

**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)**

**35<sup>th</sup> Monthly Progress Report for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau – July 2015**

Final (Revision 1)

1 September 2015

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# Environmental Monitoring and Audit for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau (2012-2017) – Investigation




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Summary:  This document presents the 35 <sup>th</sup> monthly progress report for Contaminated Mud Pits at the South of The Brothers and at East Sha Chau.		Date: 1 September 2015			
		Approved by: 			
		Craig A. Reid Partner			
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v0	35 <sup>th</sup> Monthly Progress Report for ESC CMPs and SB CMPs	CY	JT	CAR	14/8/15
Revision	Description	By	Checked	Approved	Date
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**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/ <del>Plan</del> -to be Certified/ Verified:	35 <sup>th</sup> Monthly Progress Report for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau - July 2015
Date of Report:	14 August 2015
Date prepared by ET:	14 August 2015
Date received by IA:	14 August 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:

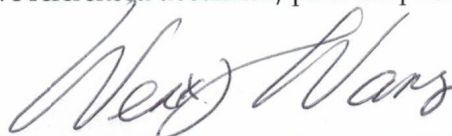


Date: 14/8/2015

**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: 14/8/2015

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

**35<sup>TH</sup> MONTHLY PROGRESS REPORT FOR JULY 2015**

**1.1 BACKGROUND**

1.1.1 Since early 1990s, contaminated sediment <sup>(1)</sup> 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) <sup>(2)</sup> 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)* <sup>(3)</sup>. 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 <sup>(4)</sup>. 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.<sup>7</sup>

(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)*

1.1.4 *Environmental Permits (EPs) (EP-312/2008/A and EP-427/2011A) were issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 for ESC CMP V and on 23 December 2011 for SB CMPs, respectively. Under the requirements of the EPs, an Environmental Monitoring and Audit (EM&A) programme as set out in the EM&A Manuals (1) (2) is required to be implemented for the CMPs.*

1.1.5 The present EM&A programme under *Agreement No. CE 23/2012 (EP)* covers the dredging, disposal and capping operations of the SB CMPs as well as ESC CMPs. Detailed works schedule for both CMPs is shown in *Figure 1.1*. In July 2015, the following works were being undertaken at the CMPs:

- Capping operations at ESC CMPs;
- Capping operations at SB CMP 1; and
- Disposal of contaminated mud at SB CMP 2.

**Figure 1.1 Works Schedule for ESC CMPs and SB CMPs**

Pit	Operation	2012			2013					2014					2015					2016					2017					
		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
ESC CMP	Dredging																													
	Backfilling																													
	Capping																													
SB CMP 1	Dredging																													
	Backfilling																													
	Capping																													
SB CMP 2	Dredging																													
	Backfilling																													
	Capping																													

## 1.2 REPORTING PERIOD

1.2.1 This 35<sup>th</sup> Monthly Progress Report covers the EM&A activities for the reporting month of July 2015.

## 1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

1.3.1 No monitoring activity has been undertaken for ESC CMPs in July 2015.

- (1) ERM (2012) Environmental Monitoring and Audit (EM&A) Manual. Final First Review. 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). Submitted to EPD in November 2012.
- (2) ERM (2010) Environmental Monitoring and Audit (EM&A) Manual. Final Second Review. Environmental Monitoring and Audit for Contaminated Mud Pit at Sha Chau (2009-2013) - Investigation. Agreement No. CE 4/2009(EP). Submitted to EPD in November 2010.

1.3.2 The following monitoring activities have been undertaken for SB CMPs in July 2015:

- *Routine Water Quality Monitoring* of CMP 2 was undertaken on 6 July 2015;
- *Water Column Profiling* of CMP 2 was undertaken on 7 July 2015;
- *Pit Specific Sediment Chemistry* of CMP 2 was undertaken on 8 July 2015;
- *Sediment Chemistry after a Major Storm* of CMP 2 was undertaken on 15 July 2015; and
- *Demersal Trawling* was undertaken on 27 and 28 July 2015.

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

1.4.1 No outstanding sampling remained for July 2015. The following laboratory analyses are in progress and will be presented in the corresponding quarterly report:

- Taxonomic identification of fishery resources collected during *Demersal Trawling* for SB CMPs on 27 and 28 July 2015.

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

#### 1.5 **BRIEF DISCUSSION OF THE MONITORING RESULTS FOR SB CMPs**

1.5.1 Brief discussion of the monitoring results of the following activities for SB CMPs is presented in this 35<sup>th</sup> *Monthly Progress Report*:

- *Pit Specific Sediment Chemistry* of CMP 2 in June and July 2015;
- *Cumulative Specific Sediment Chemistry* of CMP 2 in June 2015;
- *Routine Water Quality Monitoring* of CMP 2 in July 2015;
- *Water Column Profiling* of CMP 2 in July 2015; and
- *Sediment Chemistry after a Major Storm* of CMP 2 in 15 July 2015.

## 1.5.2 *Pit Specific Sediment Chemistry of CMP 2 – June and July 2015*

1.5.3 Monitoring locations for *Pit Specific Sediment Chemistry for CMP 2* are shown in *Figure 1.2*. A total of six (6) monitoring stations were sampled in June and July 2015.

1.5.4 Copper exceeded the Lower Chemical Exceedance Level (LCEL) at Active Pit station SB-NPBB in June 2015 and the Upper Chemical Exceedance Level (UCEL) at Active Pit station SB-NPBA in June and July 2015. In addition, Silver exceeded the LCEL at Active Pit stations SB-NPBA and SB-NPBB in June 2015 and the UCEL at Active Pit station SB-NPBA in July 2015. Exceedances of LCEL were also recorded for Mercury at Active Pit station SB-NPBB and Zinc at Active Pit station SB-NPBA in July 2015. The concentrations of other inorganic contaminants (Cadmium, Chromium, Lead, Nickel and Arsenic in June and July 2015 & Mercury and Zinc in June 2015) were lower than the LCEL at all stations. As higher Copper, Silver, Mercury and Zinc concentrations were recorded within the Active Pit stations only which were receiving contaminated mud during the reporting month, there is no evidence indicating any dispersal of contaminants from the active pit.

1.5.5 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were similar at all stations in June and July 2015. Tributyltin (TBT) concentrations were observed to be higher at Active Pit station SB-NPBA in June and July 2015 (*Figure 4 and 9 of Annex B*). Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs), Total Polychlorinated Biphenyls (PCBs), 4,4'-dichlorodiphenyldichloroethylene (DDE) and Total dichlorodiphenyltrichloroethane (DDT) concentrations were below the limit of reporting at most stations in June and July 2015 (except High MW PAHs at Active Pit station SB-NPBA in June 2015 and at Active Pit stations SB-NPBA and SB-NPBB in July 2015) (*Figure 5 and 10 of Annex B*).

1.5.6 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 in June and July 2015. Statistical analysis will be undertaken and presented in the quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.

## 1.5.7 *Cumulative Impact Sediment Chemistry of SB CMPs – June 2015*

1.5.8 Monitoring locations for *Cumulative Impact Sediment Chemistry for SB CMPs* are shown in *Figure 1.3*. A total of eleven (11) monitoring stations were sampled in June 2015.

1.5.9 Analyses of results for the *Cumulative Impact Sediment Chemistry Monitoring* indicated that the concentrations of all inorganic contaminants were below the Lower Chemical Exceedance Level (LCEL) in June 2015 (*Figures 11 and 12 of Annex B*).



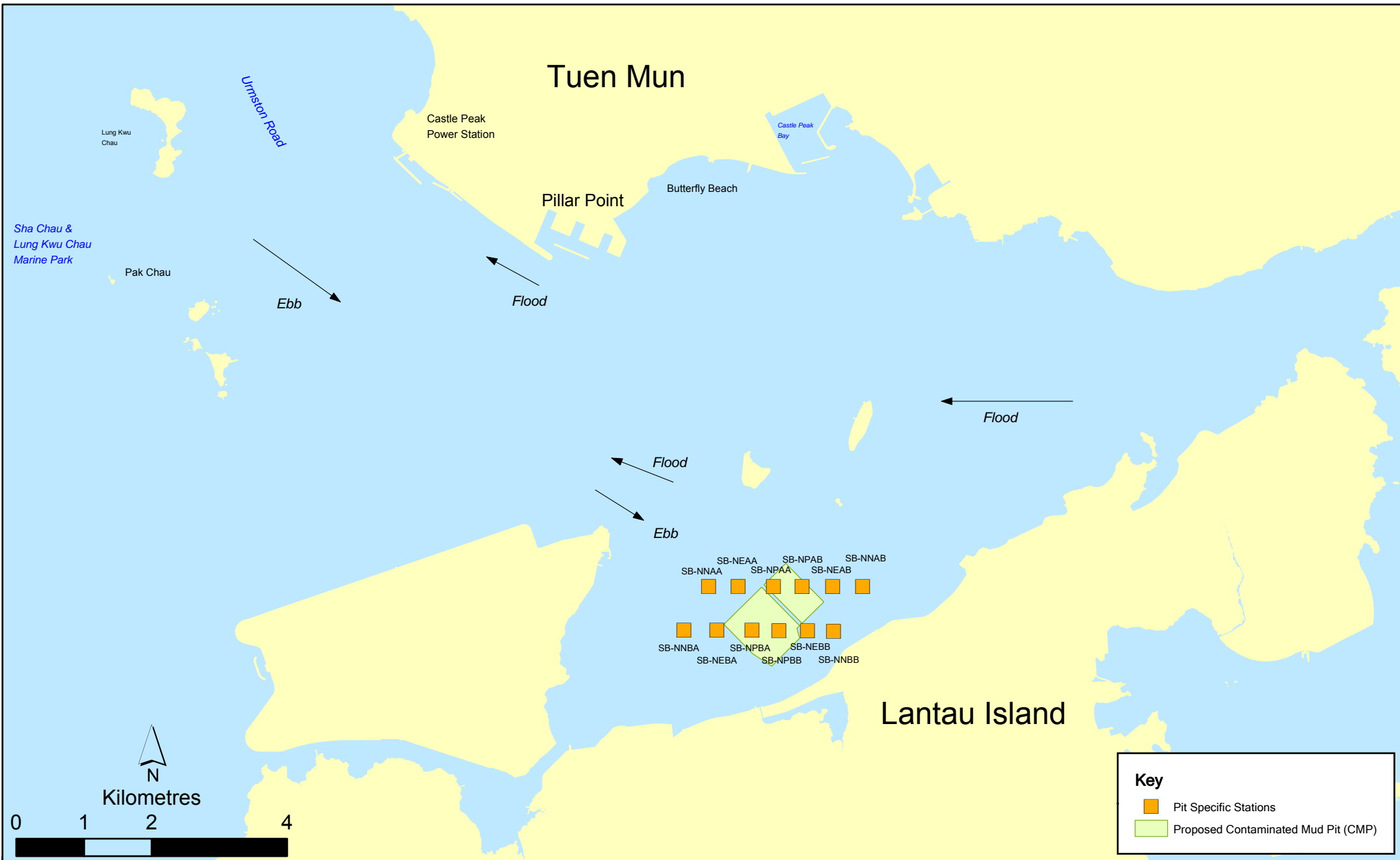


Figure 1.2

Pit Specific Sediment Quality Monitoring Stations for South Brothers Facility

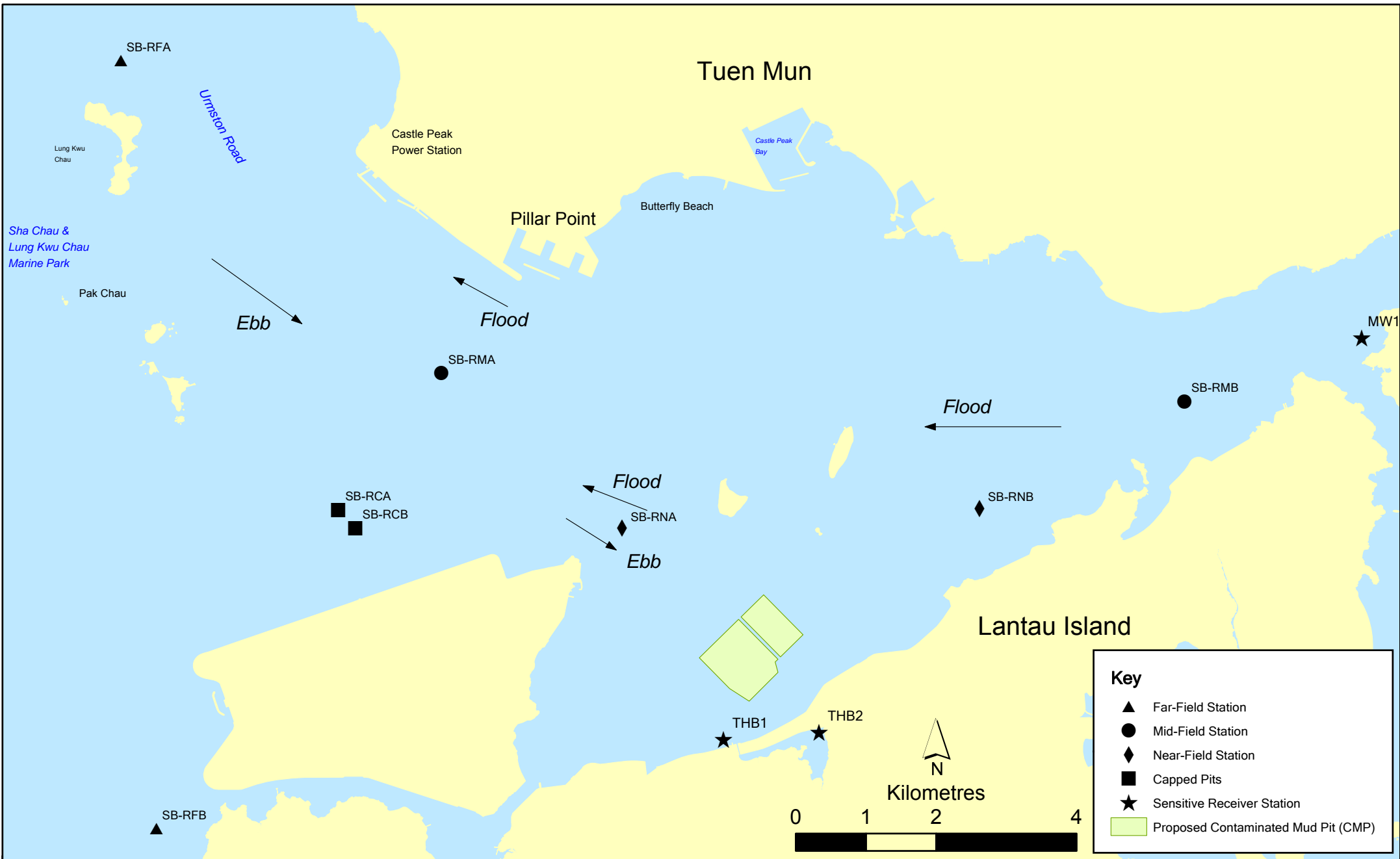


Figure 1.3

Cumulative Impacts Sediment Quality Monitoring Stations for South Brothers Facility

