Contract No. HY/2011/03

Hong Kong-Zhuhai-Macao Bridge Hong Link Road Section between Scenic Hill and Hong Kong Boundary Crossing Facilities

Method Statement – Silt Curtain Pilot Test

Rev. 9

22 October 2013

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1. Introduction

1.1 Background

The Hong Kong-Zhuhai-Macao Bridge ("HZMB") Hong Kong Link Road ("HKLR") serves to connect the HZMB Main Bridge at the Hong Kong Special Administrative Region ("HKSAR") Boundary and the HZMB Hong Kong Boundary Crossing Facilities ("HKBCF") located at the north eastern waters of the Hong Kong International Airport ("HKIA"). The Contract No. and Contract Title of this Contract are HY/2011/03 and HZMB Hong Kong Link Road – Section between Scenic Hill and Hong Kong Boundary Crossing Facilities respectively (see **Figure 2**).

This Method Statement outlines the requirements for a Silt Curtain Pilot Test that is required as part of the above Contract, specifically, Section 9.6 of the Updated Environmental Monitoring and Audit Manual (Version 1.0) for HKLR ("Updated EM&A Manual"). Based on the latest engineering design, a non-dredged method has been adopted for the Contract. There will be no dredging activities but there will be filling works for the Contract.

The Method Statement – Silt Curtain Pilot Test (Rev. 7) was approved by EPD on 9 May 2013. The silt curtain layout has been changed due to the setup of temporary barging point for importing of fill material (Southern) and interfacing with Contract No. HY/2010/02 HZMB HKBCF Reclamation Works (Northern). Therefore, the plan has to be updated based on the latest silt curtain layout and site conditions.

2. Silt Curtain

2.1 Introduction

In accordance with Section 9.6 of the Updated EM&A Manual, suitable silt curtains shall be deployed by the contractor, China State Construction Engineering (Hong Kong) Ltd. ("CSHK") enclosing the entire site at all times during the contract.

The silt curtains are intended as a measure to prevent the displacement and movement of sediments during construction and reclamation activities at the site. Therefore the effectiveness of the silt removal curtains will need to be verified by carrying out a Pilot Test, during the early stages of marine construction.

2.2 Pilot Test

The contract documents require that single layer of floating type silt curtains will be required during the course of the project. In order to ensure that the type of silt curtain that is deployed at the site will be effective in preventing the movement of silt from within the contract area, a Pilot Test will be undertaken.

The Pilot Test will be carried out during early construction and reclamation activities to confirm that the silt curtains that are deployed by CSHK can meet the required silt removal efficiency. The required silt removal rates, as specified in Section 9.6.4 of the Updated EM&A Manual, are defined as the degree of suspended solid reduction of the water passing through the silt curtain are provided in **Table 1** below.

Table 1 Required Removal Efficiency of Silt Curtain for Filling Activities

Testing Scenario	*Silt Removal Rate to be Tested*
	Filling Activities
Scenario 1 - Floating Type Single Silt Curtain	45%

3. Silt Curtain – Pilot Test

3.1 Objectives

As outlined in Section 2 above, the silt curtains need to be effective at reducing the concentration of suspended solids. The performance of the silt curtains, for this contract, is measured as a percentage of reduction of suspended solids within the water as it passes through the curtain.

In order to determine the efficiency of the silt curtains, water quality data will be required from sampling points selected inside and outside the area delineated by the silt curtains. Control points will also be used to provide background concentrations of turbidity that are typically present in the area of the project.

A Pilot Test for the floating type silt curtain scenario will be required, the sampling points to be used and the sampling data to be collected during the Pilot Test is outlined below.

To ensure that the Pilot Test that is undertaken is representative of the works undertaken at the HKLR site, the Pilot Test will only be undertaken when marine filling activities are underway at the HKLR site.

3.2 Pilot Test Sampling Points

In order to determine the effectiveness of the single layer of silt curtain, a suitable number of sampling points (see Section 3.2.2 below) inside and outside the area delineated by the silt curtains will be required, along with the use of two (2) control points.

