

**Environmental Monitoring and Audit
 for Contaminated Mud Pits to the
 South of The Brothers and at East
 Sha Chau (2012-2017) – Investigation
 Agreement No. CE 23/2012(EP)**

**28th Monthly Progress Report for Contaminated
 Mud Pits to the South of The Brothers and at
 East Sha Chau – December 2014**

Revision 0

14 January 2015

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Client: Civil Engineering and Development Department (CEDD)		Project No: 0175086			
Summary: This document presents the 28 th monthly progress report for Contaminated Mud Pits at the South of The Brothers and at East Sha Chau.		Date: 14 January 2015			
		Approved by:  Craig A. Reid Partner			
v0	28 th Monthly Progress Report for ESC CMPs and SB CMPs	CY	JNG	CAR	14/1/15
Revision	Description	By	Checked	Approved	Date
<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		Distribution <input type="checkbox"/> Internal <input checked="" type="checkbox"/> Public <input type="checkbox"/> Confidential			
				 	

**Dredging, Management and Capping of Contaminated Sediment Disposal
Facility to the South of The Brothers**

**Environmental Certification Sheet
EP-427/2011/A**

Reference Document/Plan

Document/ Plan to be Certified/ Verified:	28 th Monthly Progress Report for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau - December 2014
Date of Report:	14 January 2015
Date prepared by ET:	14 January 2015
Date received by IA:	14 January 2015

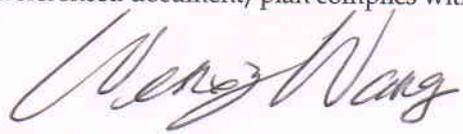
Reference EP Condition

Environmental Permit Condition:	Condition No.: 4.4
4 hard copies and 1 electronic copy of monthly EM&A Report shall be submitted to the Director within 2 weeks after the end of the reporting month. The EM&A Reports shall include a summary of all non-compliance (exceedances) of the environmental quality performance limits (Action and Limit Levels). The submissions shall be certified by the ET Leader and verified by the Independent Auditor. Additional copies of the submission shall be provided to the Director upon request by the Director.	

ET Certification

I hereby certify that the above referenced document/ plan complies with the above referenced condition of EP-427/2011/A	
Craig A. Reid, Environmental Team Leader:	 Date: 14/1/2015

IA Verification

I hereby verify that the above referenced document/ plan complies with the above referenced condition of EP-427/2011/A	
Dr Wang Wen Xiong, Independent Auditor:	 Date: 14/1/2015

CONTENTS

1.1	<i>BACKGROUND</i>	1
1.2	<i>REPORTING PERIOD</i>	2
1.3	<i>DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES</i>	2
1.4	<i>DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS</i>	3
1.5	<i>BRIEF DISCUSSION OF THE MONITORING RESULTS FOR SB CMPS</i>	4
1.6	<i>ACTIVITIES SCHEDULED FOR THE NEXT MONTH</i>	7
1.7	<i>STUDY PROGRAMME</i>	7

ANNEXES

<i>Annex A</i>	<i>Sampling Schedule</i>
<i>Annex B</i>	<i>Graphical Presentations</i>
<i>Annex C</i>	<i>Water Quality Monitoring Results</i>
<i>Annex D</i>	<i>Study Programme</i>

Agreement No. CE 23/2012 (EP)
Environmental Monitoring and Audit
for Contaminated Mud Pits to the South of The Brothers and at East Sha
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28TH MONTHLY PROGRESS REPORT FOR DECEMBER 2014

1.1 BACKGROUND

1.1.1 Since early 1990s, contaminated sediment ⁽¹⁾ arising from various construction works (e.g. dredging and reclamation projects) in Hong Kong has been disposed of at a series of seabed pits at East of Sha Chau (ESC). In late 2008, a review indicated that the existing and planned facilities at ESC would not be able to meet the disposal demand after 2012. In order to meet this demand, the Hong Kong Special Administrative Region Government (HKSARG) decided to implement a new contained aquatic disposal (CAD) ⁽²⁾ facility at the South of The Brothers (SB CMPs) which had been under consideration for a number of years.

1.1.2 The environmental acceptability of the construction and operation of the Project had been confirmed by findings of the associated Environmental Impact Assessment (EIA) study completed in 2005 under *Agreement No. CE 12/2002(EP)* ⁽³⁾. The Director of Environmental Protection (DEP) approved this EIA report under the *Environmental Impact Assessment Ordinance (Cap. 499) (EIAO)* in September 2005 (*EIA Register No.: AEIAR-089/2005*).

1.1.3 In accordance with the EIA recommendation, prior to commencement of construction works for the SB CMPs, the Civil Engineering and Development Department (CEDD) undertook a detailed review and update of the EIA findings for the SB site ⁽⁴⁾. Findings of the EIA review undertaken in 2009/2010 confirmed that the construction and operation of the SB site had been predicted to be environmentally acceptable.

(1) According to the Management Framework of Dredged/ Excavated Sediment of ETWB TC(W) No. 34/2002, contaminated sediment in general shall mean those sediment requiring Type 2 – Confined Marine Disposal as determined according to this TC(W).

(2) CAD options may involve use of excavated borrow pits, or may involve purpose-built excavated pits. CAD sites are those which involve filling a seabed pit with contaminated mud and capping it with uncontaminated material such that the original seabed level is restored and the contaminated material is isolated from the surrounding marine environment.⁷

(3) Detailed Site Selection Study for a Proposed Contaminated Mud Disposal Facility within the Airport East/ East of Sha Chau Area (*Agreement No. CE 12/2002(EP)*)

(4) Under the CEDD study *Contaminated Sediment Disposal Facility to the South of The Brothers (Agreement No. FM 2/2009)*

1.3.2 The following monitoring activities have been undertaken for SB CMPs in December 2014:

- *Pit Specific Sediment Chemistry of CMP 2* was undertaken on 11 December 2014;
- *Cumulative Impact Sediment Chemistry of CMP 2* was undertaken on 3 December 2014;
- *Water Column Profiling of CMP 2* was undertaken on 4 December 2014; and
- *Water Quality Monitoring during Capping Operations of CMP 1* was undertaken on 9 December 2014.

1.4 **DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS**

1.4.1 No outstanding sampling remained for December 2014. The following laboratory analyses were still in progress during the preparation of this monthly report and hence are not presented in this monthly report:

- Laboratory analyses of sediment samples collected for *Benthic Recolonisation Studies* of ESC CMPs in December 2014;
- Laboratory analyses of sediment samples collected for *Pit Specific Sediment Chemistry* in December; and
- Laboratory analyses of suspended solids in samples collected for *Water Quality Monitoring during Capping of CMP 1*.

1.4.2 A summary of field activities conducted are presented in *Annex A*.

1.5 BRIEF DISCUSSION OF THE MONITORING RESULTS FOR ESC CMPs

1.5.1 A brief discussion of the monitoring results of the *Water Quality Monitoring during Capping* of ESC CMPs conducted on 9 December 2014 is presented below.

1.5.2 *Water Quality Monitoring during Capping – December 2014*

1.5.3 The monitoring results obtained during December 2014 sampling in the dry season have been assessed for compliance with the Water Quality Objectives (WQOs) through a review of the Environmental Protection Department (EPD) routine water quality monitoring data for the dry season period (November to March) of 2003-2013 from stations in the North Western Water Control Zone (WCZ), where ESC CMPs are located. For Salinity, the average value obtained from the Reference stations was used for the basis as the WQO. A total of sixteen (16) monitoring stations were sampled in December 2014 as shown in *Figure 1.2*. Graphical presentation of the monitoring results is provided in *Annex B*.

In-situ Measurements

1.5.4 Graphical presentation of the monitoring results is shown in *Figures 1-6* of *Annex B*. Levels of Dissolved Oxygen (DO), pH and Salinity at all stations in December 2014 complied with the WQO.

Laboratory Measurements for Suspended Solids (SS)

1.5.5 Concentrations of SS complied with the WQO at all stations in December 2014 (*Figure 7* of *Annex B*). There did not appear to be any spatial trend of increasing SS levels towards the capping operations. Further statistical analysis will be undertaken in the quarterly report to investigate whether the capping operations at ESC CMPs is causing any unacceptable deterioration in water quality of the area.

1.6 BRIEF DISCUSSION OF THE MONITORING RESULTS FOR SB CMPs

1.6.1 A brief discussion of the monitoring results of the following activities for SB CMPs is presented in this 28th *Monthly Progress Report*:

- *Cumulative Impact Sediment Chemistry of CMP 2* conducted on 3 December 2014;
- *Water Column Profiling of CMP 2* conducted on 4 December 2014 ; and
- *Water Quality Monitoring during Capping Operations of CMP 1* conducted on 9 December 2014.