- 1.5.10 For organic contaminants, concentration of TOC at Tai Ho Bay Station 2 (THB2) was recorded to be higher than other stations (*Figure 13 of Annex B*). Concentrations of TBTs were recorded to be higher at Near-field station SB-RNB, Mid-field SB-RMB and Ma Wan station (*Figure 14 of Annex B*). Total DDT, 4,4'-DDE, Total PCBs as well as Low and High Molecular Weight PAHs were recorded below the limit of reporting at most stations, except High Molecular Weight PAHs at Capped Pit station SB-RCA and Tai Ho Bay Station 1 (THB1) (*Figure 15 of Annex B*).
- 1.5.11 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 in June 2015. Statistical analysis will be undertaken and presented in the quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.
- 1.5.12 ***Routine Water Quality Monitoring of SB CMP 2 - July 2015***
- 1.5.13 The monitoring results for the Routine Water Quality Monitoring conducted in July 2015 in the wet season have been assessed for compliance with the Water Quality Objectives (WQOs) set by EPD. This consists of a review of the EPD routine water quality monitoring data for the wet season period (April to October) of 2004 - 2013 from stations in the Northwestern Water Control Zone, where the CMPs are located <sup>(1)</sup>. For Salinity, the averaged value obtained from the Reference stations was used for the basis as the WQO. Levels of Dissolved Oxygen (DO) and Turbidity were also assessed for compliance with the Action and Limit Levels (see *Table C1 of Annex C* for details). The monitoring results are shown in *Figures 16-26 of Annex B* and *Tables C2 and C3 of Annex C*. A total of twenty (20) monitoring stations were sampled in July 2015 as shown in *Figure 1.4*.

#### *In-situ Measurements*

<sup>(1)</sup> <http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en>

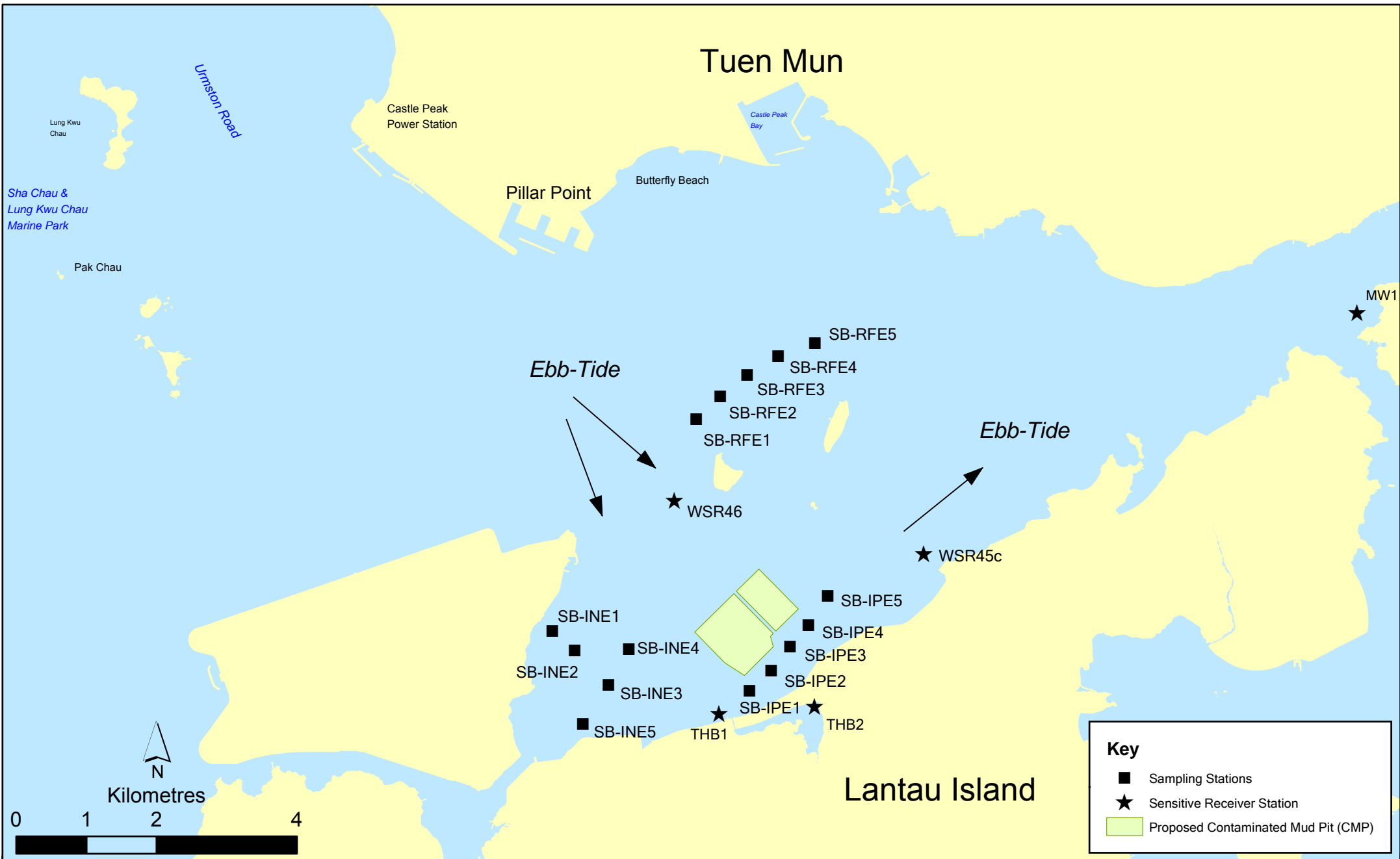


Figure 1.4

Routine Water Quality Sampling Stations (Ebb-Tide) for South Brothers Facility

- 1.5.14 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 16-21 of Annex B*. Analyses of results for July 2015 indicated that the levels of pH complied with the WQOs at all stations (Impact, Intermediate, Reference and Water Sensitive Receiver stations) in July 2015 (*Figure 16 of Annex B*). Levels of DO complied with the WQO at most stations except at Reference and Tai Mo To stations (*Figures 17 and 18 of Annex B*). As Tai Mo To station is located further from the CMP 2 and a low DO level was also recorded at Reference station, it is considered that the WQO exceedance of DO at these stations were possibly caused by the natural background variation in water quality of the area, instead of the disposal operation at CMP 2.
- 1.5.15 The levels of Salinity at Impact, Intermediate and Water Sensitive Receiver stations exceeded the WQO range in July 2015 (*Figure 20 of Annex B*). The lower Salinities recorded at these stations is likely to be caused by the freshwater discharged from the Pearl River Delta during the summer months which tend to form a surface layer of low salinity water at these stations with shallower depth when compared with the Reference stations.
- 1.5.16 The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (*Figures 18 and 21 of Annex B; Table C1 of Annex C*).
- 1.5.17 Overall, *in-situ* measurement results of the *Routine Water Quality Monitoring* indicated that the disposal operation at CMP 2 did not appear to cause any unacceptable impacts in water quality in July 2015.

#### *Laboratory Measurements*

- 1.5.18 Laboratory analysis of July 2015 results indicated that concentrations of Cadmium, Chromium and Silver were below their limit of reporting at all stations. Arsenic, Copper, Lead, Mercury, Nickel and Zinc were detected in July 2015 samples and the concentrations were similar amongst stations (*Figures 22-23 of Annex B*). Results of laboratory analysis were shown in *Table C3 of Annex C*.
- 1.5.19 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at all stations in July 2015 exceeded the WQO (0.5mg/L) (*Figures 24 of Annex B*). It is important to note that due to the effect of the Pearl River discharges, the North Western WCZ has historically experienced higher levels of TIN <sup>(1)</sup>. Therefore, the exceedances of TIN WQO at all stations in July 2015 were unlikely to be caused by the disposal operation at CMP 2. Ammonia Nitrogen (NH<sub>3</sub>-N) concentration was relatively similar amongst all stations (*Figures 24 of Annex B*). Levels of 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>) appear to be higher at Tai Ho Bay 1 station in July 2015 (*Figures 25 of Annex B*).

(1) [http://www.epd.gov.hk/epd/misc/marine\\_quality/1986-2005/textonly/eng/index.htm](http://www.epd.gov.hk/epd/misc/marine_quality/1986-2005/textonly/eng/index.htm)

1.5.20 Concentrations of SS exceeded the WQO (11.6 mg/L for wet season) at Impact, Intermediate and Reference stations in July 2015. Since exceedance and higher level of SS was also recorded at Reference station, exceedances at Impact and Intermediate stations were considered to be due to natural background fluctuation in this area of Hong Kong. Concentrations of SS complied with the Action and Limit Levels at all stations in July 2015 (*Figure 26 of Annex B; Table C3 of Annex C*).

1.5.21 Overall, results of the *Routine Water Quality Monitoring* indicated that the disposal operation at CMP 2 did not appear to cause any unacceptable deterioration in water quality in July 2015. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

#### 1.5.22 ***Water Column Profiling of CMP 2 – July 2015***

1.5.23 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 7 July 2015. The water quality monitoring results have been assessed for compliance with the WQOs as discussed in *Section 1.5.13*. 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*

1.5.24 Analyses of results for July 2015 indicated that levels of pH complied with the WQOs at both Downstream and Upstream stations (*Table C4 of Annex C*). Salinity and DO at Downstream station did not comply with the WQO. The non-compliance of Salinity was possibly caused by the stratification of seawater during summer when the freshwater discharged from the Pearl River tended to form a surface layer of lower salinity water, which is probably responsible for the lower salinity recorded at the shallower Upstream station compared to the higher salinity recorded at the deeper Downstream station. DO and Turbidity at all stations complied with the Action and Limit Levels and the exceedance of DO WQO at the Downstream station thus did not appear to indicate any unacceptable water quality impact from the mud disposal operation (*Tables C1 and C4 of Annex C*).

#### *Laboratory Measurements for SS*

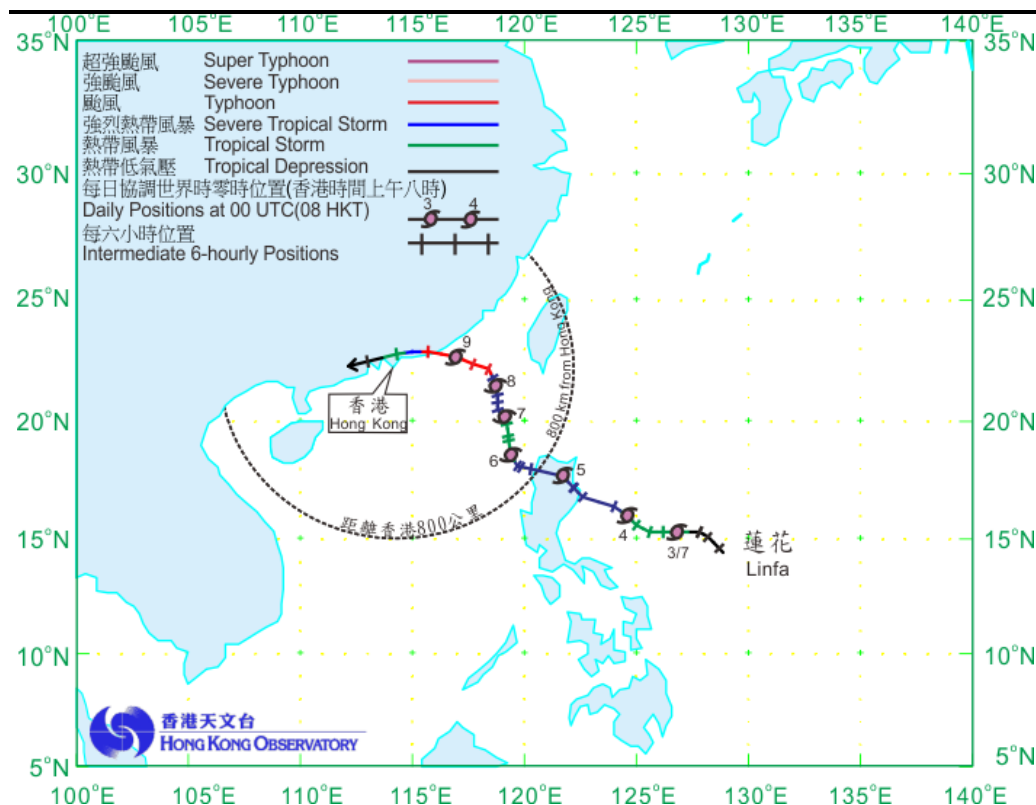
1.5.25 Analyses of results for June 2015 indicated that the SS levels at both Upstream and Downstream stations complied with the WQO. Both Upstream and Downstream stations also complied with the Action and Limit Levels (*Tables C2 and C3 of Annex C*).