Measurements and water samples are to be collected from each sampling point at up to three (3) different depths, depending upon the water depth (see Section 3.2.1 below) at each sampling point.

3.2.1 Sample Depths

Water parameters and the concentrations of suspended solids, will be needed at the following depths at each sampling location and control point location:

- 1m below the surface of the water.
- Mid depth at the sampling point.
- 1m above the sea bed.

However, if the depth of water at a sampling location is found to be less than 3m, then only the mid depth sample and parameters will be taken.

A portable, battery powered echo sounder (or similar) is to be used to determine the depth of water at each of the sampling locations and control point locations.

3.2.2 Sampling Points

For the purposes of the Pilot Tests, sampling points inside and outside the silt curtains and one (1) upstream sampling point and one (1) downstream sampling point will be used. According to CSHK, the initial filling work will be undertaken at Seawall Chainage (SWCH) 300 – 800 and SWCH 900 – 1300. **Figure 3** indicates the position of the sampling points for each of the Pilot Tests.

Control data will be required for the Pilot Tests, therefore water parameters and water samples will be collected from the impact monitoring Control Stations CS2 and CS(Mf)5 (see **Figure 1**).

Given that the predicted currents from the EIA model simulations for this specific coastal area are rather weak and that the localized flow pattern is complicated by the new construction activities associated with the HKBCF, the actual conditions at the proposed monitoring positions may vary. Additionally, given the variable conditions influenced by the HKBCF (that have not been modeled) the proposed monitoring stations may be all located upstream of the identified filling work that will be undertaken by CSHK.

Given the complicated situation envisaged within the sampling area, the water current should be determined at each of the proposed monitoring positions prior to undertaking the proposed testing. Should conditions at the monitoring positions be identified to be weak or unsuitable (e.g. low current flow rate, or current in an unanticipated direction etc.) for the proposed testing, alternative sampling points suitable situated relative to each of the initial filling points will be proposed to confirm the effectiveness of the silt curtain.

Table 2 below provides details on the number of proposed monitoring points for each of the anticipated construction scenarios.

Table 2 Monitoring Details for Silt Curtain Pilot Tests

Monitoring Details	Single Layer of Floating Type Silt Curtain
Control Stations	CS2 and CS(Mf)5
Sampling Points	4 number for each tidal condition, to be collected on the same day. See **Figure 3**. Additionally, sample points within the perimeter shall be sampled first.
	(i) Ebb condition when filling works are undertaking at SWCH 300-800 – Undertake water sampling work at upstream (S1 and S3) and downstream (S2 and S4) locations. (ii) Flood condition when filling works are undertaking at SWCH 900-1300 – Undertake water sampling work at upstream (S6 and S8) and downstream (S5 and S7) locations.
Collection of Parameters at Depth	1m below water surface, mid-depth and 1m above seabed
Water Sample (for suspended solids) Depths	

3.3 Sampling Parameters and Equipment

3.3.1 Sampling Parameters

As the silt removal efficiency of the silt curtains will be determined by the analysis of collected water samples, the following parameters, outlined in **Table 3**, will be analysed.

Table 3 Parameters Required for the Silt Curtain Pilot Tests

Parameter	Data Recorded in situ with Meter	Water Sample Required
Dissolved Oxygen	✓	
Salinity	✓	
Temperature	✓	
pH	✓	
Turbidity	✓	
Suspended Solids		✓
Water depth	✓	
Water velocity and direction	✓	

3.3.2 Sampling Equipment

The equipment used at each sampling point will be required to record the following:

- Dissolved oxygen ("DO") and temperature measurements, DO in the range of 0 – 20mg/l and 0 -200% saturation, and a temperature range of 0 – 45 degrees Celsius. It should have a membrane electrode with automatic temperature compensation complete with a cable.
- Salinity measured in the range of 0 -40 on the practical salinity scale.
- The pH measured between 0 and 14 on the pH scale.
- Turbidity will be measured in the range of 0 – 1,000NTU.
- Water depth will be recorded using a portable battery powered echo sounder or similar.
- A water current meter capable of measuring the rate and direction of flow with a range of 0.1m/s to 6.06m/s and an accuracy of 0.03m/s. For example, the water current meter to be used shall be a Falmouth Scientific, Inc. 2-Dimensional Acoustic Current Meter, or an approved similar instrument.
- A hand held or boat-fixed type digital Global Positioning System (dGPS) with way point bearing indication and Radio Technical Commission for maritime Type 16 error message "screen pop-up" facilities (for real-time auto-display of error messages and dGPS corrections from the Hong Kong Hydrographic Office), or other equipment of similar accuracy, should be used during maritime water monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

Water samples, for analysis for suspended solids, will be collected using a Kahlsico Water Sampler or approved similar instrument. The water samples will be stored in high density polythene bottle ware with no preservatives added (cooled to 4^{o}C without being frozen), kept in the dark and transported to an HOKLAS approved testing laboratory within 24hours of the sample being collected.

For quality assurance and quality control purposes, independent duplicate water samples for suspended solids are to be taken at each sampling point and control station.

Duplicate samples will be taken for the suspended solids measurement and the analysis shall be carried out at a HOKLAS or other international accredited laboratory. The laboratory determination work shall start within 24 hours after collection of the water samples. The analysis for SS is summarized in **Table 4** below.

Table 4 Laboratory Analysis for Suspended Solids

Parameter	Instrumentation	Reference Method	Detection Limit
Suspended Solid (SS)	Weighting	APHA 2540-D	0.5mg/l

Two consecutive measurements of DO concentration, DO saturation, pH, salinity, temperature and turbidity for data quality control. The monitoring probes shall be retrieved out of water after the first measurement and then redeployed for the second measurement. Where the difference in value between the first and second readings of DO or turbidity parameters is more than 25% of the value of the first reading, the reading shall be discarded and further readings shall be taken.

3.3.3 Sampling Equipment Calibration

The pH meter, DO meter, water meter and turbidimeter shall be checked and calibrated before use. The DO meter and turbidimeter will be certified by a laboratory accredited under HOKLAS or any other international accreditation scheme. The responses of sensors and electrodes will be checked with certified standard solutions before use. Wet bulb calibration for the DO meter will be carried out before carrying out measurements at each monitoring location.

3.4 Pilot Test Duration and Sampling Frequency

3.4.1 Pilot Test Duration

In order to ascertain the efficiency of the silt curtains that are intended for use by CSHK during filling activities, it is proposed that the Pilot Tests outlined in this Method Statement last for a period of 4 hours and be undertaken during ebb and flood tides, subject to marine construction activities and encountered weather conditions.

The sampling parameters will be collected from the sampling points indicated in Section 3.2.2 during the Pilot Test.

3.4.2 Sampling Frequency

It is proposed that the water parameters and water samples for SS outlined in **Table 3** will be collected from the sampling points, before commencement of the Pilot Test, at commencement of the Pilot Test, and then at intervals dependent upon the flood condition for the duration of the Pilot Test. The Pilot Test under ebb and flood conditions will be conducted at the same time as commencement of the marine filling works.

For ebb conditions it is proposed that the sampling interval will be 30 minutes for a total time period of 2 hours and for flood conditions it is proposed that the sampling interval will be 30 minutes for a total time period of 2 hours.

3.5 Other Conditions

As stated in the Updated EM&A Manual, regardless of the measured efficiency of the silt curtain system the event and action plan provided in the Updated EM&A Manual will only be based on the monitoring results at the designated monitoring stations.

The Environmental Project Office, Supervising Office and Environmental Protection Department will be notified at least one week in advance of conducting the pilot test.

If inclement weather conditions are forecast for the day of the Pilot Test, the test will be postponed to the next day as appropriate.

3.5 Determination of Silt Removal Efficiency

The laboratory results of the pilot test will be utilized to determine the efficiency of the silt curtains that will be deployed at the site. The silt curtain is intended to act as a barrier to suspended solids by holding them in a stagnation pocket behind the silt curtain.