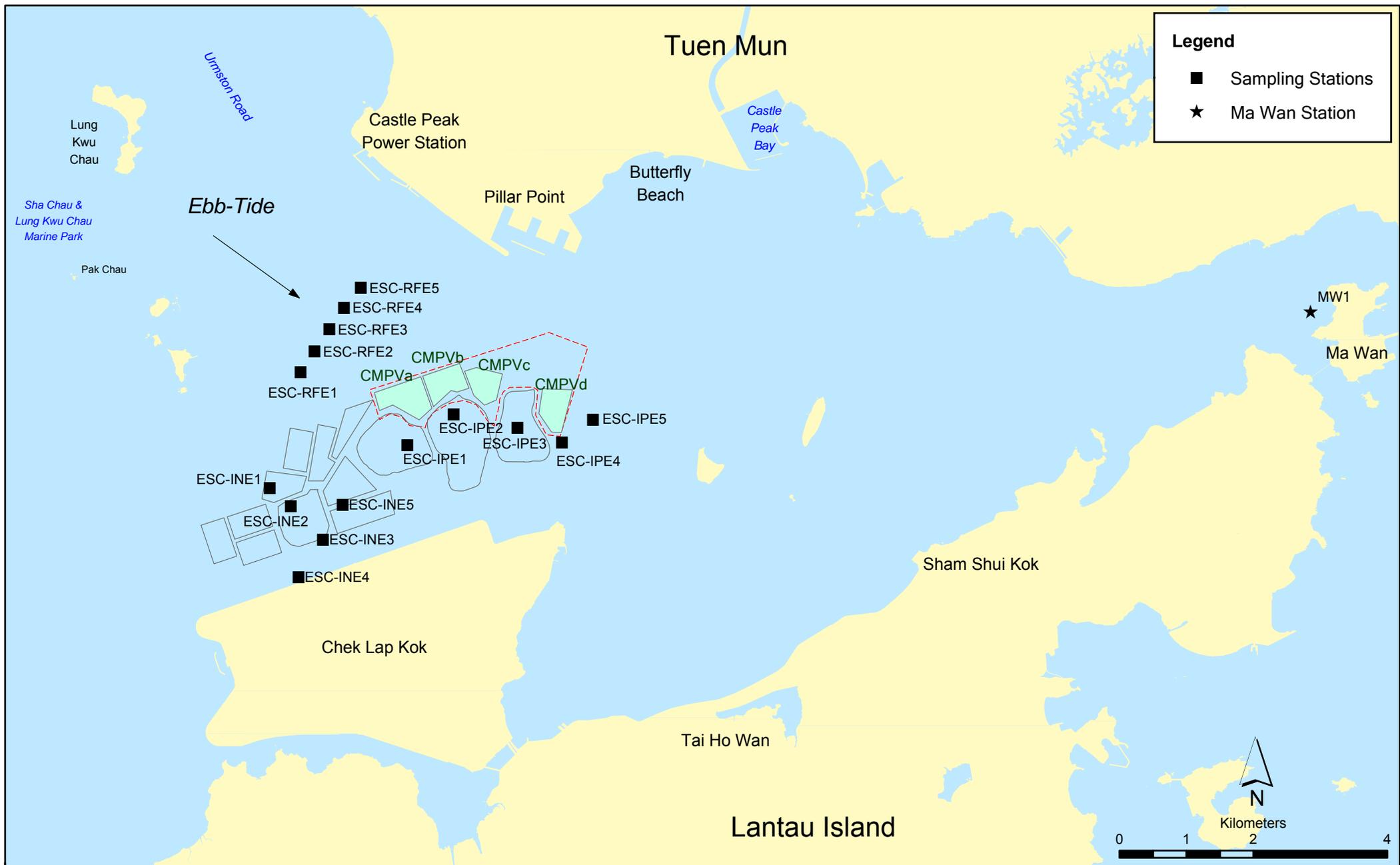


Figure 1.2

Routine & Capping Water Quality Sampling Stations (Ebb-Tide) for CMPV

- 1.6.2 *Cumulative Impact Sediment Chemistry of CMP 2 – December 2014*
- 1.6.3 Monitoring locations for *Cumulative Impact Sediment Chemistry for CMP 2* are shown in *Figure 1.3*. A total of eleven (11) monitoring stations were sampled in December 2014.
- 1.6.4 Analyses of results for the *Cumulative Impact Sediment Chemistry Monitoring* indicated that the concentrations of all metals, except Arsenic at Capped Pit SB-RCA Station, were below the Lower Chemical Exceedance Level (LCEL) in December 2014 (*Figure 8 and 9 of Annex B*).
- 1.6.5 Whilst the average concentration of Arsenic in the Earth's crust is generally ~ 2mg/kg, significantly higher Arsenic concentrations (median = 14 mg/kg) have been recorded in Hong Kong's onshore sediments ⁽¹⁾. It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments ⁽²⁾, and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the LCEL exceedance of Arsenic at the Capped Pit SB-RCA Station is unlikely to be caused by the disposal operations at CMP 1 but rather as a result of naturally occurring deposits.
- 1.6.6 For organic contaminants, concentration of Total Organic Carbon (TOC) at Tai Ho Bay Station 2 (THB2) was recorded to be higher than other stations (*Figure 10 of Annex B*). Concentrations of Tributyltin (TBT) were recorded to be higher at Near-field station SB-RNB station (*Figure 11 of Annex B*). Total Dichloro-diphenyl-trichloroethane (DDT) and 4,4'-Dichloro-diphenyl-dichloroethylene (4,4'-DDE) were recorded below the limit of detection at all stations with no apparent spatial trend. Concentrations of Total Polychlorinated Biphenyls (PCBs) as well as Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (Low and High MW PAHs) were recorded below the limit of reporting at all the stations.
- 1.6.7 Overall, there is no evidence indicating any unacceptable environmental impacts to sediment quality as a result of the contaminated mud disposal operations at CMP 2 during this monthly period.

(1) Sewell RJ (1999) *Geochemical Atlas of Hong Kong*. Geotechnical Engineering Office, Government of the Hong Kong Special Administrative Region

(2) Whiteside PGD (2000) Natural geochemistry and contamination of marine sediments in Hong Kong. In: *The Urban Geology of Hong Kong* (ed Page A & Reels SJ). Geological Society of Hong Kong Bulletin No. 6, p109-121

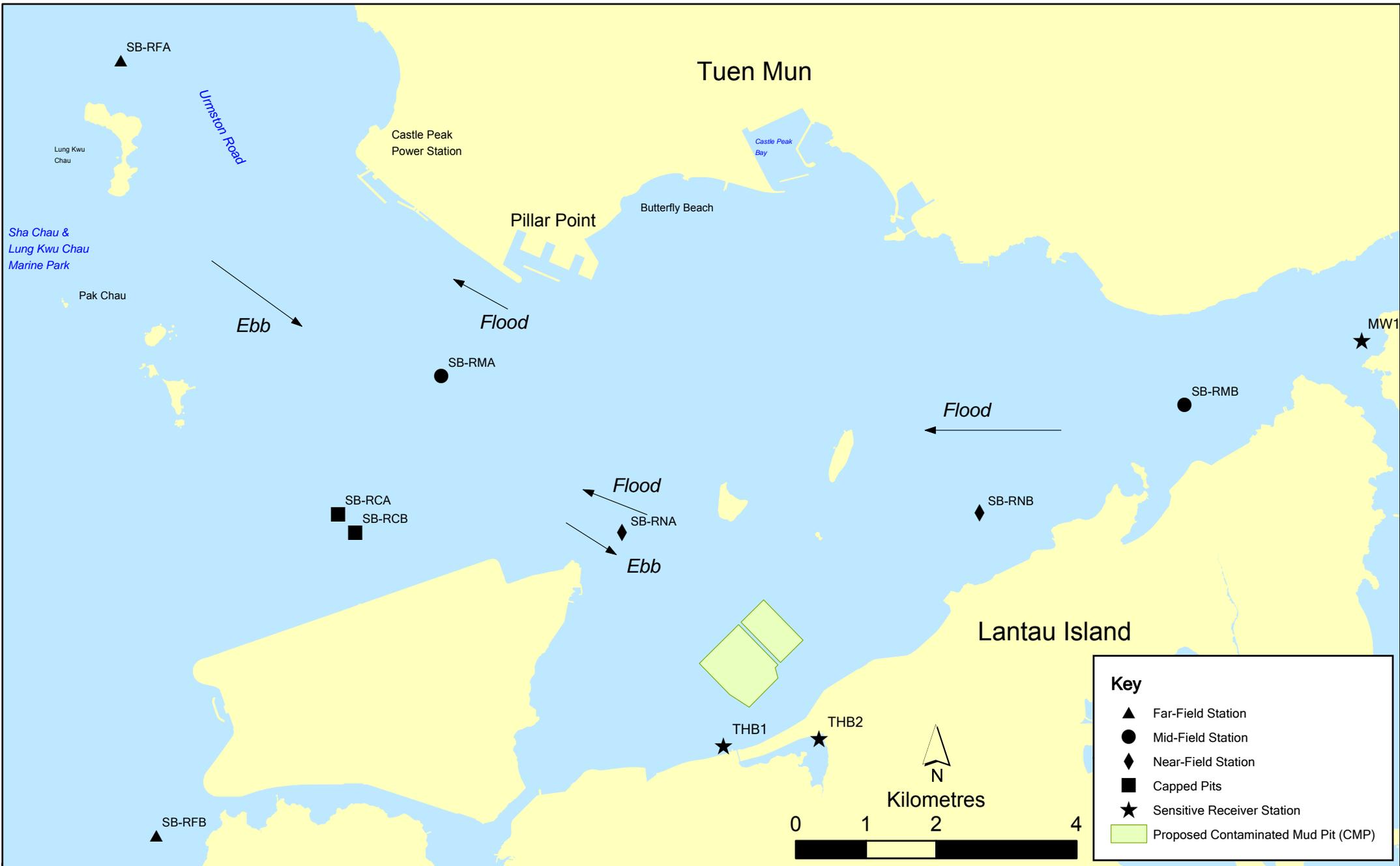


Figure 1.3

Cumulative Impacts Sediment Quality Monitoring Stations for South Brothers Facility

1.6.8 ***Water Column Profiling of CMP 2 – December 2014***

1.6.9 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 4 December 2014. The water quality monitoring results have been assessed for compliance with the WQO. The monitoring results were also compared with the Action and Limit Levels set in *Baseline Monitoring Report* (see *Table C2 of Annex C* for details).