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.

1.5.26 *Sediment Chemistry after a Major Storm of CMP 2 – July 2015*

1.5.27 Sampling for Sediment Chemistry after a Major Storm Event was conducted at eleven (11) monitoring stations (*Figure 1.3*) on 15 July 2015 after the visit of Typhoon Linfa, which led to the issue of Gale or Storm Wind Signal No.8 on 9 July 2015. The track of Linfa is shown in *Figure 1.5*.

**Figure 1.5** *Track of Typhoon Linfa from 2 to 10 July 2015 (Source: Hong Kong Observatory)*



1.5.28 Analyses of results for the *Sediment Chemistry after a Major Storm* indicated that the concentrations of most inorganic contaminants, except Mercury, were below the LCEL (*Figures 27 and 28 of Annex B*). Concentration of Mercury exceeded the LCEL at Capped Pit station SB-RCB, Near Field stations SB-RNA and RNB and Mid field station SB-RMA. As lower Mercury concentrations were recorded at the Capped Pit stations, it is considered that the exceedances of Mercury LCEL at these stations were unlikely to be caused by the failure of the cap in retaining contaminated sediment within the mud pit.

1.5.29 Overall, there appeared to be no evidence showing the failure of CMPs in retaining disposed mud or causing contamination of sediments after the major storm event in July 2015.

1.5.30 ***Activities Scheduled for the Next Month***

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

- *Pit Specific Sediment Chemistry of CMP 2;*
- *Cumulative Impact Sediment Chemistry of CMP 2;*
- *Water Quality Monitoring During Capping of CMP 1;*
- *Water Column Profiling of CMP 2;*
- *Routine Water Quality Monitoring of CMP 2;*
- *Sediment Toxicity Test of CMP 2;*
- *Benthic Recolonisation Studies of CMP 1; and*
- *Demersal Trawling for SB CMPs.*

1.5.32 The following monitoring activities will be conducted in the next monthly period of August 2015 for ESC CMPs:

- *Water Quality Monitoring During Capping of ESC CMPs; and*
- *Benthic Recolonisation Studies of ESC CMPs.*

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

**1.6 STUDY PROGRAMME**

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



Annex A

## Sampling Schedule













Annex A2 - Environmental Monitoring and Audit Sampling Schedule for South of The Brothers (July 2012 - February 2017)

			2012					2013					2014					2015					2016					2017																					
			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	M	A	M	J	J	A	S	O	N	D	J	F			
<b>Capping Water Quality Monitoring</b>																																																	
<i>Ebb Tide</i>																																																	
Impact Stations Downcurrent	SB-IPE1	4 times per year																								3	3					3	3					3	3					3	3				
	SB-IPE2	4 times per year																								3	3					3	3					3	3					3	3				
	SB-IPE3	4 times per year																								3	3					3	3					3	3					3	3				
	SB-IPE4	4 times per year																								3	3					3	3					3	3					3	3				
	SB-IPE5	4 times per year																								3	3					3	3					3	3					3	3				
Intermediate Stations Downcurrent	SB-INE1	4 times per year																								3	3					3	3					3	3					3	3				
	SB-INE2	4 times per year																								3	3					3	3					3	3					3	3				
	SB-INE3	4 times per year																								3	3					3	3					3	3					3	3				
	SB-INE4	4 times per year																								3	3					3	3					3	3					3	3				
	SB-INE5	4 times per year																								3	3					3	3					3	3					3	3				
Reference Stations Upcurrent	SB-RFE1	4 times per year																								3	3					3	3					3	3					3	3				
	SB-RFE2	4 times per year																								3	3					3	3					3	3					3	3				
	SB-RFE3	4 times per year																								3	3					3	3					3	3					3	3				
	SB-RFE4	4 times per year																								3	3					3	3					3	3					3	3				
	SB-RFE5	4 times per year																								3	3					3	3					3	3					3	3				
Sensitive Receiver Stations	MW1	4 times per year																								3	3					3	3					3	3					3	3				
	THB1	4 times per year																								3	3					3	3					3	3					3	3				
	THB2	4 times per year																								3	3					3	3					3	3					3	3				
	WSR45C	4 times per year																								3	3					3	3					3	3					3	3				
	WSR46	4 times per year																								3	3					3	3					3	3					3	3				
<i>Flood Tide</i>																																																	
Impact Stations Downcurrent	SB-IPF1	4 times per year																								3	3					3	3					3	3					3	3				
	SB-IPF2	4 times per year																								3	3					3	3					3	3					3	3				
	SB-IPF3	4 times per year																								3	3					3	3					3	3					3	3				
Intermediate Stations Downcurrent	SB-INF1	4 times per year																								3	3					3	3					3	3					3	3				
	SB-INF2	4 times per year																								3	3					3	3					3	3					3	3				
	SB-INF3	4 times per year																								3	3					3	3					3	3					3	3				
Reference Stations Upcurrent	SB-RFF1	4 times per year																								3	3					3	3					3	3					3	3				
	SB-RFF2	4 times per year																								3	3					3	3					3	3					3	3				
	SB-RFF3	4 times per year																								3	3					3	3					3	3					3	3				
Sensitive Receiver Stations	MW1	4 times per year																								3	3					3	3					3	3					3	3				
	THB1	4 times per year																								3	3					3	3					3	3					3	3				
	THB2	4 times per year																								3	3					3	3					3	3					3	3				
	WSR45C	4 times per year																								3	3					3	3					3	3					3	3				
	WSR46	4 times per year																								3	3					3	3					3	3					3	3				
<b>Benthic Recolonisation Studies</b>																																																	
Capped Contaminated Mud Pits																																																	
	SB-CPA	2 times per year																												12					12									12					
	SB-CPB	2 times per year																																12									12						
Reference Stations	RBA	2 times per year																																				12									12		
	RBB	2 times per year																																				12									12		
	RBC	2 times per year																																				12									12		

Notes:  
 "n" = Number of replicates depends on parameters  
 Naming of stations are tentative only and will be subjected to changes



Annex B

## Graphical Presentations

**Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at SB CMP 2  
June 2015**

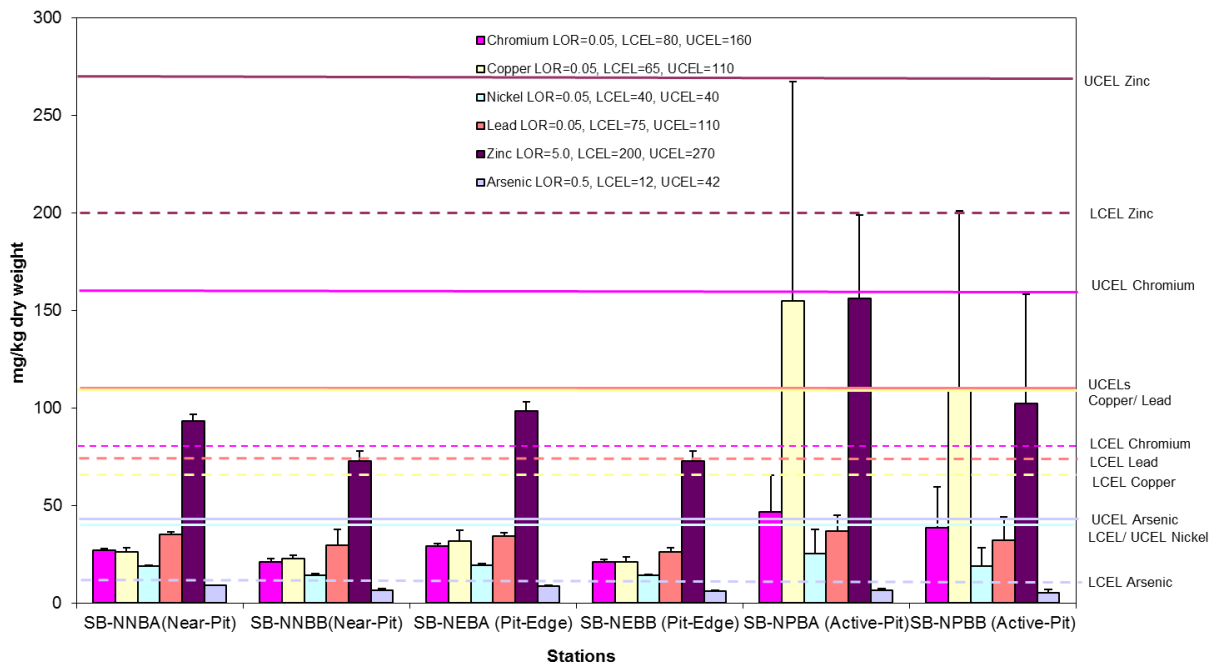


Figure 1: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in June 2015.

**Pit Specific Sediment Chemistry for Metal Contaminants at SB CMP 2  
June 2015**

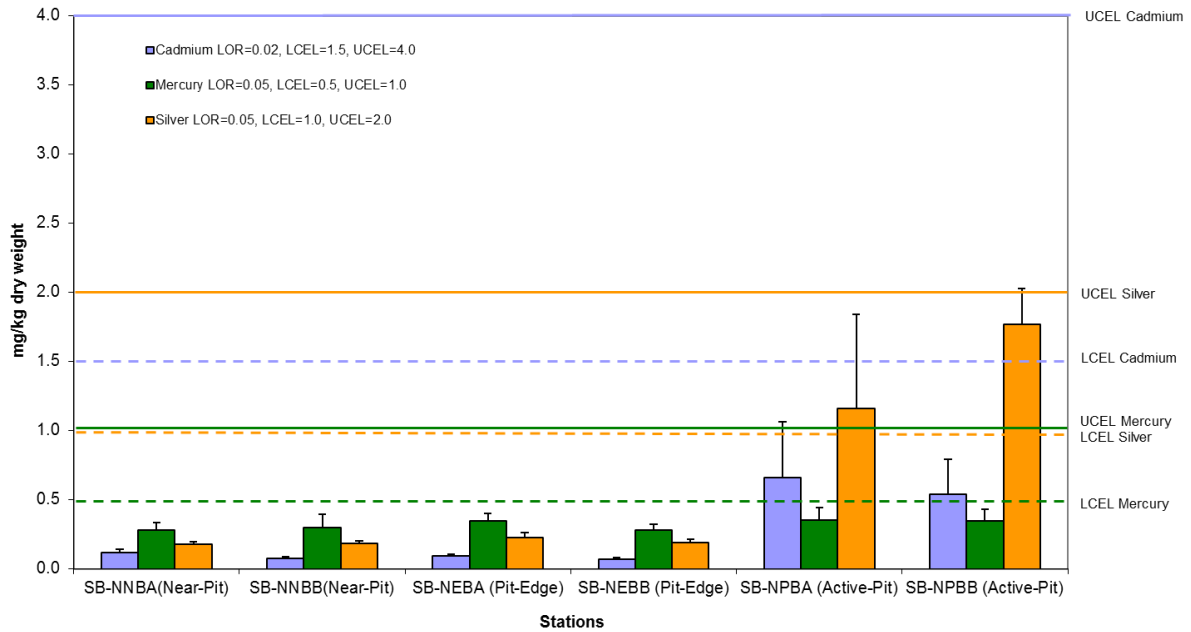
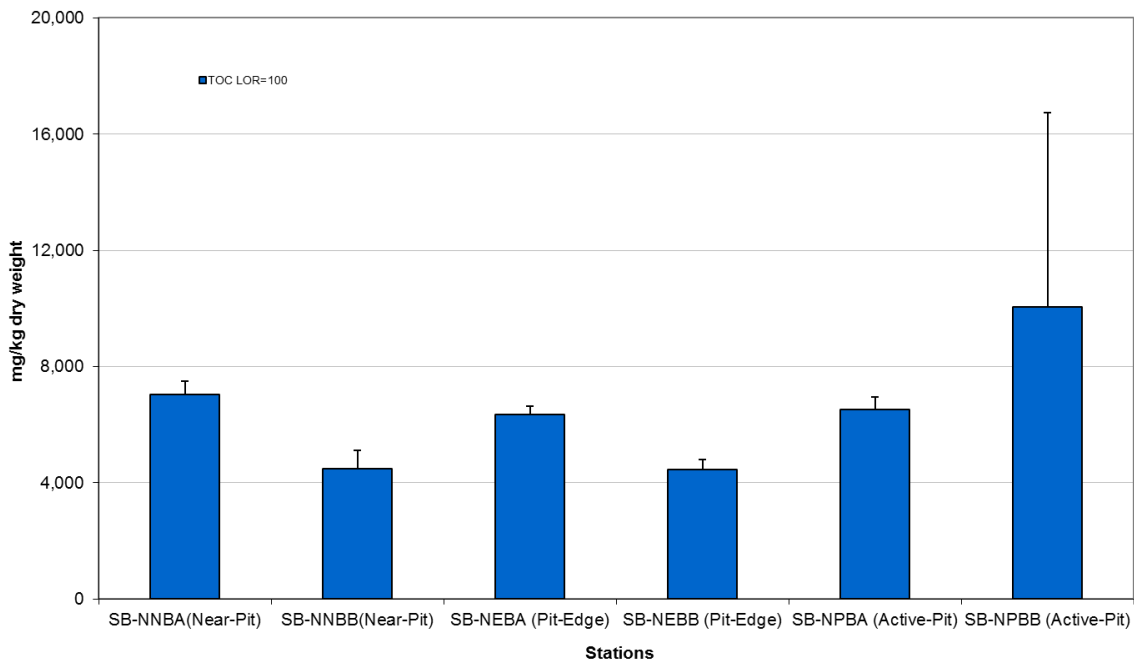