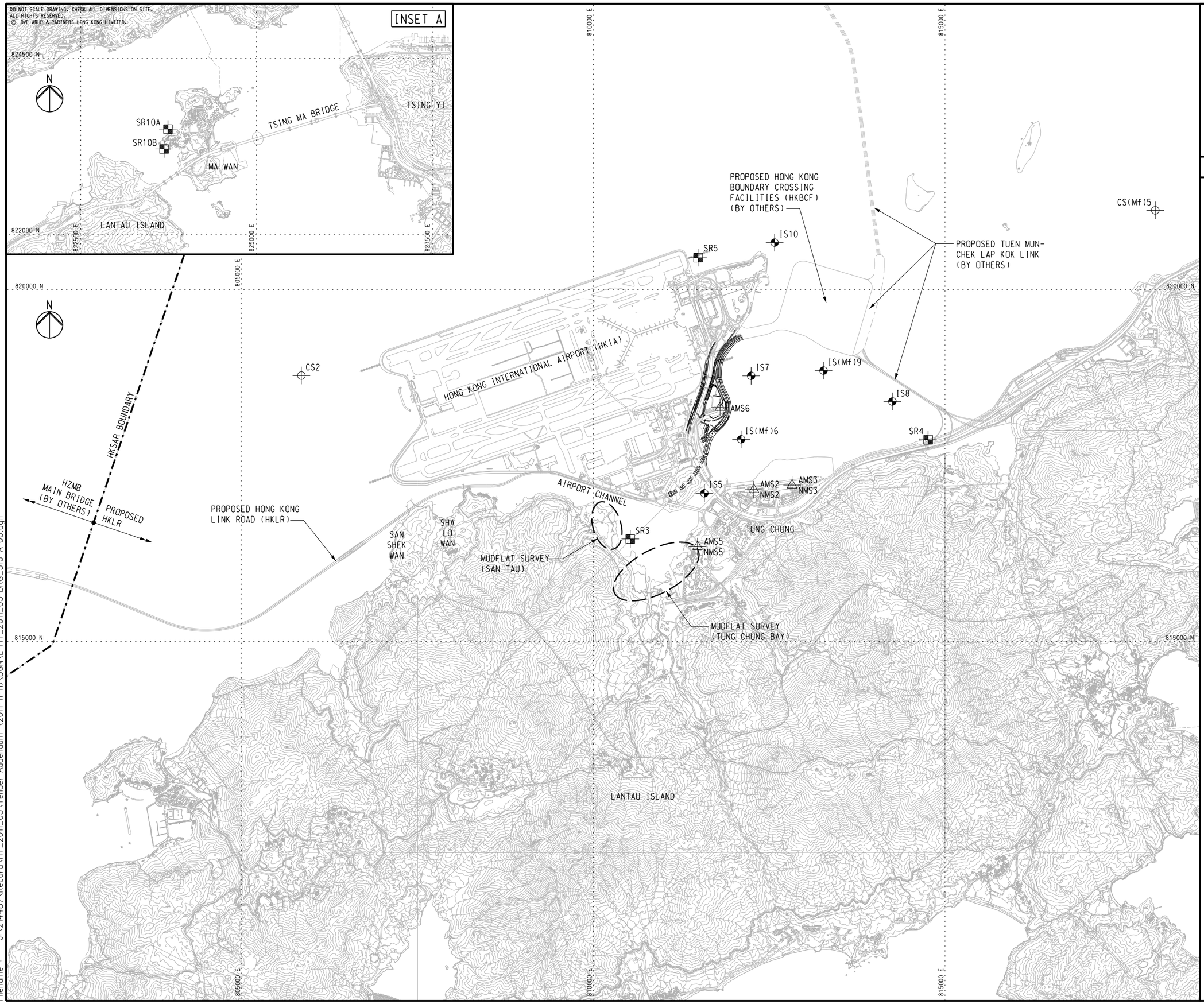
In order to quantify the effectiveness of the silt curtain type that is deployed by CSHK, the concentrations of SS and the levels of turbidity inside and outside of the curtain will be compared. The percent reduction in the level of SS is to be used as the effectiveness parameter. Percent reduction is defined as 100 times the ratio of the difference in readings.