In-situ Measurements

1.6.10 Analyses of results for December 2014 indicated that levels of Salinity, turbidity, DO and pH complied with the WQOs at both Downstream and Upstream stations (*Table C1 of Annex C*).

Laboratory Measurements for SS

1.6.11 Analyses of results for December 2014 indicated that the SS levels at both Upstream and Downstream stations complied with the WQO. SS levels at all stations complied with the Action and Limit Levels (*Table C1 of Annex C*).

1.6.12 Overall, the monitoring results indicated that the mud disposal operation at CMP 2 did not appear to cause any deterioration in water quality during this reporting period.

1.6.13 ***Water Quality Monitoring during Capping Operations of CMP 1– December 2014***

1.6.14 The monitoring results obtained during December 2014 sampling in the dry season have been assessed for compliance with the WQOs through a review of the EPD routine water quality monitoring data for the dry season period (November to March) of 2003-2013 from stations in the North Western WCZ, where SB CMP 1 is located. For Salinity, the average value obtained from the Reference stations was used for the basis as the WQO. A total of fourteen (14) monitoring stations were sampled in December 2014 as shown in *Figure 1.4*. Graphical presentation of the monitoring results is provided in *Annex B*.

In-situ Measurements

1.6.15 Graphical presentation of the monitoring results is shown in *Figure 12-17 of Annex B*. Levels of Dissolved Oxygen (DO), pH and Salinity at all stations in December 2014 complied with the WQO.

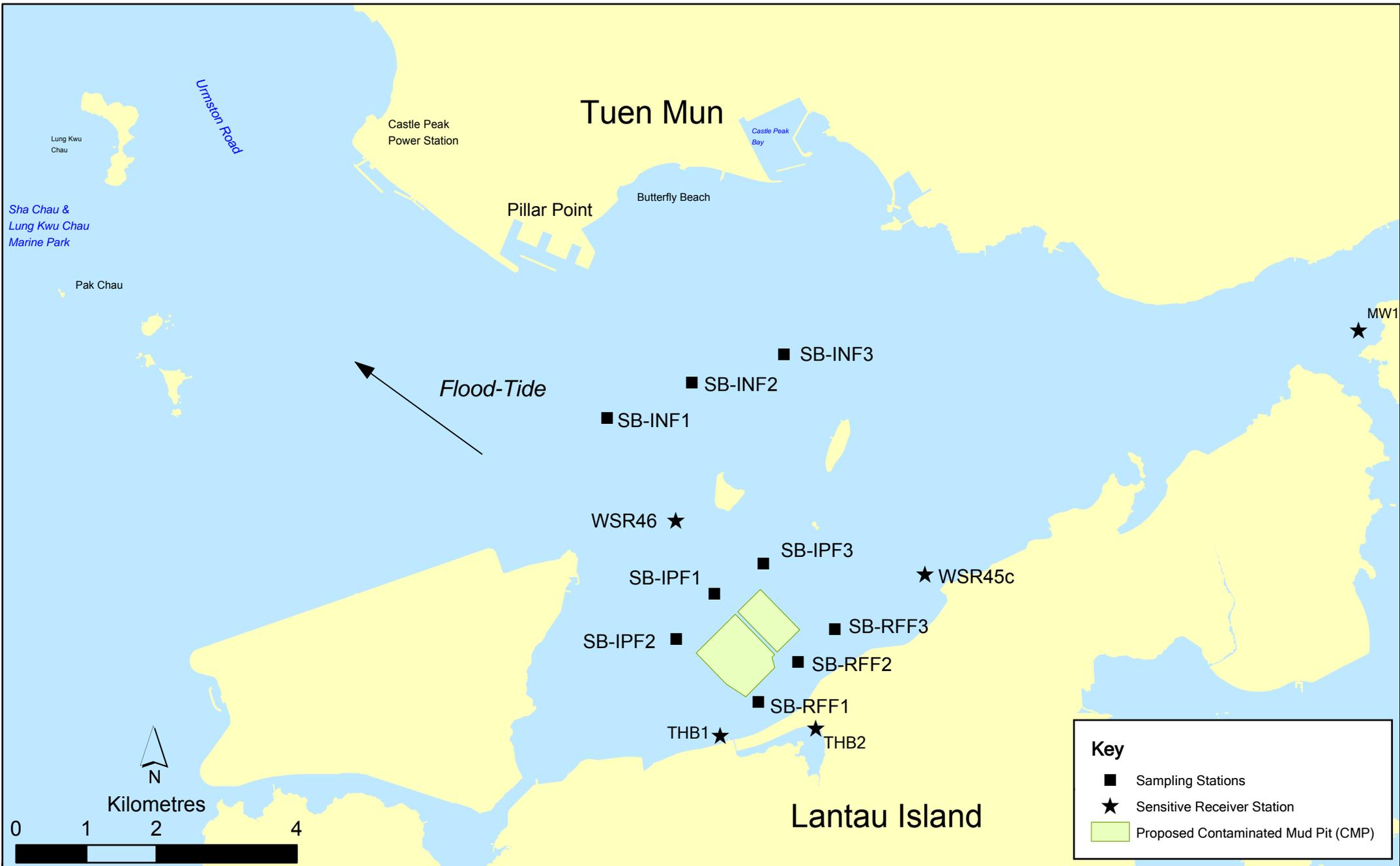


Figure 1.4

Routine & Capping Water Quality Sampling Stations (Flood-Tide) for South Brothers Facility

1.7 *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

1.7.1 The following monitoring activities will be conducted in the next monthly period of January 2015 for SB CMPs:

- *Pit Specific Sediment Chemistry of CMP 2;*
- *Demersal Trawling for CMP2;*
- *Routine Water Quality Monitoring for CMP2;*
- *Water Column Profiling of CMP 2; and*
- *Water Quality Monitoring during Capping Operations of CMP 1.*

1.7.2 No monitoring activities will be conducted in the next monthly period of January 2015 for ESC CMPs.

1.7.3 The sampling schedule is presented in *Annex A*.

1.8 *STUDY PROGRAMME*

1.8.1 A summary of the Study programme is presented in *Annex D*.

Annex A

Sampling Schedule

Annex A1 - Environmental Monitoring and Audit Sampling Schedule for East of Sha Chau (September 2012 - February 2017)

		2012				2013					2014					2015					2016					2017																	
Routine Water Quality Monitoring		S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Ebb Tide																																											
Impact Station																																											
	ESC-IPE1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-IPE2	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-IPE3	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-IPE4	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-IPE5	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Intermediate Station																																											
	ESC-INE1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-INE2	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-INE3	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-INE4	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-INE5	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Reference Station																																											
	ESC-RFE1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-RFE2	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-RFE3	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-RFE4	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-RFE5	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Ma Wan Station																																											
	MW1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Flood Tide																																											
Impact Station																																											
	ESC-IPF1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-IPF2	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-IPF3	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Intermediate Station																																											
	ESC-INF1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-INF2	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-INF3	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Reference Station																																											
	ESC-RFF1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-RFF2	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
	ESC-RFF3	*	*			*	*			*	*																			*	*			*	*			*	*			*	*
Ma Wan Station																																											
	MW1	*	*			*	*			*	*																			*	*			*	*			*	*			*	*