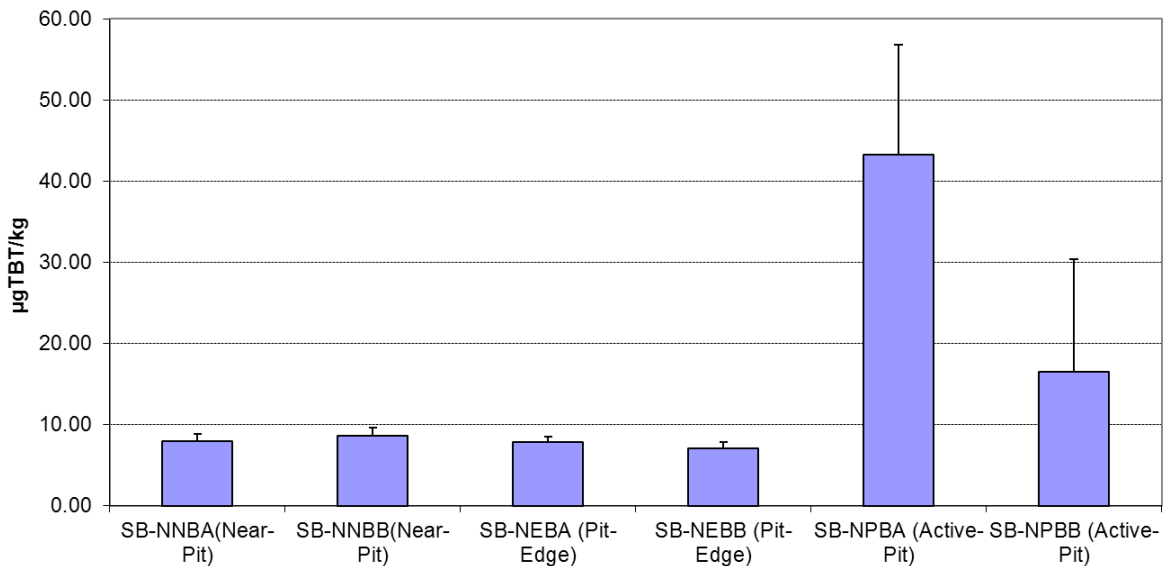
Figure 2: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in June 2015.

**Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at SB CMP 2  
June 2015**



**Figure 3:** Concentration of Total Organic Carbon (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in June 2015.

**Pit Specific Sediment Chemistry for Tributyltin (TBT) at SB CMP 2  
June 2015**



**Figure 4:** Concentration of Tributyltin (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in June 2015.

**Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at CMP 2 in June 2015**

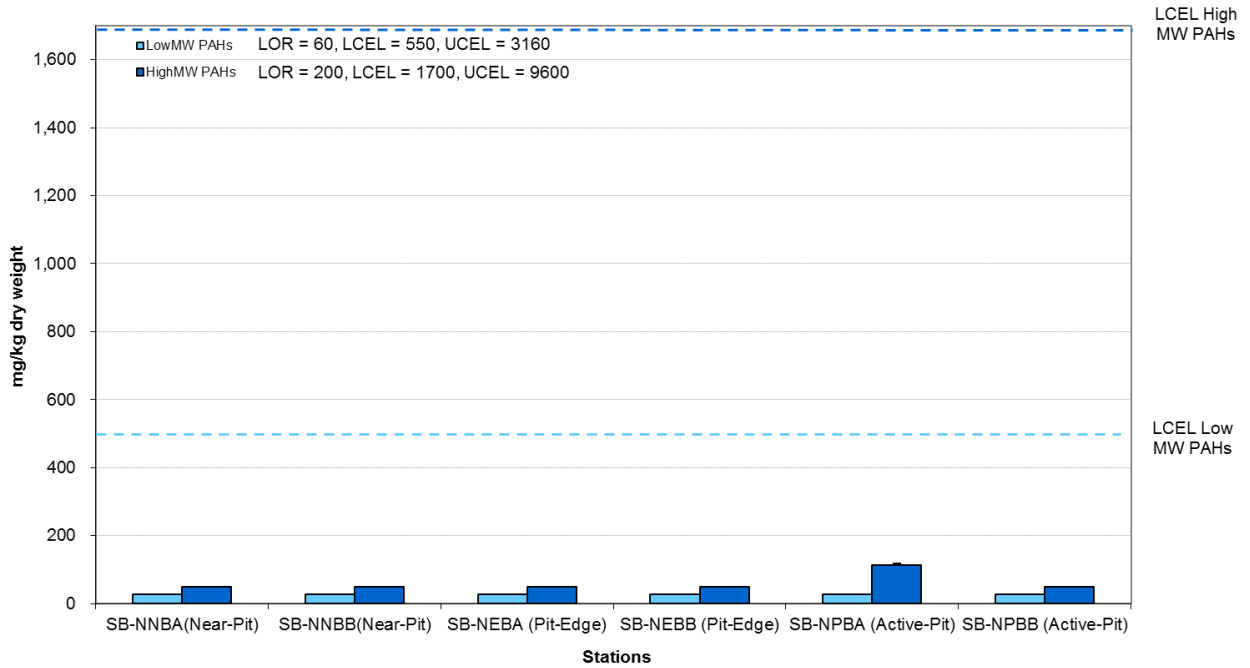


Figure 5: Concentration of Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in June 2015.

**Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at SB CMP 2 July 2015**

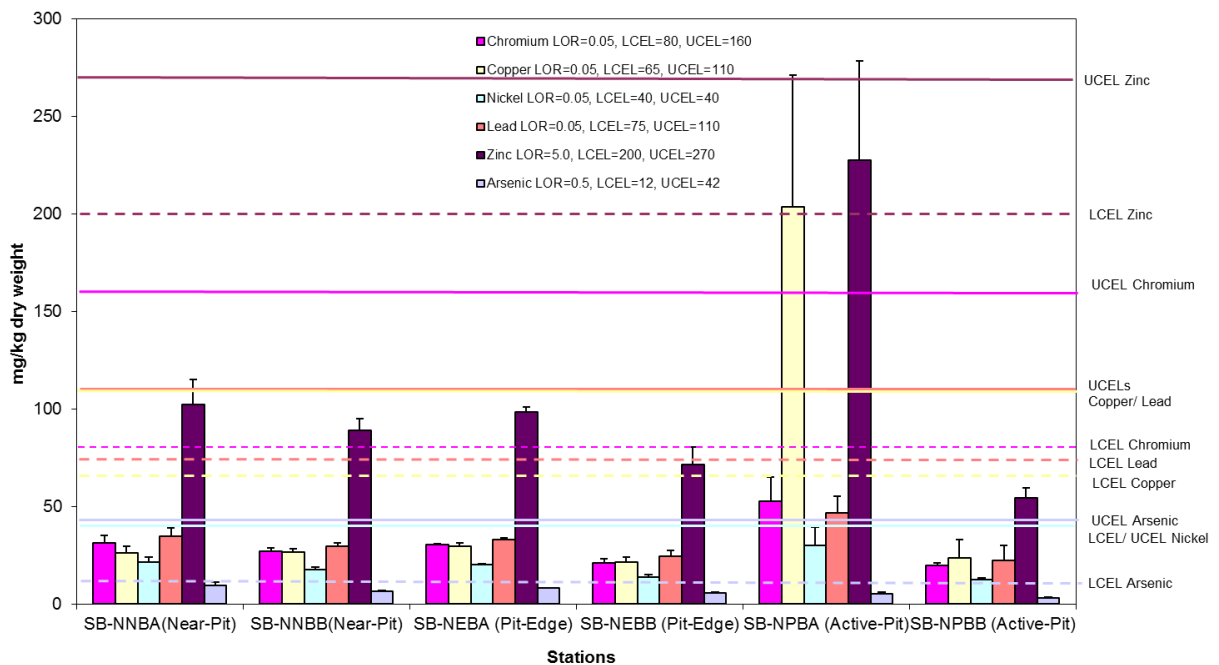


Figure 6: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in July 2015.

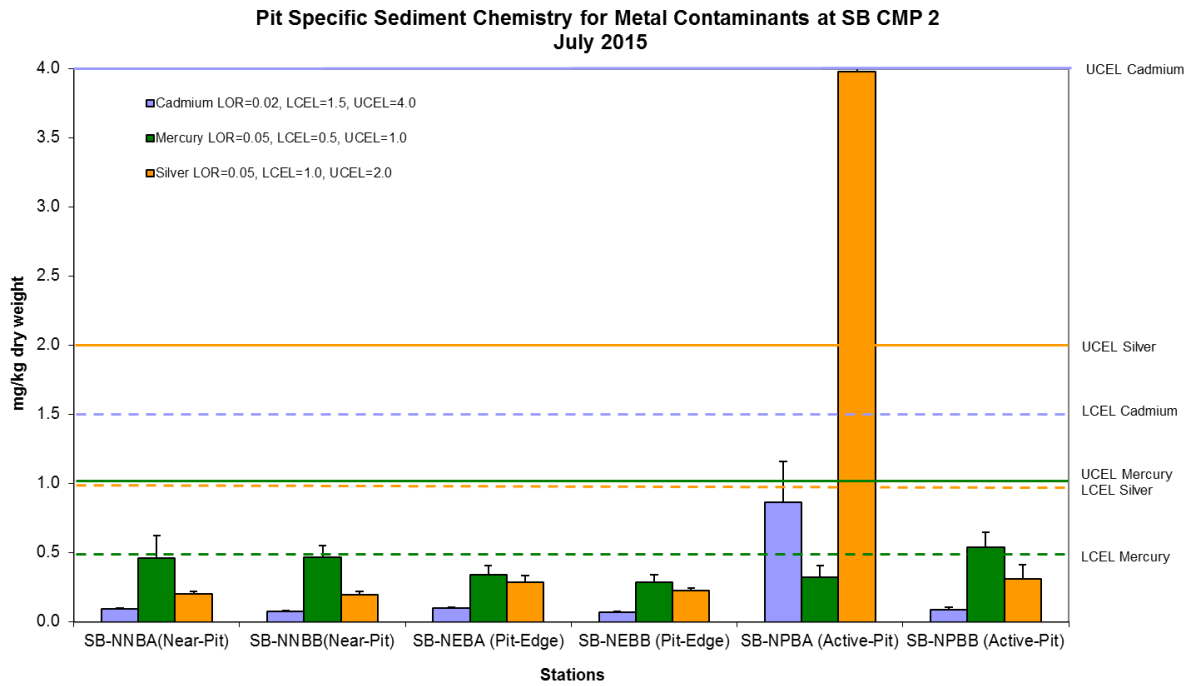


Figure 7: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in May 2015.

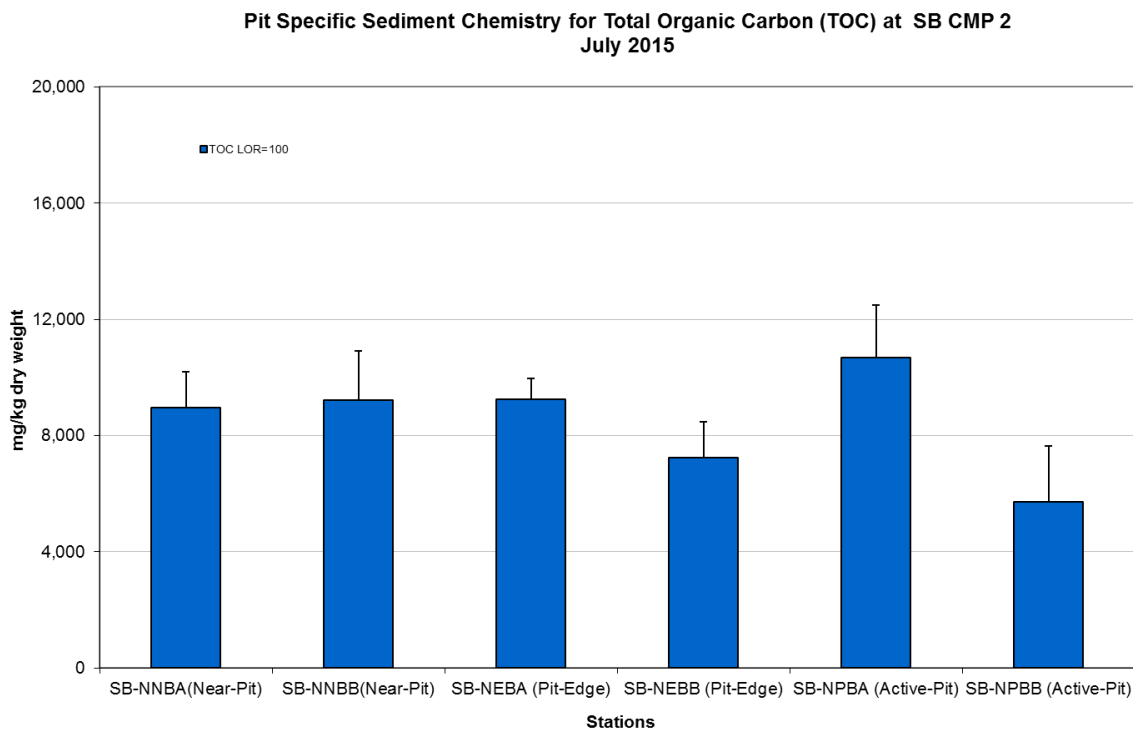


Figure 8: Concentration of Total Organic Carbon (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in July 2015.