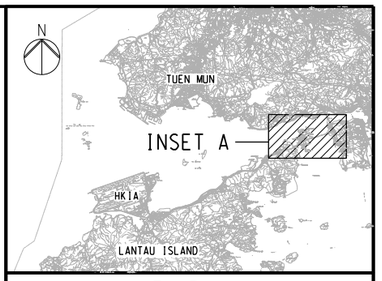
The overall reduction in the concentrations of SS will be determined for the three depth positions and an overall reduction will also be calculated for all depths to provide the silt removal efficiency of the silt curtain.

The TSS removal efficiency shall be calculated by:

$$TSS\ reduction\ \% = \frac{\text{Upstream TSS (mg/l)} - \text{Downstream TSS (mg/l)}}{\text{Upstream TSS (mg/l)}} \text{ x } 100$$

FIGURES





KEY PLAN

NOTES

1. EXACT LOCATIONS OF MONITORING STATIONS ARE TO BE DETERMINED ON SITE. THE CONTRACTOR AND ENVIRONMENTAL TEAM (ET) SHALL AGREE WITH THE INDEPENDENT ENVIRONMENTAL CHECKER (IEC) AND ENVIRONMENTAL PROJECT OFFICE (ENPO) AND APPROVED BY THE SUPERVISING OFFICER FOR THE PROPOSED LOCATION OF THE MONITORING STATIONS.
2. THE LOCATION AND EXTENT OF MUDFLAT SURVEY SHOWN ON THIS DRAWING ARE APPROXIMATE ONLY. THE CONTRACTOR AND ET SHALL DETERMINE AND AGREE WITH THE IEC, ENPO AND SUPERVISING OFFICER THE DETAILS OF THE MUDFLAT SURVEY IN ACCORDANCE WITH THE REQUIREMENTS STIPULATED IN THE EIA REPORTS AND E&MA MANUALS.
3. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS STIPULATED IN THE EM&A MANUALS TO CONDUCT THE ENVIRONMENTAL MONITORING AND AUDIT WORKS.

LEGEND

- IS — IMPACT STATIONS (WATER QUALITY)
- CS — CONTROL/FAR FIELD STATIONS (WATER QUALITY)
- SR — SENSITIVE RECEIVERS STATIONS (WATER QUALITY)
- ST — STATION FOR SENSITIVITY TEST RESULT (WATER QUALITY)
- AMS — MONITORING STATIONS (AIR QUALITY)
- NMS — MONITORING STATIONS (NOISE)

Rev	Description	By	Date
A	TENDER ADDENDUM ISSUE	AW	11/11

Consultant

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Contract No. and Title:

Contract No. HY/2011/03

Hong Kong-Zhuhai-Macao Bridge
Hong Kong Link Road -
Section Between Scenic Hill and
Hong Kong Boundary Crossing Facilities

Drawing title

ENVIRONMENTAL MONITORING STATIONS

Drawing no.	Rev.
Figure 1	0

Drawn	Date	Checked	Approved
RY	11/11	AW	SK

Scale: 1:25000 @A1 | Status: TENDER

路政署 HIGHWAYS DEPARTMENT
港珠澳大橋香港工程管理處
Hong Kong - Zhuhai - Macao Bridge
Hong Kong Project Management Office

