taken at each station at three depths, namely, 1m below the sea surface, mid-depth and 1 m above the seabed. Where water depth is less than 6 m the mid-depth station may be omitted. If water depth is less than 3 m, only the surface samples shall be monitored, to avoid natural resuspension of sediments from confounding the results. In-situ measurements shall be made during both the descent and ascent of the sensor. On site measurements shall be made on sub-sample of water samples collected for laboratory suspended solid measurement.

If the difference between the first and second measurement of DO or turbidity parameters at any one depth is greater than 25%, the measurements shall be repeated until an acceptable match is made. If no match is achieved, the equipment shall be checked for accurate calibration or malfunction.

Duplicated water samples for laboratory analysis of SS shall be collected on separate descent (or ascent, but not both direction), but samples for different depth can be collected on the descent (or ascent) if multi-samplers is used. Water samples of different depth shall be collected and analysed separately in the baseline water quality monitoring.

5.2.2 Water Sampling

Analysis of total suspended solids (SS) will be carried out in a HOKLAS or other international accredited laboratory. Water samples of at least 500mL shall be collected at the monitoring stations for carrying out the laboratory SS determination. The SS determination work should start within 24 hours after collection of the water samples. The analyses should follow the standard methods as described in APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition, with a reporting limit of not more than 2.0 mg/L.

The limits of detection for the in-situ and laboratory measurements that shall be obtained are shown in **Table 1**.

Table 1 Detection Limits and Precision for Water Quality Determinands

Determinand	Limit of Detection	Description Precision
Dissolved Oxygen	0.1 mg/L	1%
Salinity	0.01 ppt	1%
Temperature	0.1 degree Celsius	1%
pH	0.01 units	1%
Turbidity (NTU)	0.1 NTU	1%
Suspended Solids	2 mg/L (minimum acceptable accredited reporting limit)	2%

If a site laboratory is set up or a non-HOKLAS and non-international accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment, analytical procedures and quality control shall be approved by the IEC and EPD.

5.3 Measurement Location

The water quality monitoring stations will depend on the current direction as measured by the on-site current direction measurement and are presented in **Figure 1**. A total of 11 monitoring stations will be measured, including 2 control stations, 4 near-field stations, 4 far-field stations, and 1 hydrodynamic station.

The monitoring parameters will include both hydrodynamic data and water quality data and the details of monitoring parameters are presented in **Table 2**.

Table 2 Monitoring Parameters

Stations	Description	Parameter
H1	Hydrodynamic Station	Current velocities, Current directions
C1	Control Station	DO, temperature, turbidity, pH, salinity and SS
C2	Control Station	DO, temperature, turbidity, pH, salinity and SS
N1	Near Field Station	DO, temperature, turbidity, pH, salinity and SS
N2	Near Field Station	DO, temperature, turbidity, pH, salinity and SS
N3	Near Field Station	DO, temperature, turbidity, pH, salinity and SS
N4	Near Field Station	DO, temperature, turbidity, pH, salinity and SS
F1	Far Field Station	DO, temperature, turbidity, pH, salinity and SS
F2	Far Field Station	DO, temperature, turbidity, pH, salinity and SS
F3	Far Field Station	DO, temperature, turbidity, pH, salinity and SS
F4	Far Field Station	DO, temperature, turbidity, pH, salinity and SS

5.4 Measurement Details

The stone column installation is the initial stage of the reclamation. There should be no concurrent marine activities throughout the Performance Review. The process includes penetration, installation and completion. The duration will be about 1 hour per stone column. Water quality monitoring should be carried out during installation stage.

During the monitoring, the silt curtain will be applied to simulate the actual situation. The silt curtain is for stone column operation and the second layer silt curtain to simulate the perimeter silt curtain is not proposed due to the limited space in Kowloon Bay for a conservative approach. The monitoring details are listed in **Table 3**.

Table 3 Monitoring Details for Stone Column Installation

	Description
Monitoring Parameters	Hydrodynamics: Current velocities, Current directions Water Quality: DO, temperature, turbidity, pH, salinity and SS
Tidal Condition	Monitored at both tides, at mid-flood (within ± 1.75 hour of the predicted time) and mid-ebb (within ± 1.75 hour of the predicted time) tides, Replicate

	Description
	measurement/sample
Number of Stone Column for Testing	2, one for mid-flood measurement and one for mid-ebb measurement. If exceedances observed, additional testing maybe required in according to the Event and Action Plan.)
Monitoring Frequencies	15 minutes intervals
Monitoring Duration	During installation and completion process. After stone column is installed, 4 additional monitoring (at 15 minutes intervals) are required.