Annex B

Graphical Presentations

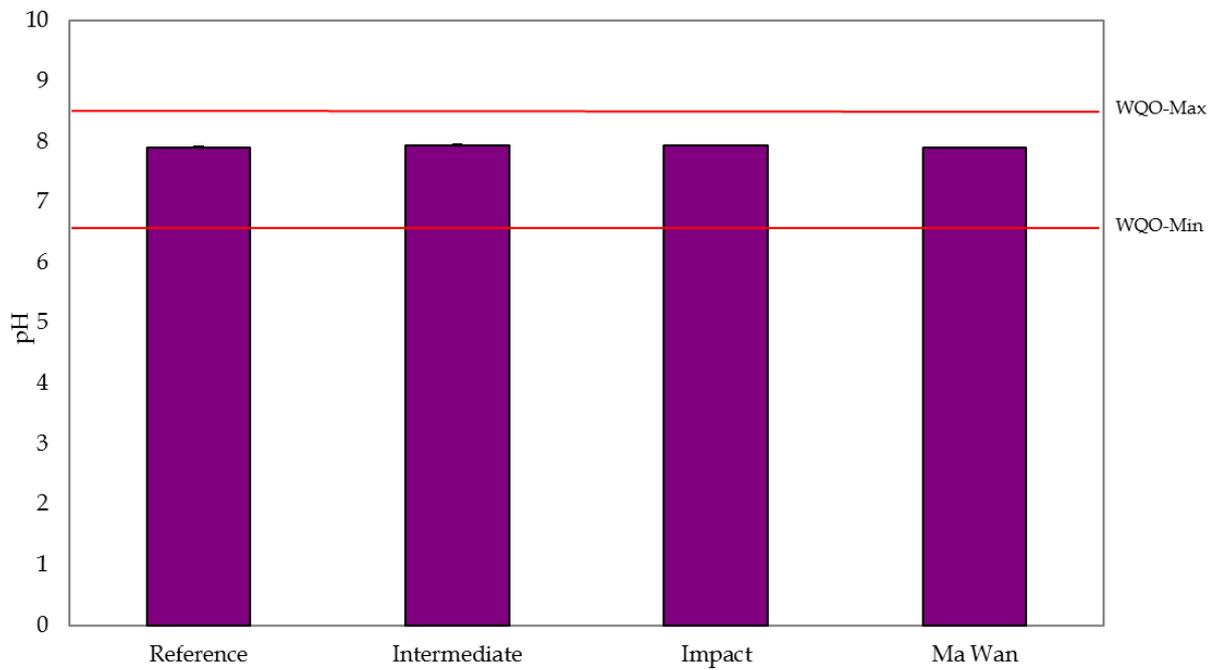


Figure 1: Levels of pH recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

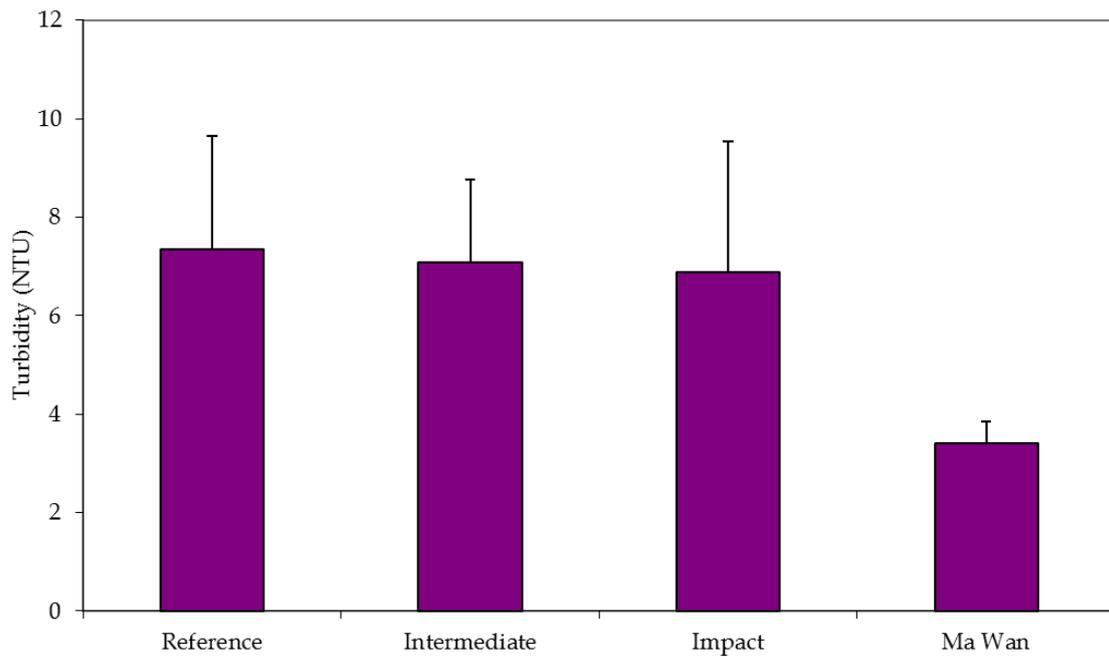


Figure 2: Levels of Turbidity recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

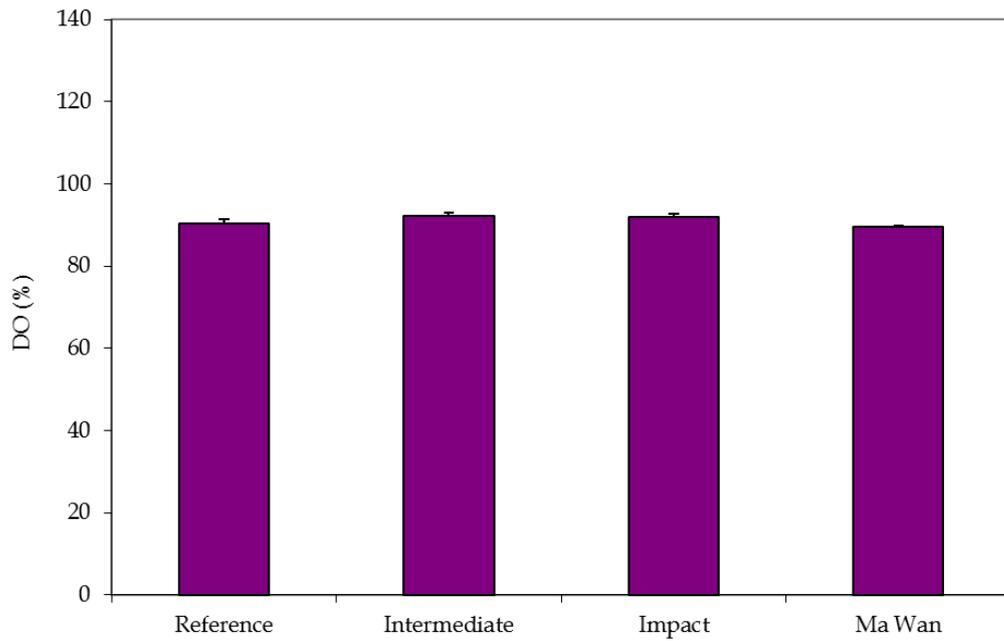


Figure 3: Level of Dissolved Oxygen (% saturation) recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

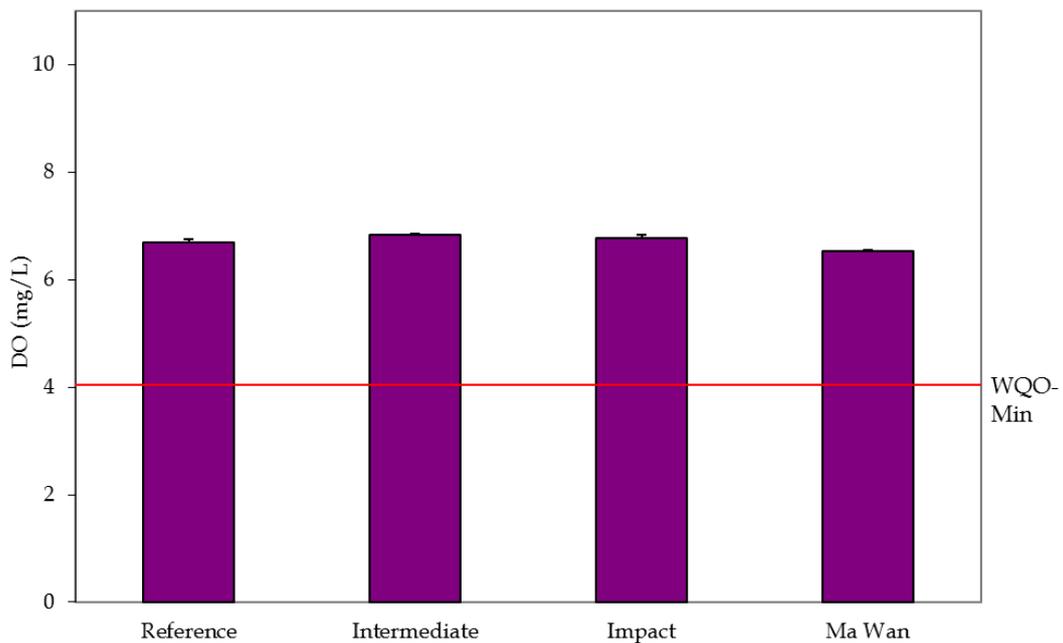


Figure 4: Concentration of Dissolved Oxygen (mg/L) recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

Source: H:\Team\EM\GMS Projects\0175086 CEDD EM&A for South Brothers\02 Deliverable\07 CMP Monthly Report\28th (December 2014)