**Pit Specific Sediment Chemistry for Tributyltin (TBT) at SB CMP 2  
July 2015**

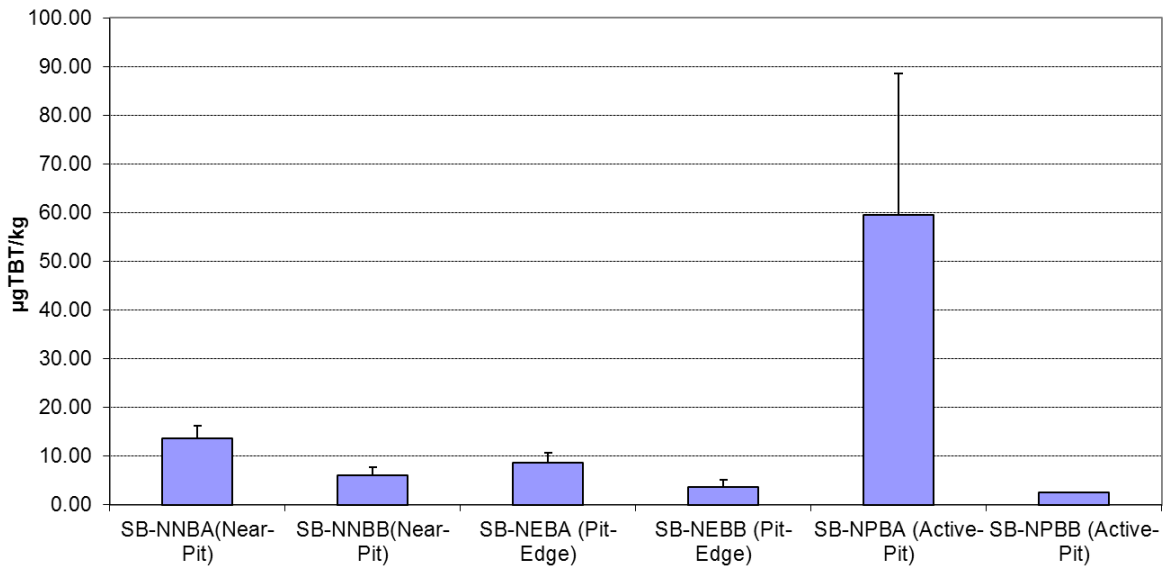


Figure 9: Concentration of Tributyltin ( $\mu\text{g TBT/kg}$ ; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in July 2015.

**Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics  
Hydrocarbons (PAHs) at CMP 2 in July 2015**

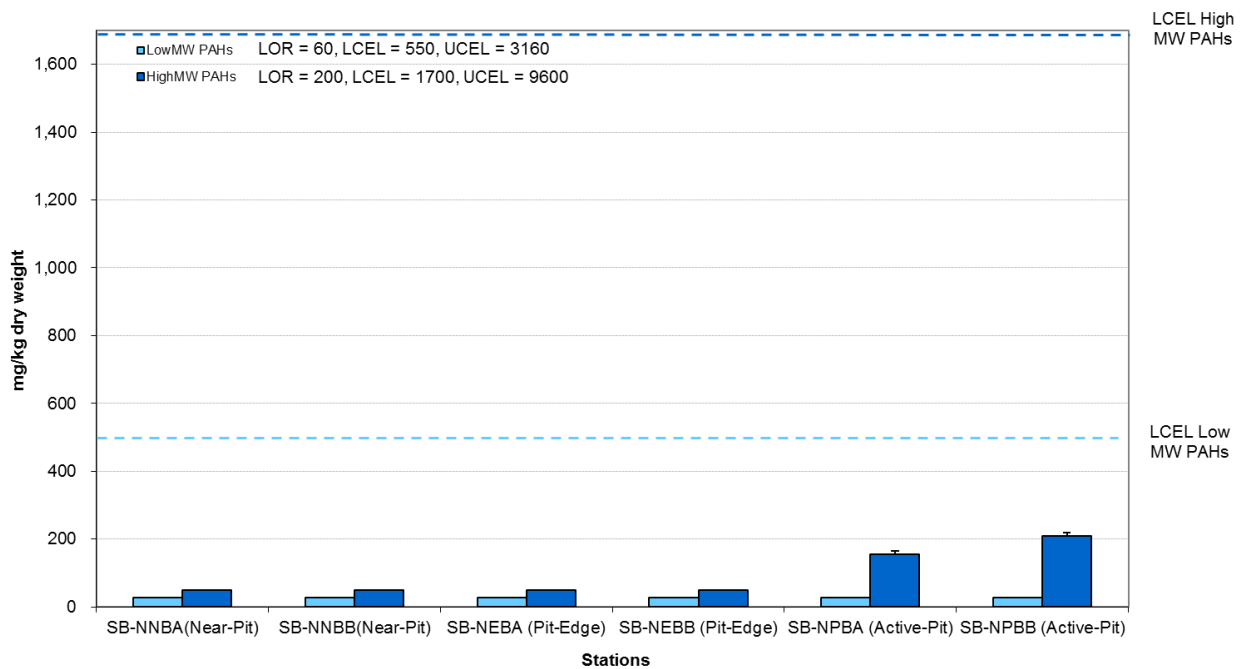


Figure 10: Concentration of Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons ( $\text{mg/kg dry weight}$ ; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for CMP 2 in July 2015.

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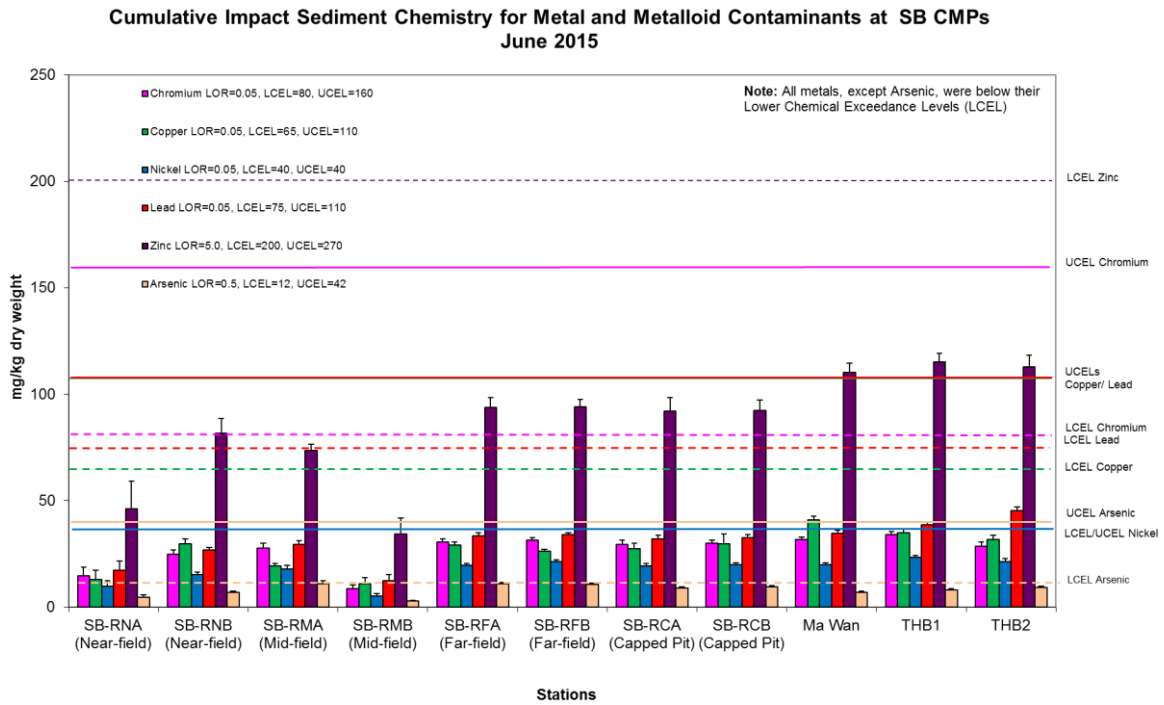


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for SB CMPs in June 2015.

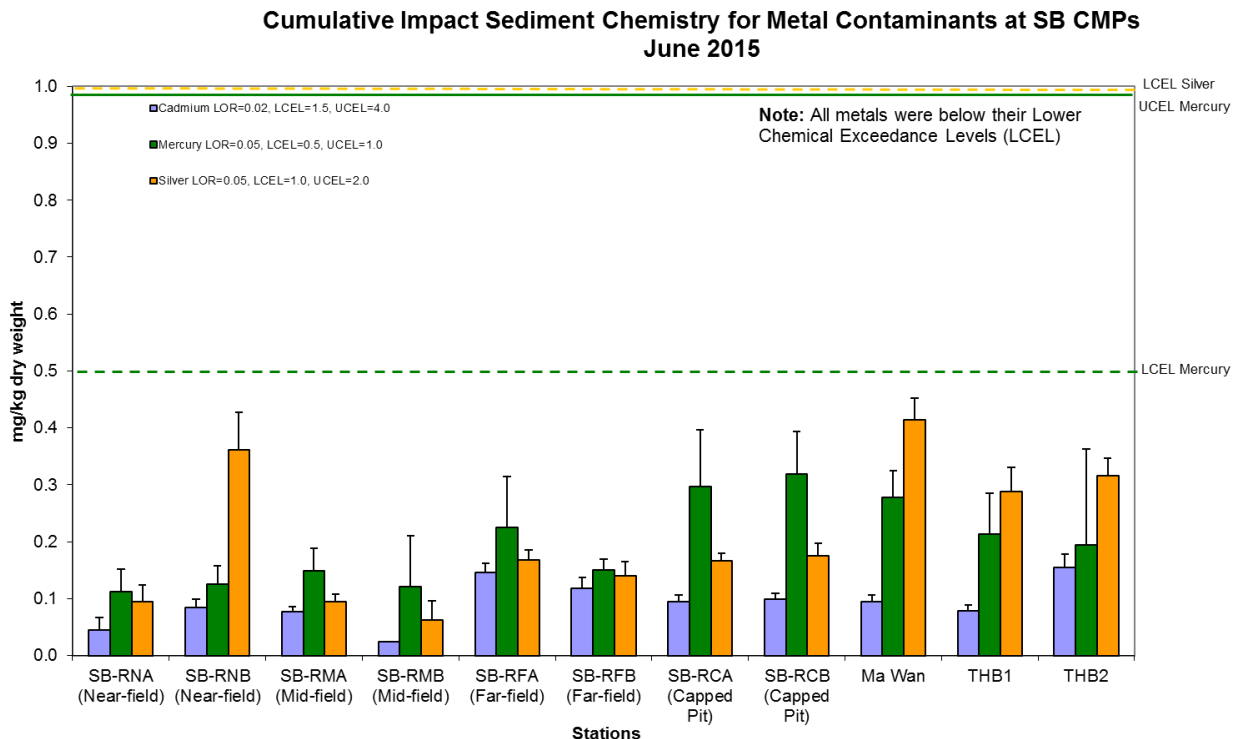


Figure 12: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for SB CMPs in June 2015.

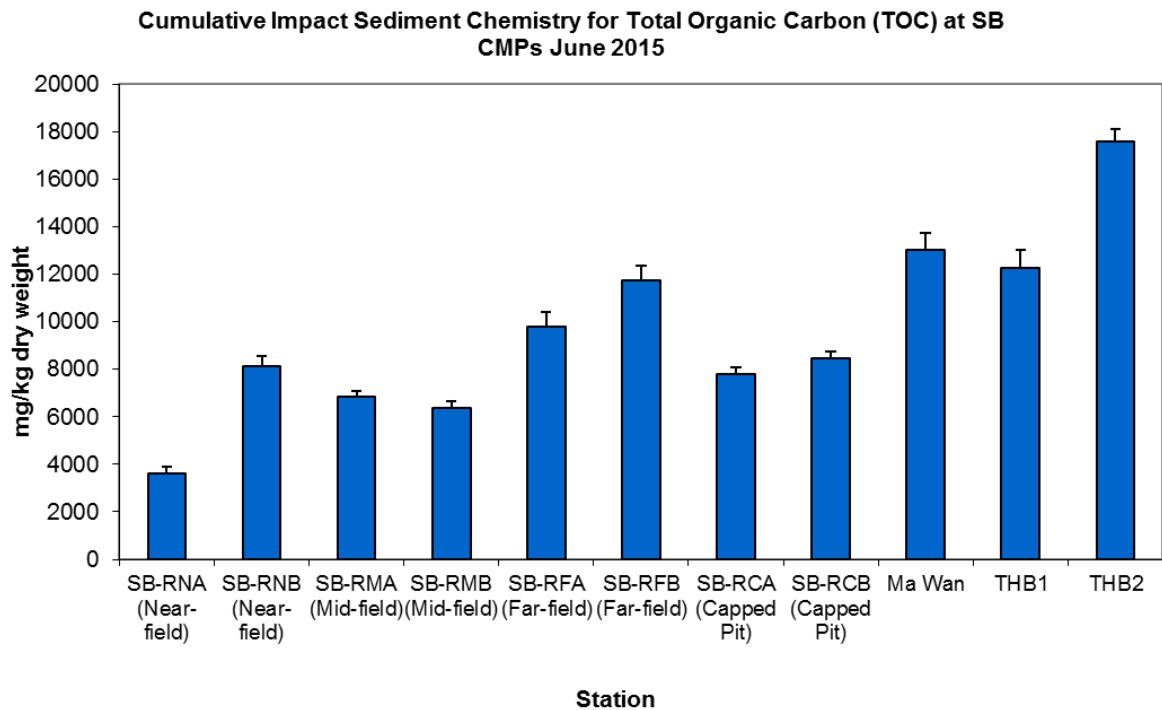


Figure 13: Concentration of Total Organic Carbon (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for SB CMPs in June 2015.