6 Result Interpretation

The monitoring will be carried out around the works area. According to S6.7.2.3 of EIA-CKR, the dilution factor to the nearest WSR is 183. This dilution factor will be applied to estimate the water quality impact at the sensitive receivers.

The Action / Limit Level at far field stations and sensitive receivers are defined in **Table 4**. The ET will determine the absolute values of criteria and submit to EPD for approval.

Table 4 Action / Limit Level at Far Field Stations and Sensitive Receivers

Parameters	Action	Limit
DO in mg L^{-1} (Surface, Middle & Bottom)	Surface and Middle 5 percentile of baseline data for surface and middle layer Bottom 5 percentile of baseline data for bottom layer	Surface and Middle 4 mg L^{-1} except 5 mg/l for FCZ or 1%-ile of baseline data for surface and middle layer Bottom 2 mg L^{-1} or 1%-ile of baseline data for bottom layer
SS in mg L^{-1} (depth-averaged) at all monitoring stations and control stations	95 percentile of baseline data or 120% of upstream control station's SS at the same tide of the same day	99 percentile of baseline or 130% of upstream control station's SS at the same tide of the same day and 10mg/L for WSD Seawater intakes
Turbidity in NTU (depth-averaged)	95 percentile of baseline data or 120% of upstream control station's Turbidity at the same tide of the same day	99 percentile of baseline or 130% of upstream control station's Turbidity at the same tide of the same day

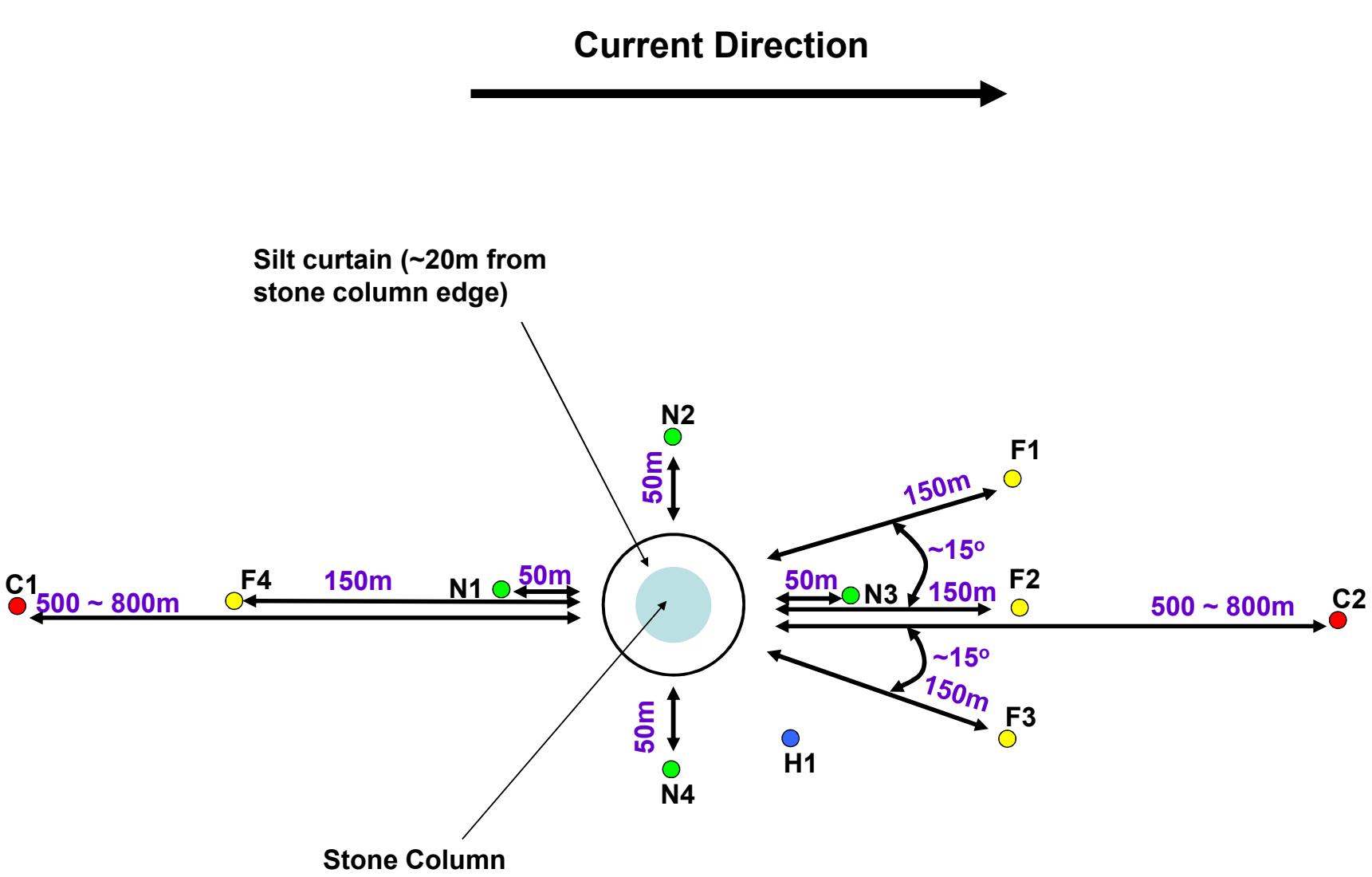
Regardless of the measured performance of stone column installation, the Event and Action Plan shall be based on the monitoring results at the designated monitoring stations. All the stone column installation during construction phase should not be carried out unless the execution of Event and Action Plan during the Performance Review. The Event and Action Plan is presented in **Table 5**.