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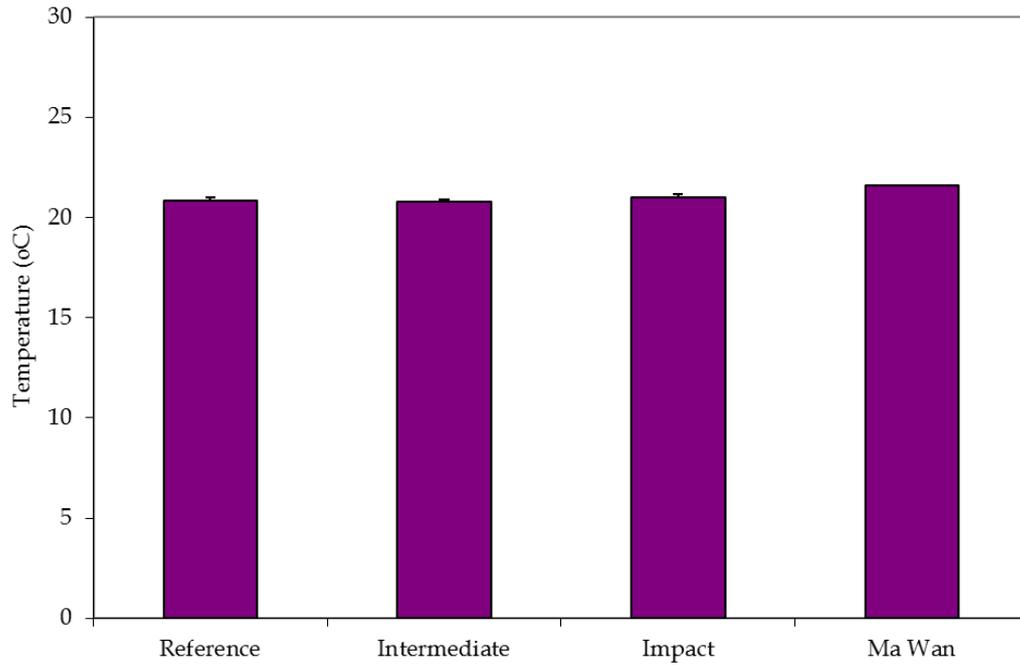


Figure 5: Levels of Temperature recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

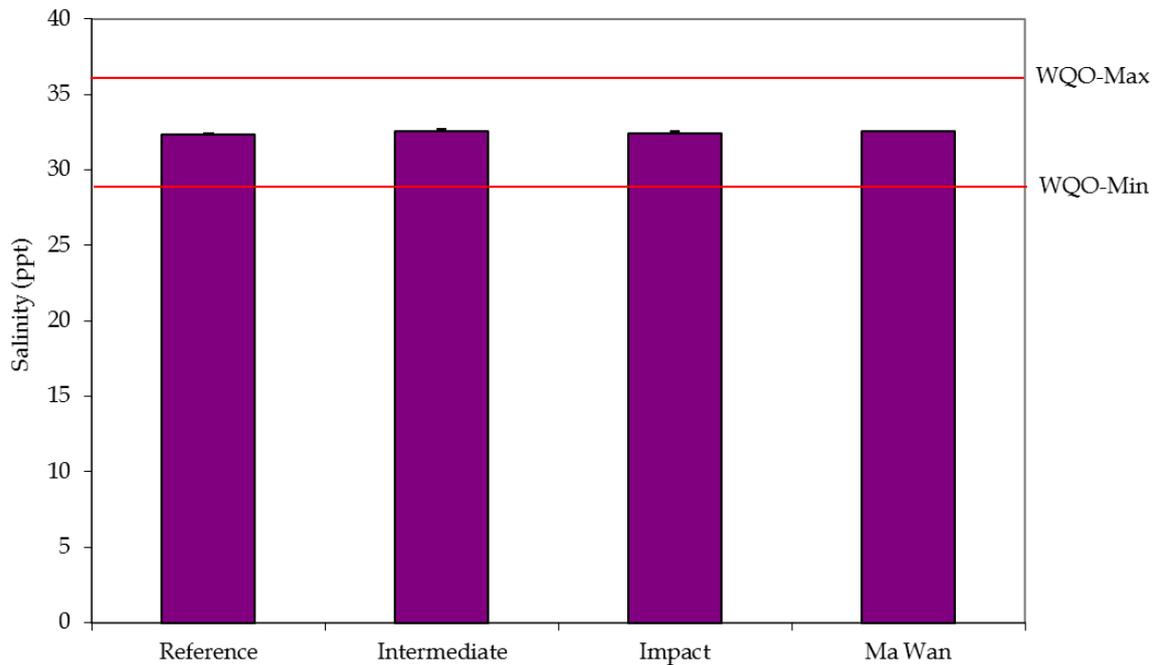


Figure 6: Levels of Salinity recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

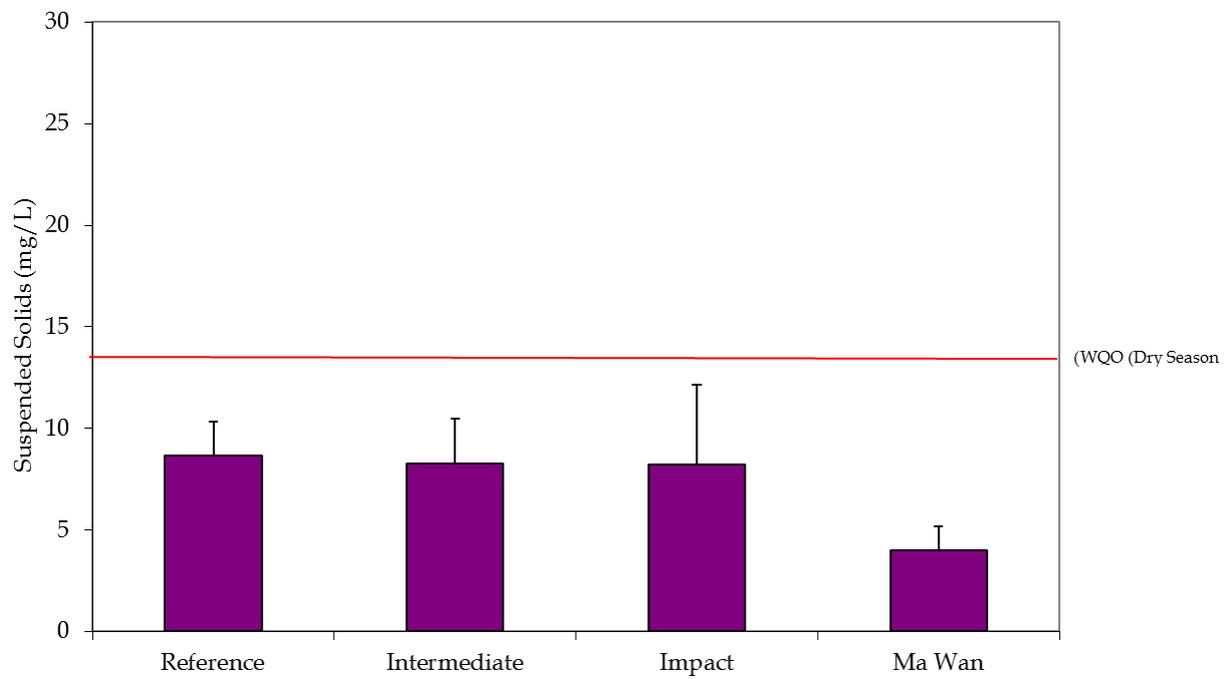


Figure 7: Concentrations of Suspended Solids recorded from Water Quality Monitoring during Capping of ESC CMPs in December 2014.

Source: H:\Team\EM\GMS Projects\0175086 CEDD EM&A for South Brothers\02 Deliverable\07 CMP Monthly Report\28th (December 2014)

Date: 14/1/2015

**Environmental
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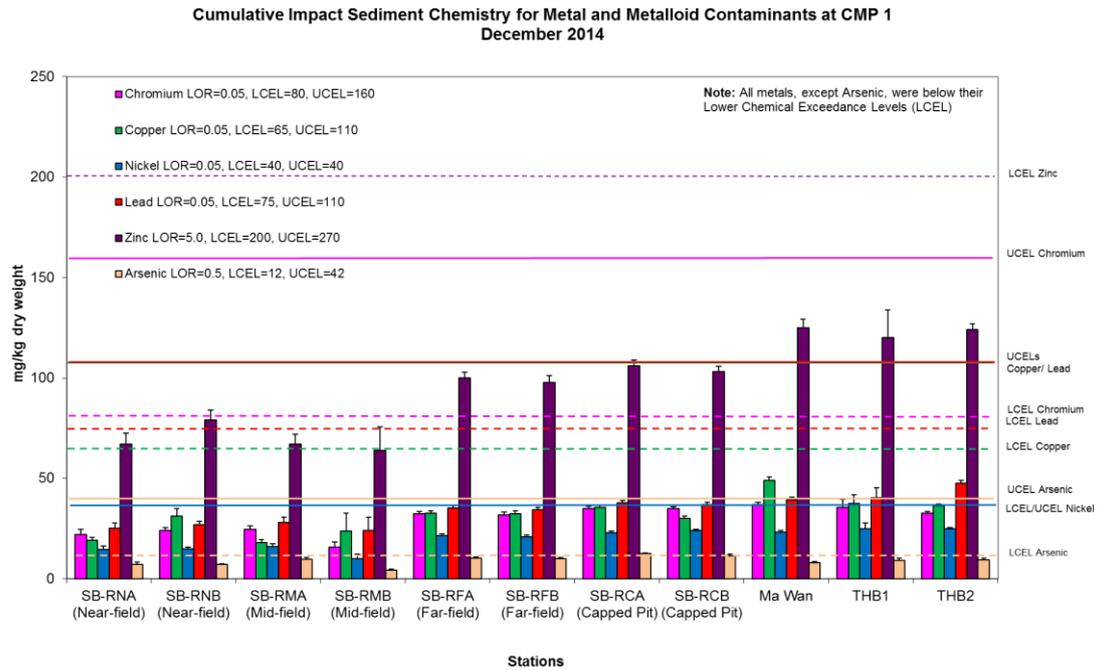


Figure 8: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected for Cumulative Impact Sediment Chemistry Monitoring for CMP 1 in December 2014.