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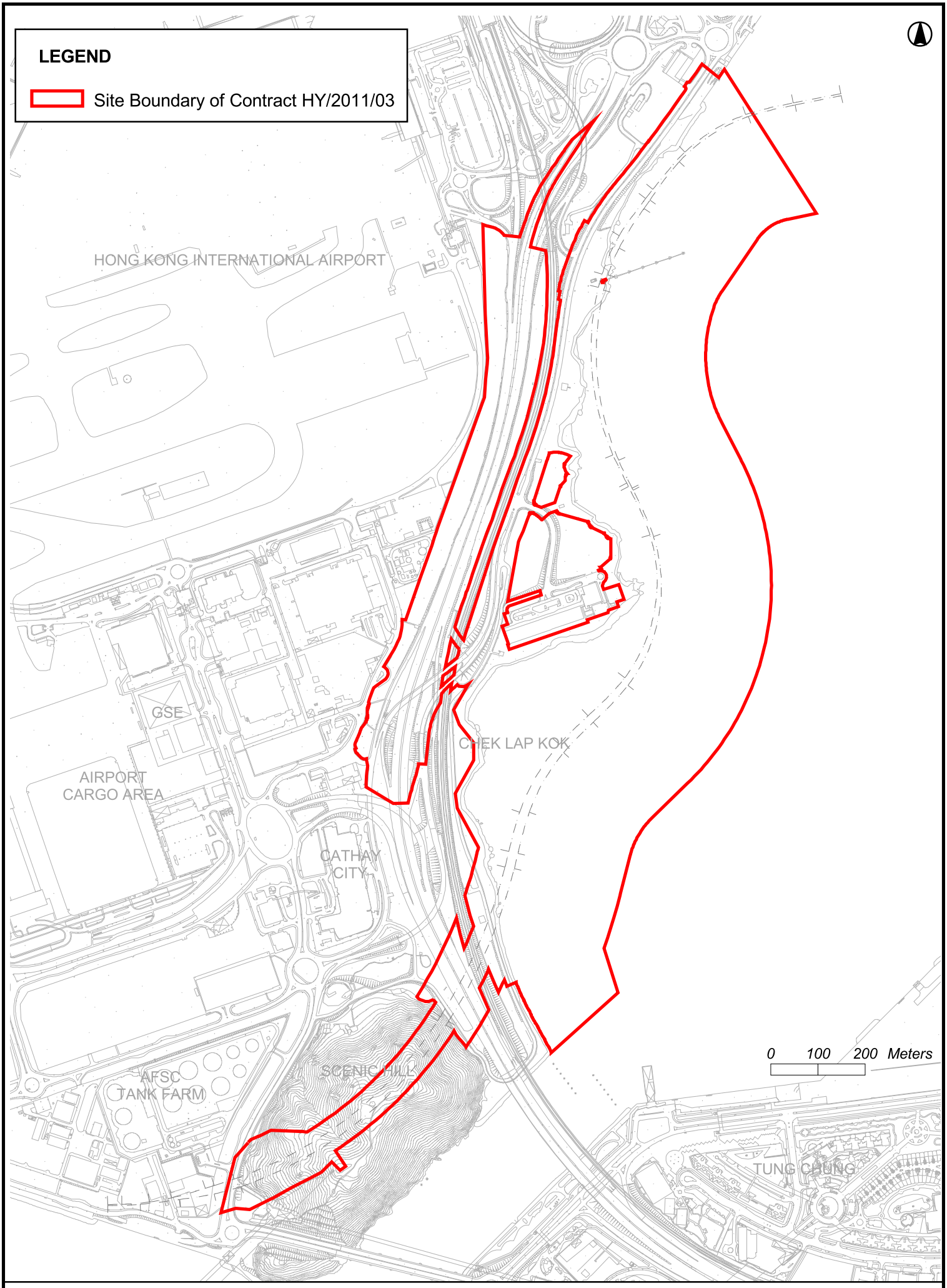
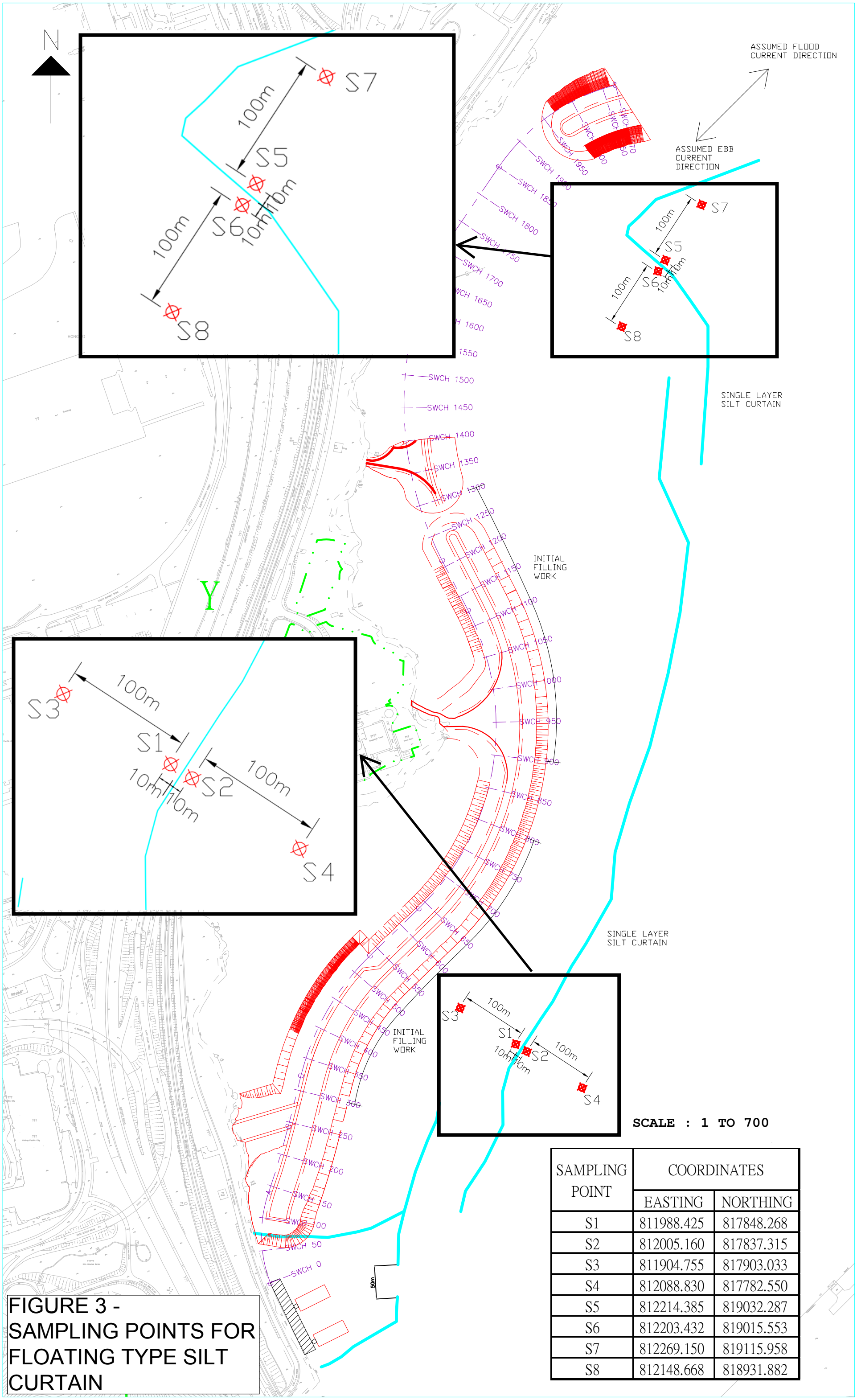


Figure 2 Location of the Site



SCALE : 1 TO 700

SAMPLING POINT	COORDINATES	
	EASTING	NORTHING
S1	811988.425	817848.268
S2	812005.160	817837.315
S3	811904.755	817903.033
S4	812088.830	817782.550
S5	812214.385	819032.287
S6	812203.432	819015.553
S7	812269.150	819115.958
S8	812148.668	818931.882

FIGURE 3 - SAMPLING POINTS FOR FLOATING TYPE SILT CURTAIN