Table 5 Event and Action Plan for Water Quality

Event	ET	IEC/ER	Contractor
Action level being exceeded by one or more sampling.	Identify source(s) of impact; Inform contractor and ER; Check monitoring data, all plant, equipment and Contractor's working methods; Review and discuss the effectiveness on the proposed	Confirm receipt of notification of non-compliance in writing; Notify Contractor. Discuss with ET on the proposed mitigation measures; Ensure mitigation measures are properly implemented;	Inform the ER and confirm notification of the non-compliance in writing; Rectify unacceptable practice; Amend working methods if appropriate: Check all plant and equipment

Event	ET	IEC/ER	Contractor
	mitigation measures.	Assess the effectiveness of the implemented mitigation measures.	and consider changes of working methods; Submit proposal of additional mitigation measures to ER and ET; Implement the agreed mitigation measures.
Limit level being exceeded by one or more sampling day	Identify source(s) of impact; Inform Contractor, ER and EPD; Check monitoring data, all plant, equipment and Contractor's working methods; Liaise with EPD if necessary to repeat measurement during stone column installation and completion process to confirm the findings; Review and discuss the effectiveness on the proposed mitigation measures.	Make agreement on the mitigation measures to be implemented; Discuss with ET on the proposed mitigation measures; Ensure mitigation measures are properly implemented; Consider and instruct, if necessary, the Contractor to slow down or review all or part of the stone column installation during construction stage.	Take immediate action to avoid further exceedance; Submit proposal of mitigation measures to ER and discuss with ET and ER; Implement the agreed mitigation measures; Resubmit proposals of mitigation measures if problem still not under control; As directed by the ER, to slow down slow down or review all or part of the stone column installation during construction stage. Arrange repeat measurement with ET if necessary.

Based on the monitoring results, the monitoring team will submit the Performance Review Report demonstrating the environmental acceptance of stone column installation.



Near Field Stations

Far Field Stations

Control Stations

Hydrodynamic Station

Rev	Description	By	Date
A	FIRST ISSUE		

Consultant

ARUP Mott MacDonald

Project title

Agreement No. CE 43/2010 (HY)

Central Kowloon Route - Design and Construction

Drawing title

Performance Review for Stone Column Installation

Drawing no. **Figure 1**

Rev.

Drawn	Date	Checked	Approved

Scale

Status PRELIMINARY

路政署 HIGHWAYS DEPARTMENT
主要工程管理處 MAJOR WORKS PROJECT MANAGEMENT OFFICE

Remarks: A 2nd layer of silt curtain to simulate the perimeter silt curtain is not proposed due to limited space in Kowloon Bay and this would be a conservative approach.

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