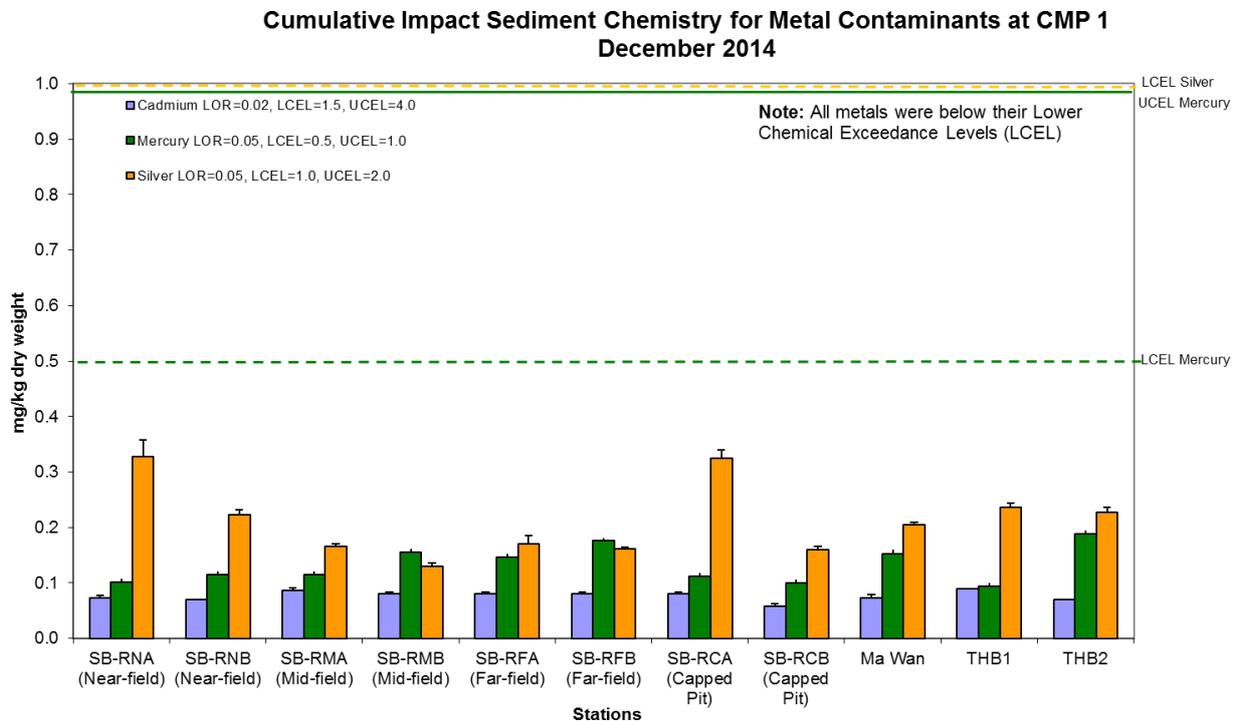


Figure 9: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected for Cumulative Impact Sediment Chemistry Monitoring for CMP 1 in December 2014.

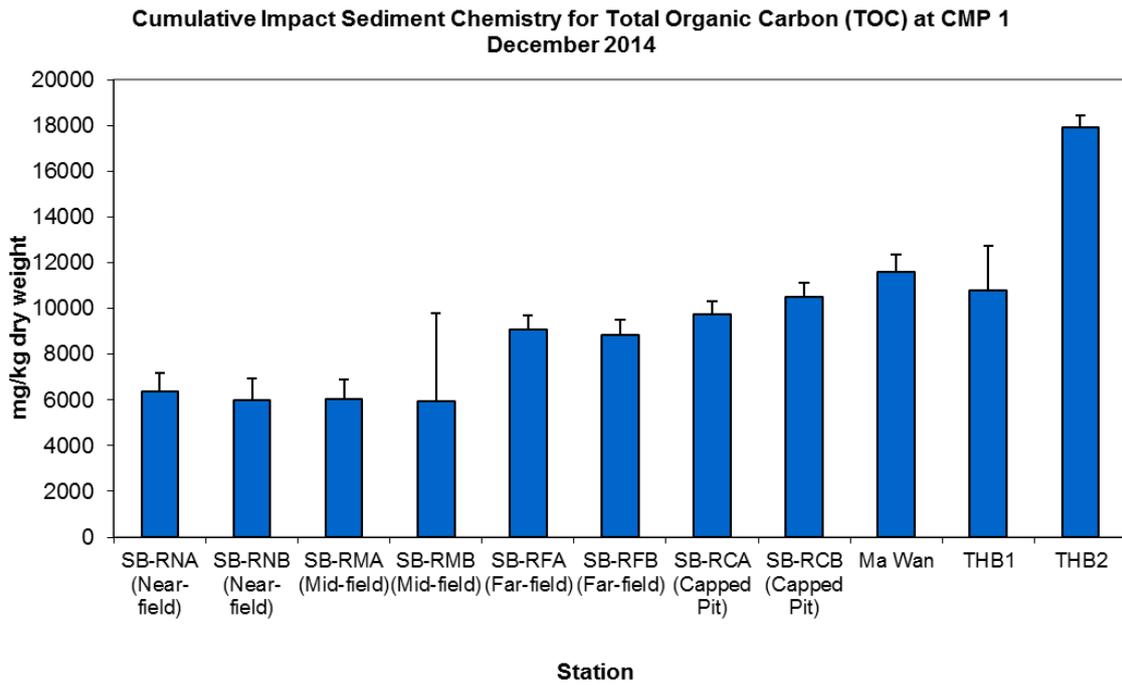


Figure 10: Concentration of Total Organic Carbon (mg/kg dry weight; mean +SD) in sediment samples collected from *Pit Specific Sediment Chemistry Monitoring* for CMP 1 in December 2014.

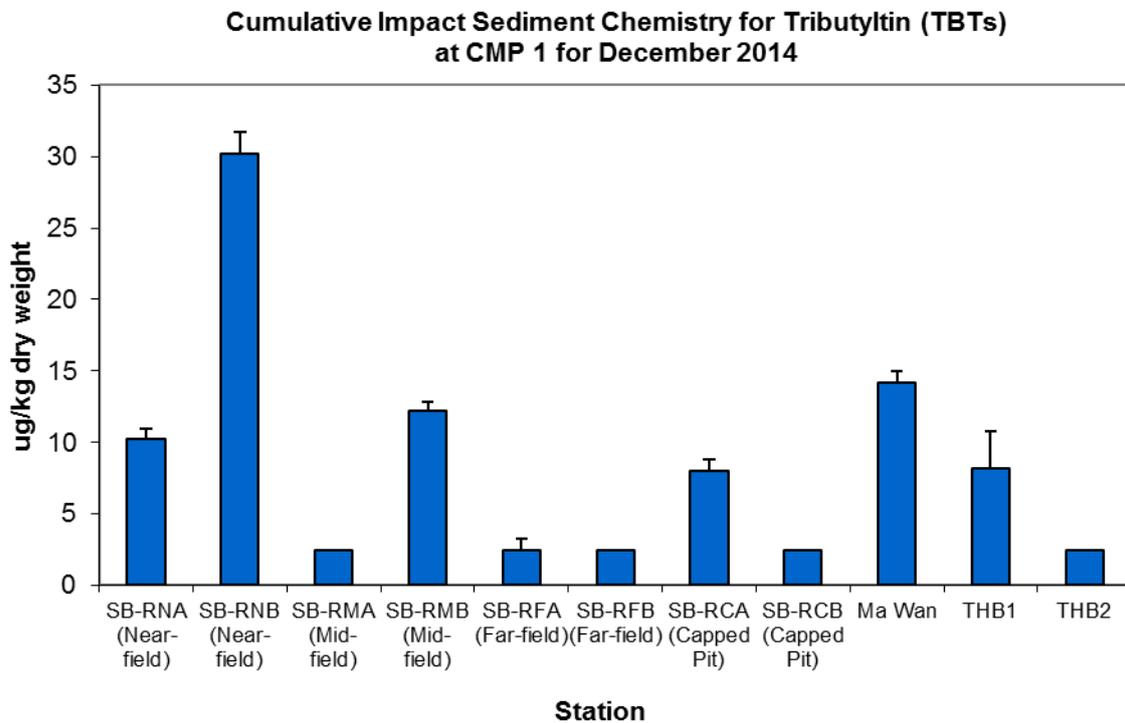


Figure 11: Concentration of Tributyltin ($\mu\text{g TBT/kg}$; mean +SD) in sediment samples collected for Cumulative Impact Sediment Chemistry Monitoring for CMP 1 in December 2014.