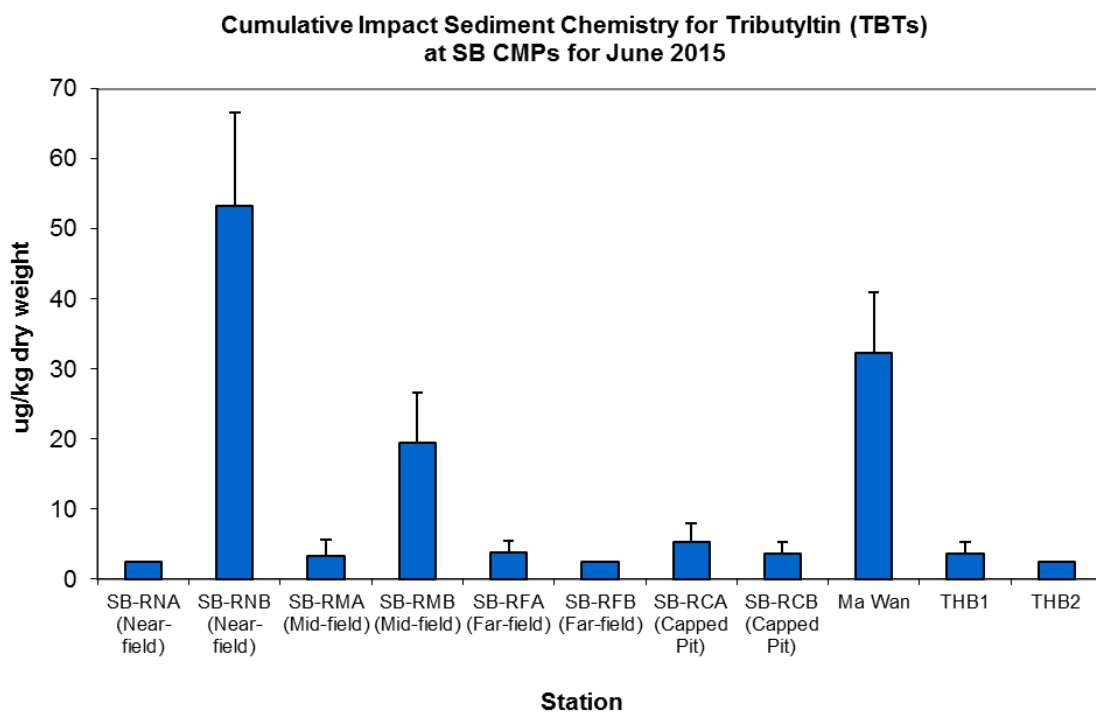


Figure 14: Concentration of Tributyltin ( $\mu\text{g}$  TBT/kg; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for SB CMPs in June 2015.



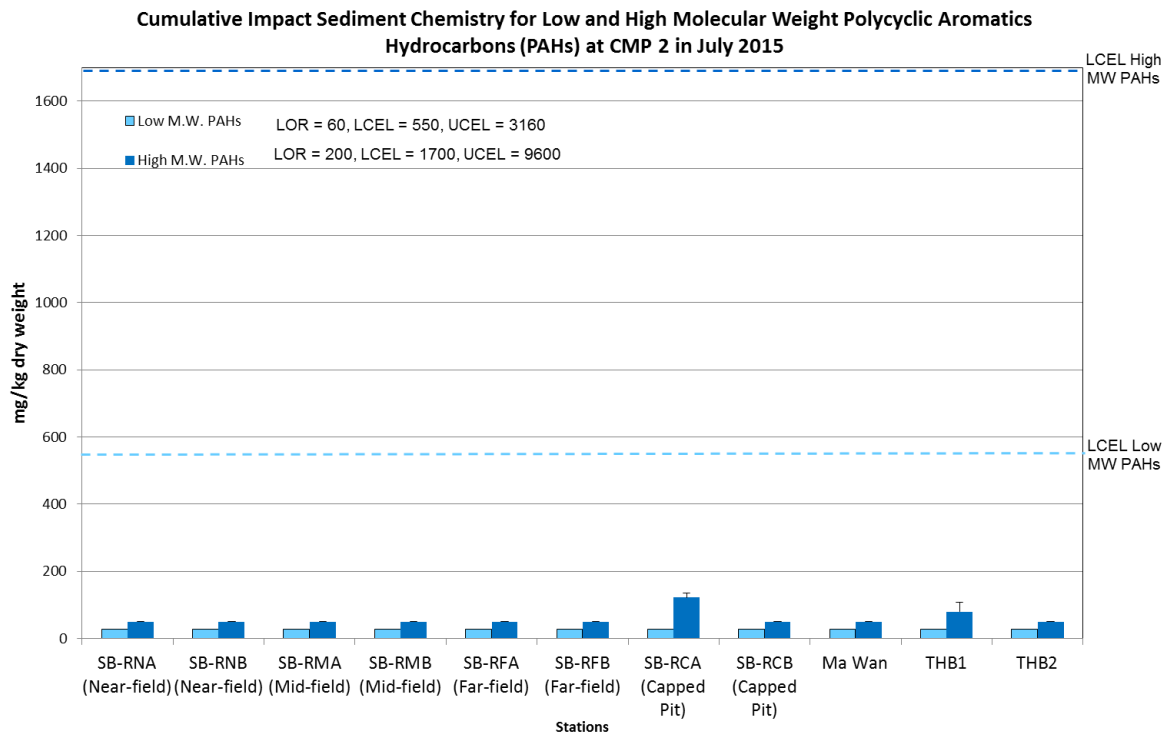


Figure 15: Concentration of Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for SB CMPs in July 2015.

**Routine Water Quality Monitoring for CMP 2 - July 2015**

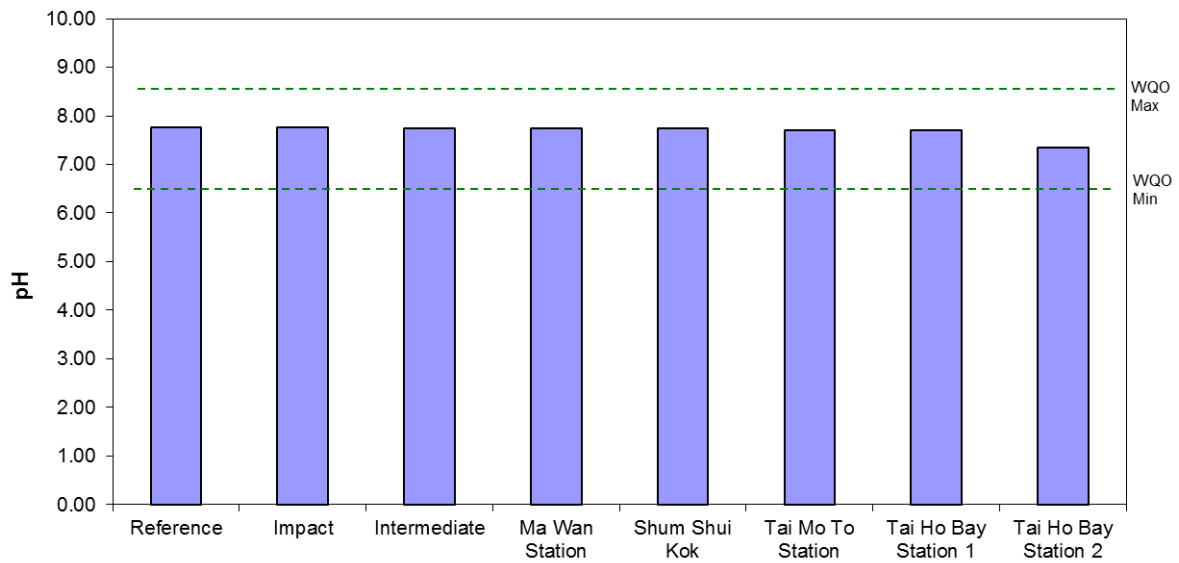


Figure 16: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

**Routine Water Quality Monitoring CMP 2 - July 2015**

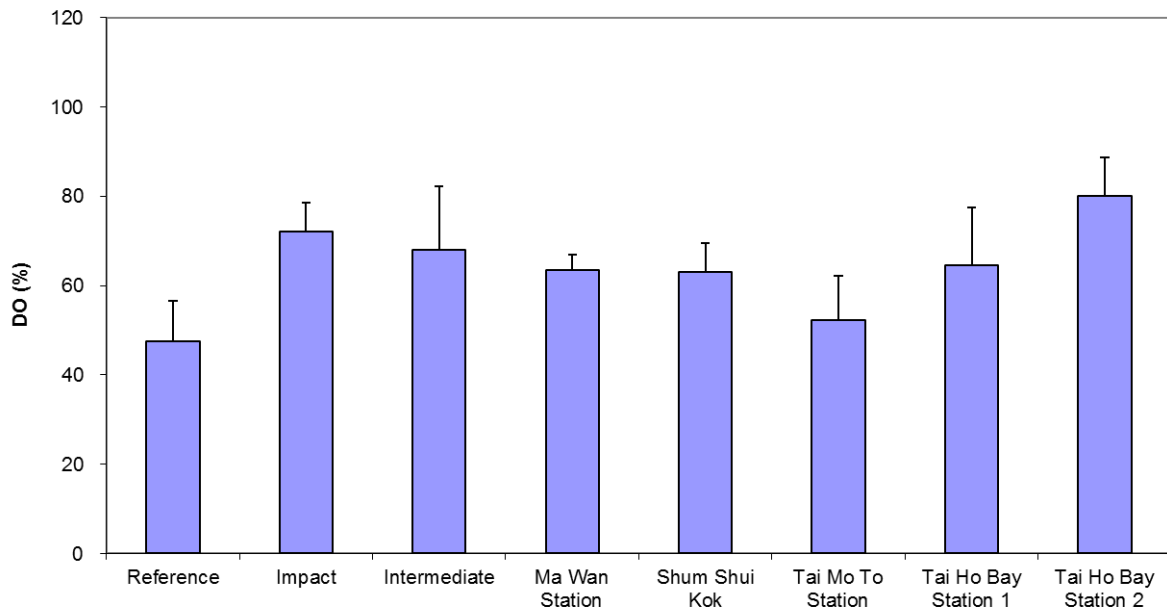


Figure 17: Level of Dissolved Oxygen (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

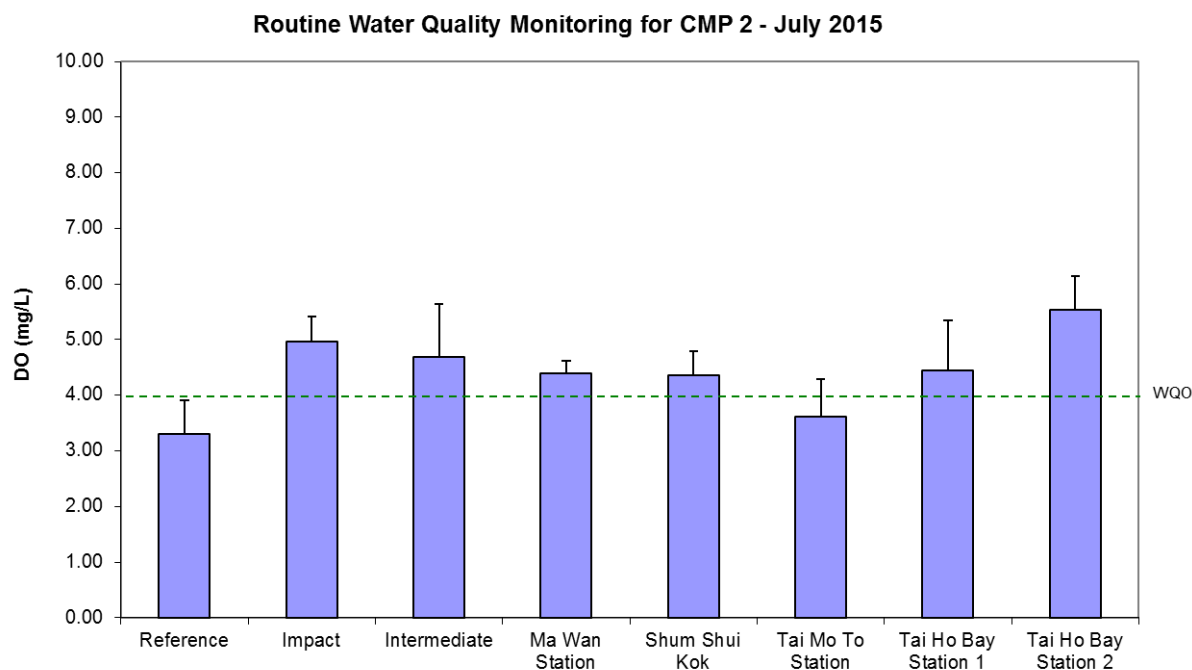


Figure 18: Concentration of Dissolved Oxygen (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