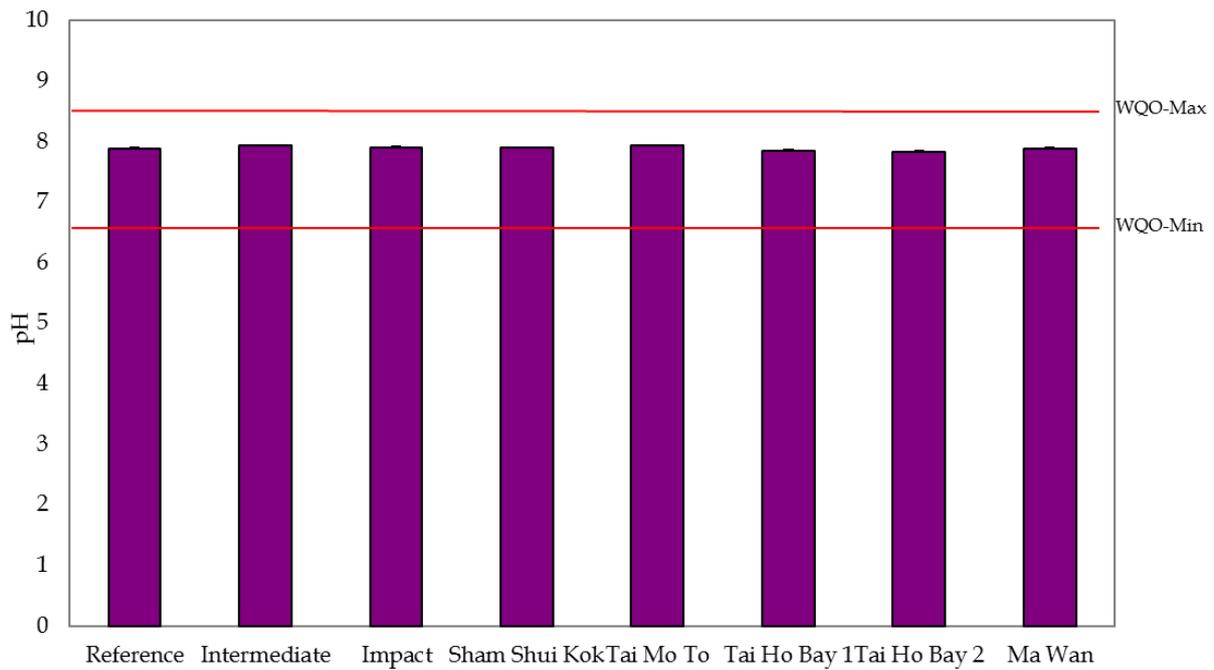


Figure 12: Levels of pH recorded from Water Quality Monitoring during Capping of SB CMP 1 in December 2014.

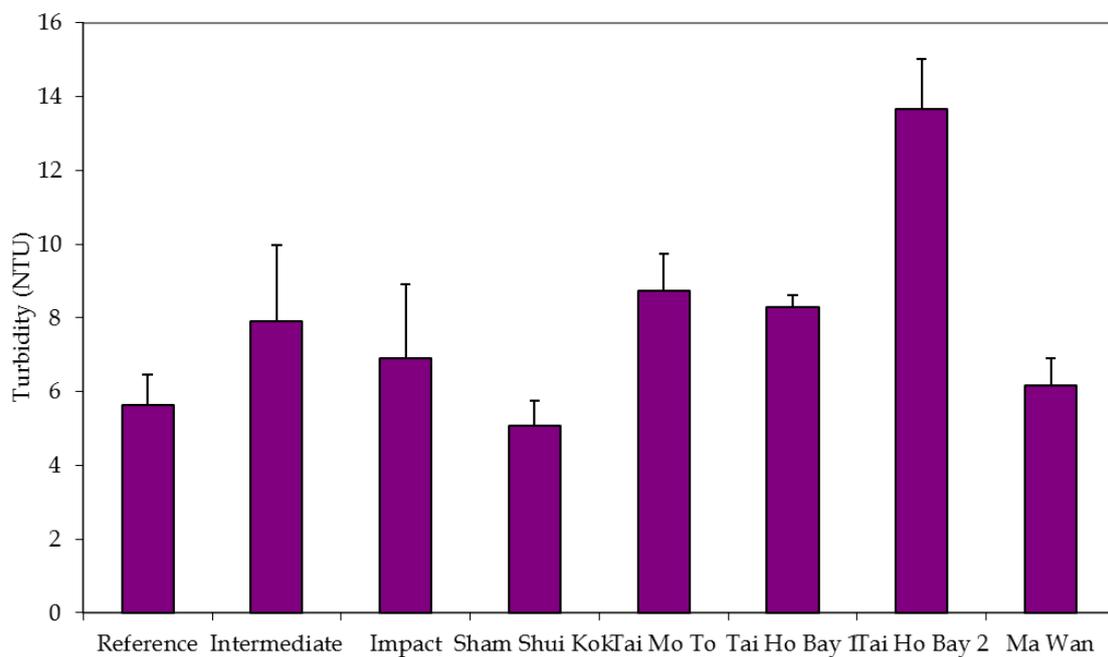


Figure 13: Levels of Turbidity recorded from Water Quality Monitoring during Capping of SB CMP 1 in December 2014.

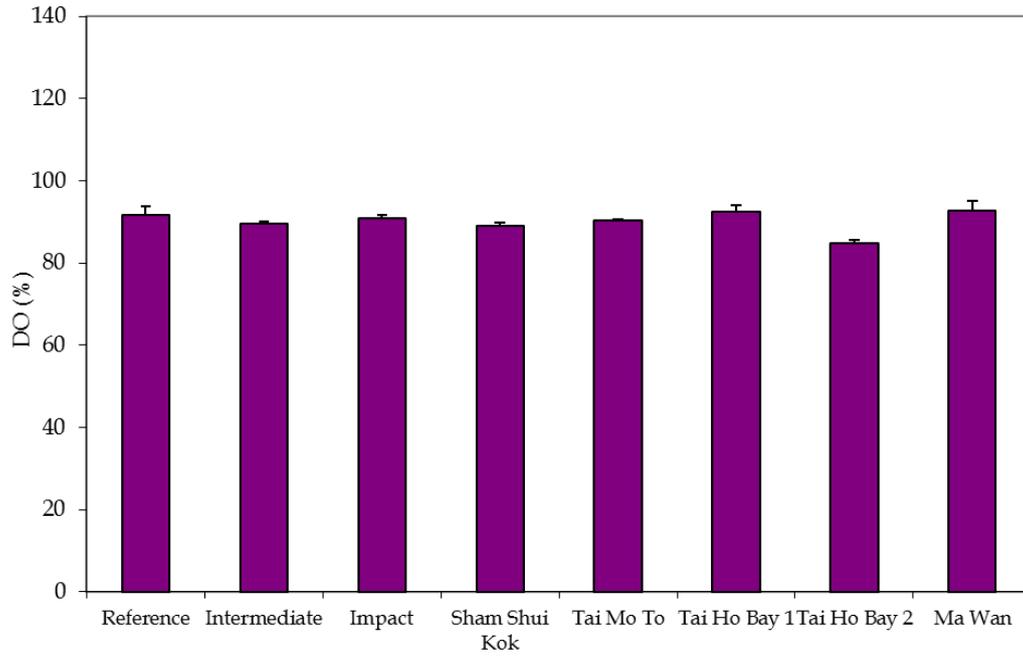


Figure 14: Level of Dissolved Oxygen (% saturation) recorded from Water Quality Monitoring during Capping of SB CMP 1 in December 2014.