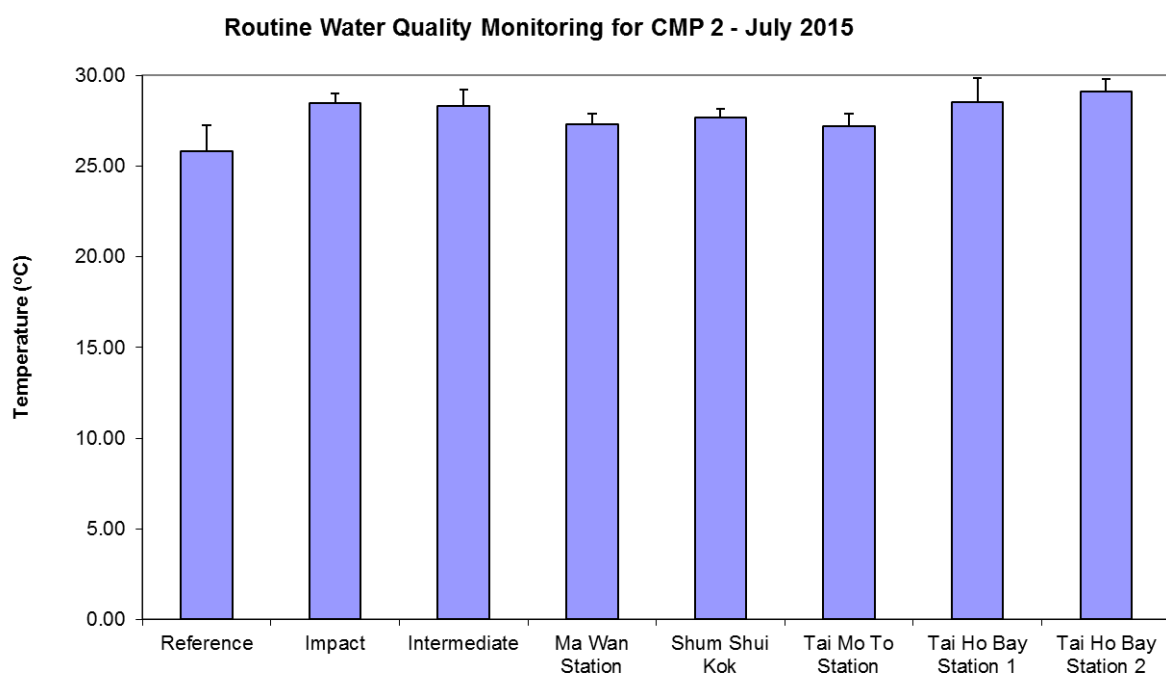


Figure 19: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

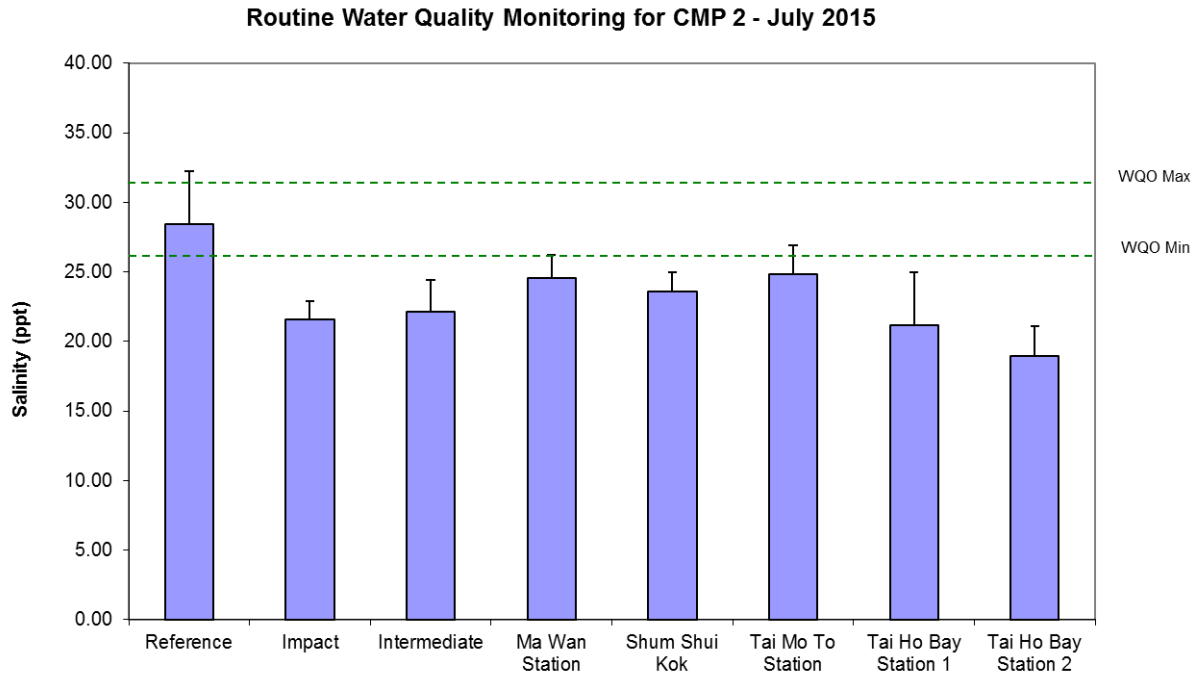


Figure 20: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

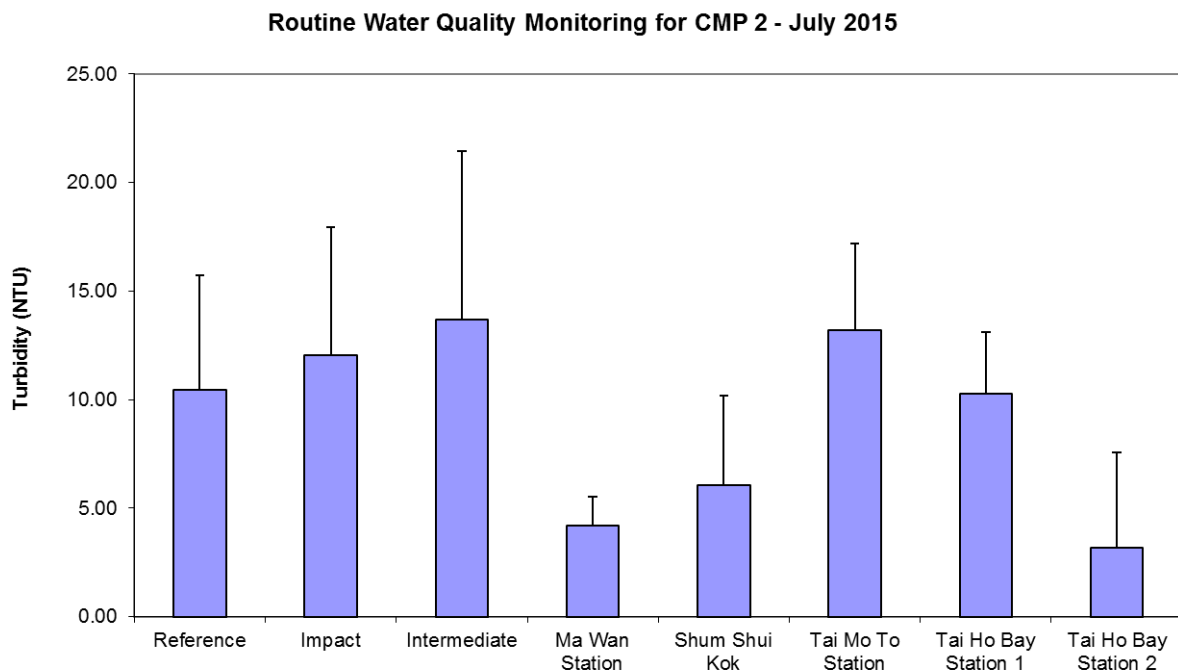


Figure 21: Levels of Turbidity (NTU; ,mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

**Routine Water Quality Monitoring Results for Metals  
July 2015**

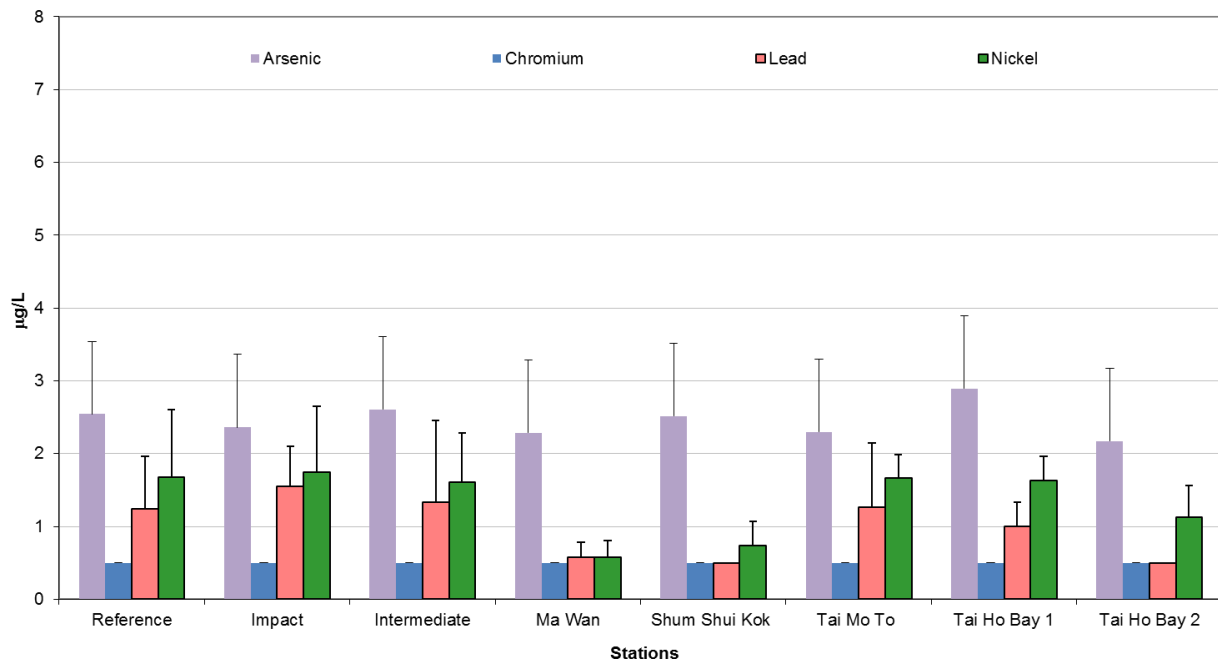


Figure 22: Concentration of Arsenic, Chromium, Lead, Nickel ( $\mu\text{g/L}$ ; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

**Routine Water Quality Monitoring Results for Metals  
July 2015**

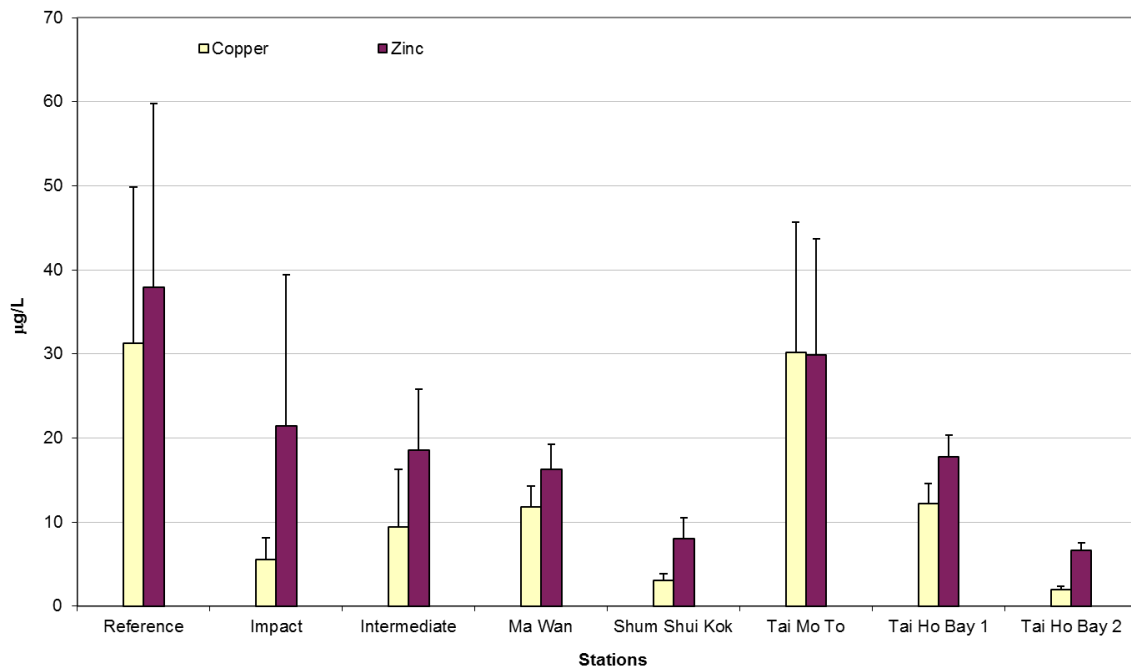


Figure 23: Concentration of Copper and Zinc ( $\mu\text{g/L}$ ; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

**Routine Water Quality Monitoring Results for Nutrients  
July 2015**

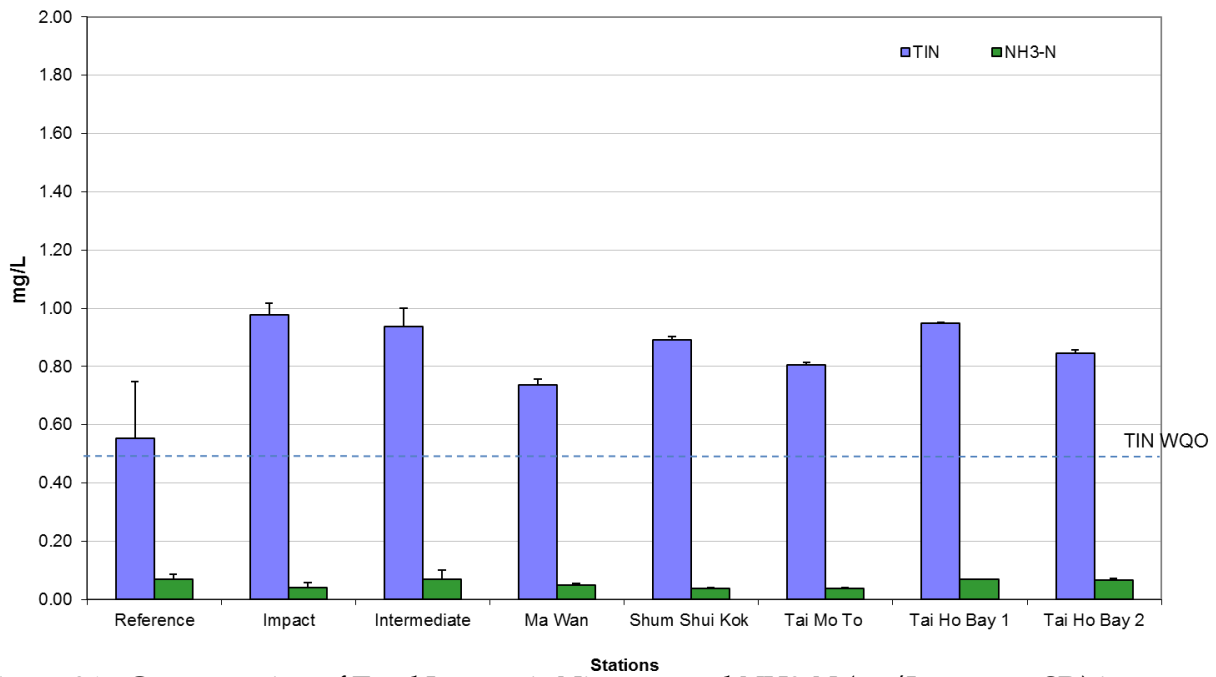


Figure 24: Concentration of Total Inorganic Nitrogen and NH3-N ( $\mu\text{g/L}$ ; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