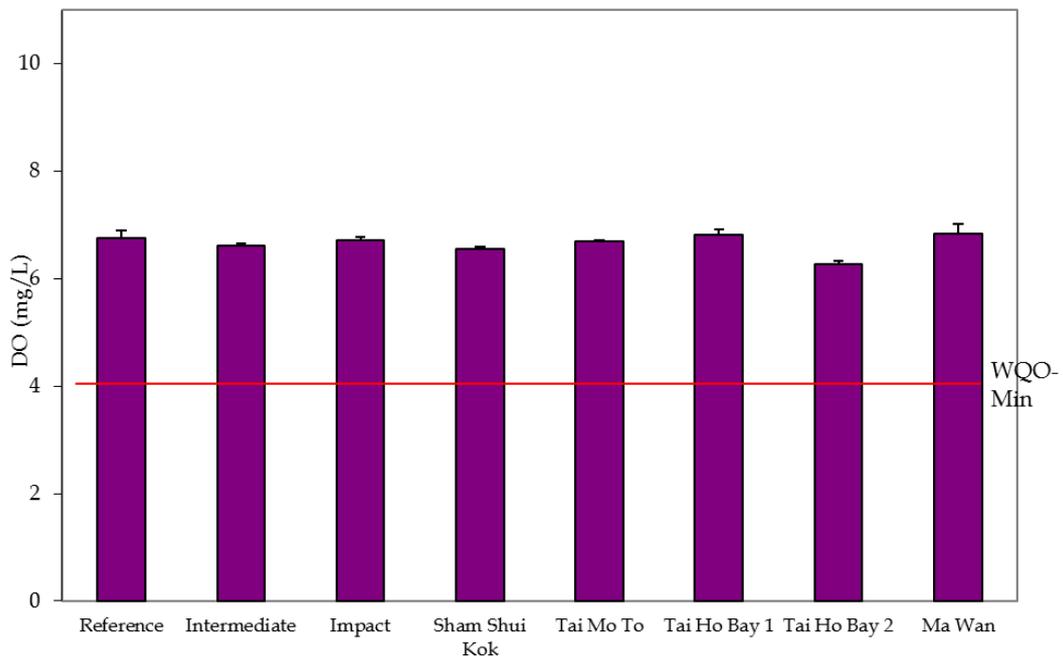


Figure 15: Concentration of Dissolved Oxygen (mg/L) recorded from Water Quality Monitoring during Capping of SB CMP 1 in December 2014.

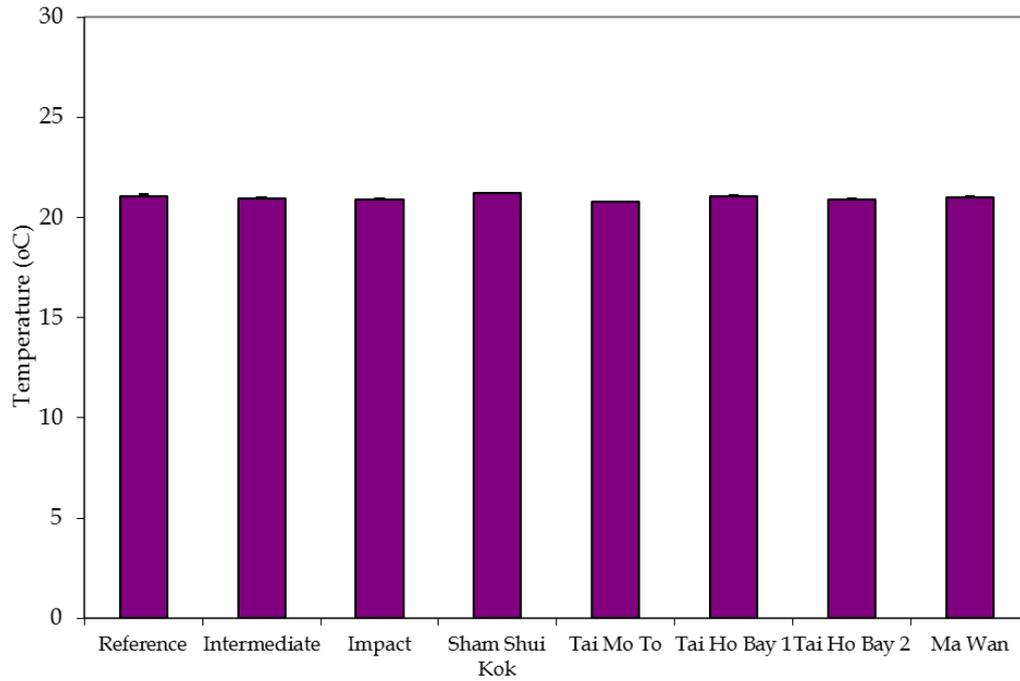


Figure 16: Levels of Temperature recorded from Water Quality Monitoring during Capping of SB CMP 1 in December 2014.

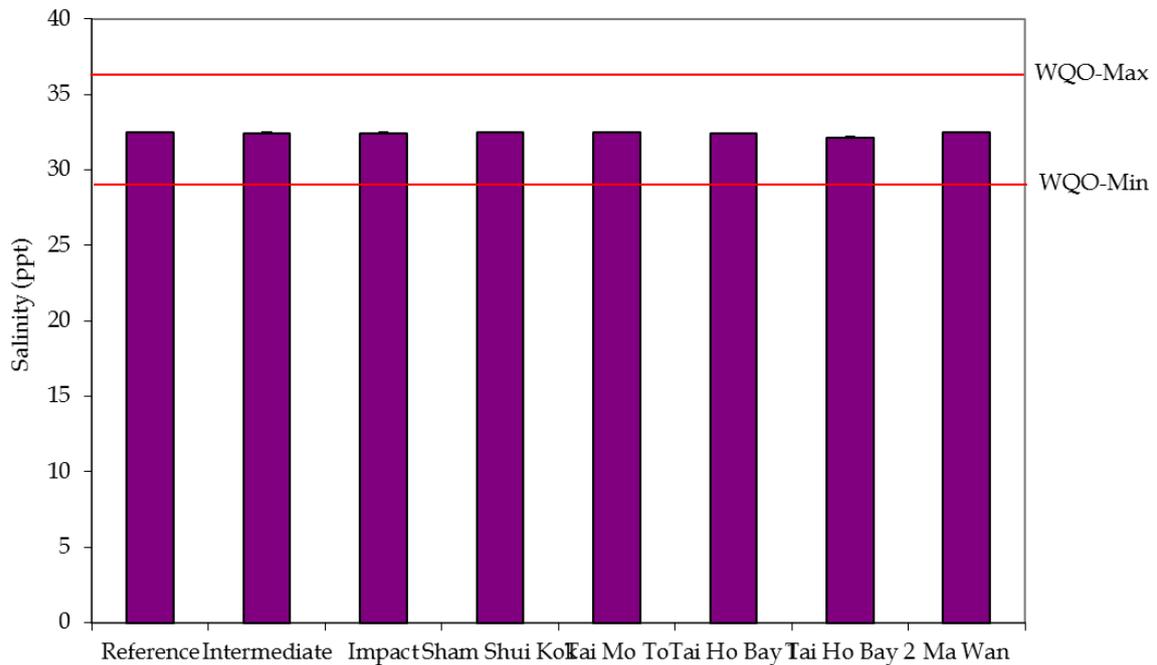


Figure 17: Levels of Salinity recorded from Water Quality Monitoring during Capping of SB CMP 1 in December 2014.

Annex C

Water Quality Monitoring Results

Table C1 *Water Column Profiling Results for CMP 1 on 4 December 2014*

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen		pH	Suspended Solids
				(%)	(mg L ⁻¹)	(mg L ⁻¹)	(mg L ⁻¹)
WCP 1 (Downstream)	22.53	31.76	11.65	94.57	6.81	7.99	9.90
WCP 2 (Upstream)	22.41	31.72	9.82	94.46	6.82	7.98	10.63
WQO (dry season)	N/A	28.57- 34.89#	N/A	N/A	>4	6.5-8.5	13.7

Note: #Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.

Table C2 Action and Limit Levels of Water Quality for Dredging, Backfilling and Capping Activities

Parameter	Action Level	Limit Level
Dissolved Oxygen (DO) ⁽¹⁾	<u>Surface and Mid-depth</u> ⁽²⁾ The average of the impact, WSR 45C and WSR 46 station readings are < 5%-ile of baseline data for surface and middle layer = 4.32 mg L⁻¹ and Significantly less than the reference stations mean DO (at the same tide of the same day)	<u>Surface and Mid-depth</u> ⁽²⁾ The average of the impact, WSR 45C and WSR 46 station readings are < 4 mg L⁻¹ and Significantly less than the reference stations mean DO (at the same tide of the same day)
	<u>Bottom</u> The average of the impact, WSR 45C and WSR 46 station readings are < 5%-ile of baseline data for bottom layers = 3.12 mg L⁻¹ and Significantly less than the reference stations mean DO (at the same tide of the same day)	<u>Bottom</u> The average of the impact station, WSR 45C and WSR 46 readings are < 2 mg L⁻¹ and Significantly less than the reference stations mean DO (at the same tide of the same day)
Depth-averaged Suspended Solids (SS) ⁽³⁾⁽⁴⁾	The average of the impact, WSR 45C and WSR 46 station readings are > 95%-ile of baseline data for depth average = 21.60 mg L⁻¹ and 120% of control station's SS at the same tide of the same day	The average of the impact, WSR 45C and WSR 46 station readings are > 99%-ile of baseline data for depth average = 40.10 mg L⁻¹ and 130% of control station's SS at the same tide of the same day
Depth-averaged Turbidity (Tby) ⁽³⁾⁽⁴⁾	The average of the impact, WSR 45C and WSR 46 station readings are > 95%-ile of baseline data = 25.04 NTU and 120% of control station's Tby at the same tide of the same day	The average of the impact, WSR 45C and WSR 46 station readings are > 99%-ile of baseline data = 32.68 NTU and 130% of control station's Tby at the same tide of the same day

Notes:

- (1) For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
- (2) The Action and Limit Levels for DO for Surface & Middle layers were calculated from the combined pool of baseline surface layer data and baseline middle layer data.
- (3) "Depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.
- (4) For turbidity and SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.

Annex D

Study Programme