**Routine Water Quality Monitoring Results for Biochemical Oxygen Demand (BOD<sub>5</sub>)  
July 2015**

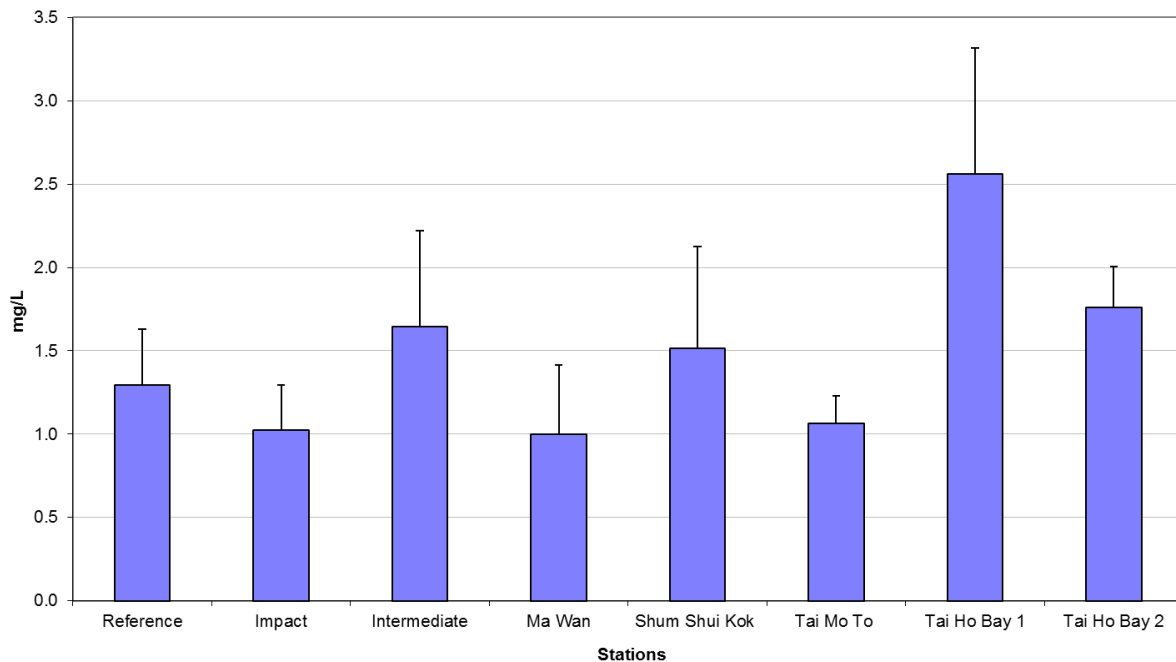


Figure 25: Level of Biochemical Oxygen Demand (BOD<sub>5</sub>) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

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**Routine Water Quality Monitoring for Suspended Solids  
July 2015**

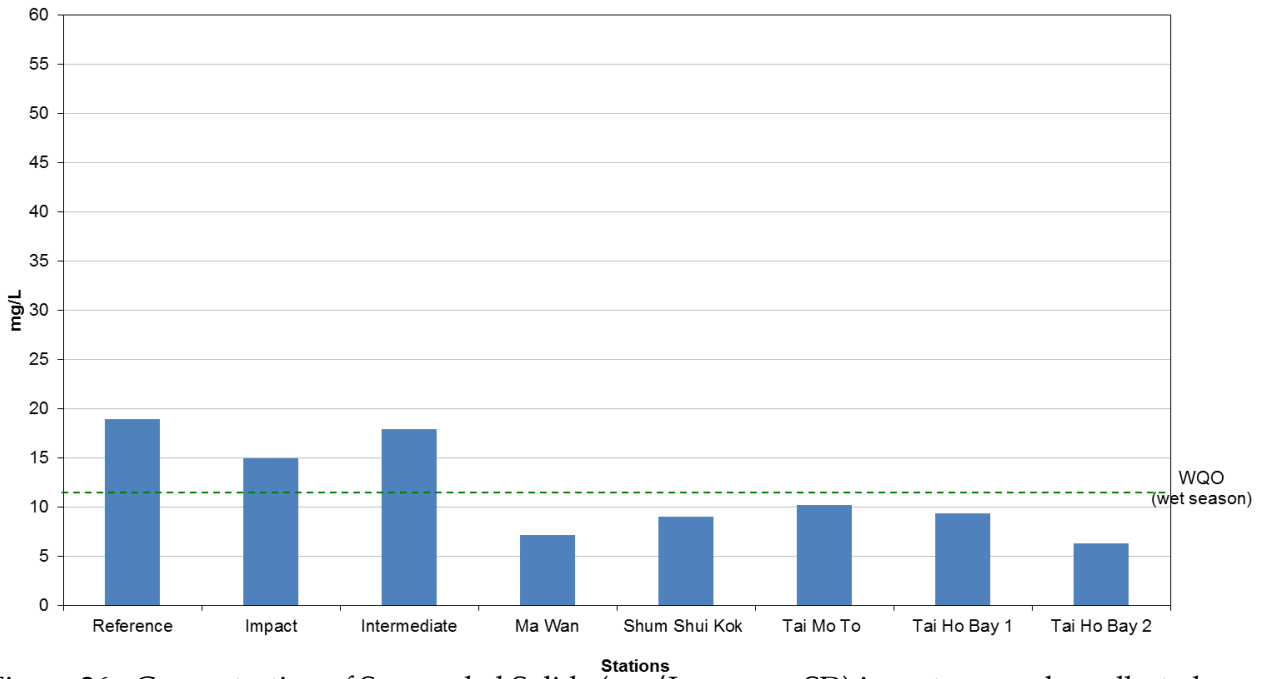


Figure 26: Concentration of Suspended Solids (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in July 2015.

**Sediment Chemistry after a Major Storm for Metal and Metalloid Contaminants at SB CMPs July 2015**

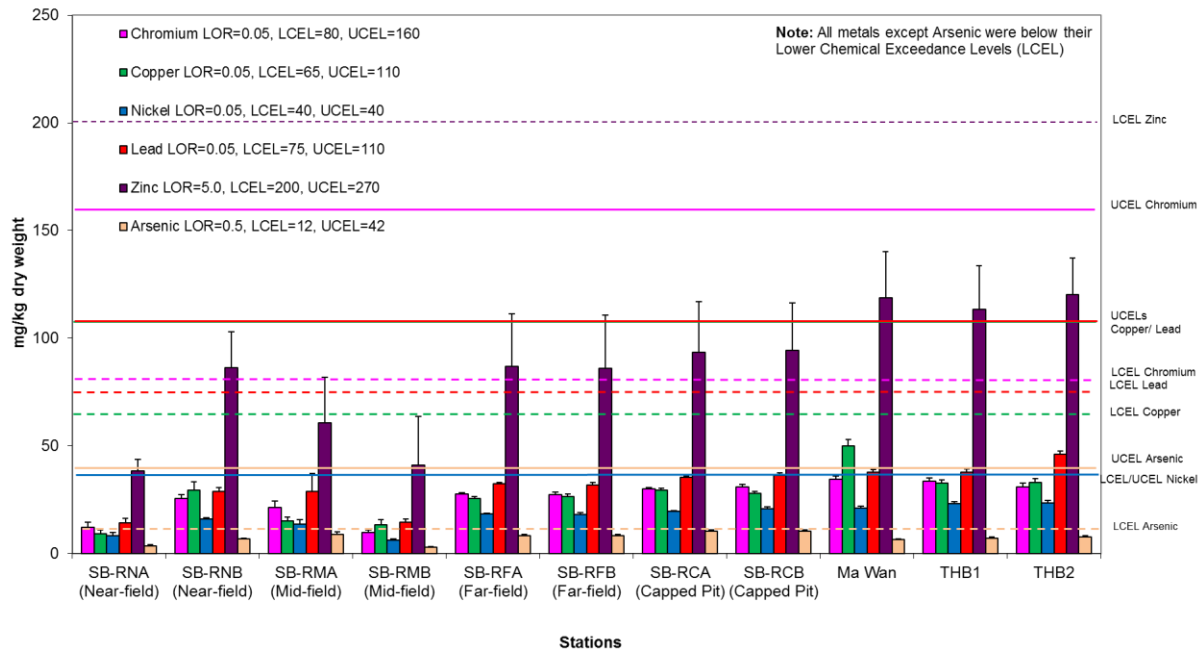


Figure 27: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from *Sediment Chemistry after a Major Storm* for SB CMPs in July 2015.

**Sediment Chemistry after a Major Storm for Metal Contaminants at SB CMPs July 2015**

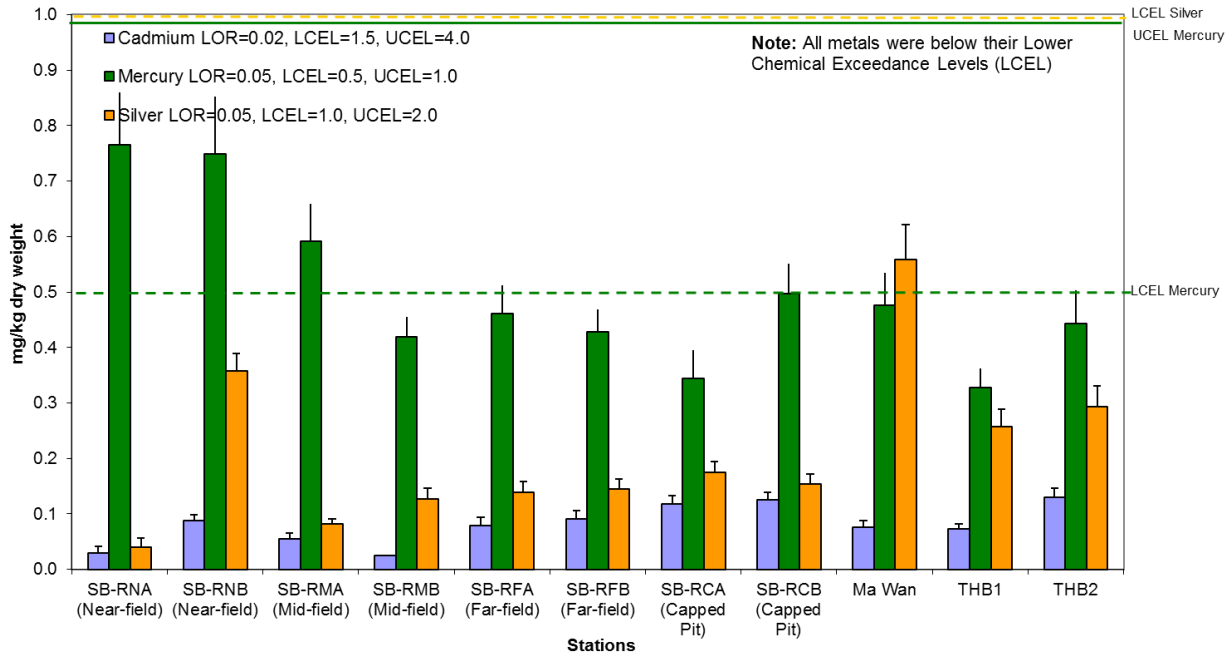


Figure 28: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from *Sediment Chemistry after a Major Storm* for SB CMPs in July 2015.



Annex C

## Water Quality Monitoring Results

**Table C1 Action and Limit Levels of Water Quality for Dredging, Backfilling and Capping Activities for SB CMPs**

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

**Table C2 In-situ Monitoring Results for Routine Water Quality Monitoring of CMP 2 on 6 July 2015**

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen		pH (mg L <sup>-1</sup> )
					(%)	(mg L <sup>-1</sup> )	
July 2015	RFF (Reference)	25.82	28.46	10.44	47.58	3.30	7.76
	IPF (Impact)	28.48	21.55	12.03	72.08	4.96	7.77
	INF (Intermediate)	28.33	22.15	13.71	68.06	4.68	7.75
	Ma Wan	27.32	24.58	4.19	63.57	4.39	7.74
	Shum Shui Kok	27.67	23.60	6.04	63.12	4.36	7.75
	Tai Mo To	27.22	24.85	13.21	52.34	3.62	7.70
	Tai Ho Bay 1	28.51	21.15	10.25	64.60	4.45	7.71
	Tai Ho Bay 2	29.09	18.98	3.18	80.17	5.54	7.34
	WQO	N/A	25.61 – 31.30#	N/A	N/A	>4	6.5-8.5

**Notes:**

# Not exceeding 2°C of change of the results from the Reference Station.

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

Cell shaded yellow / red indicate value exceeding the Action/Limit levels.

Cell shaded grey indicate value exceeding the WQO.

**Table C3 Laboratory Results for Routine Water Quality Monitoring of CMP 2 in July 2015**

Sampling Period	Stations	As (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Pb (µg/L)	Hg (µg/L)	Ni (µg/L)	Ag (µg/L)	Zn (µg/L)	NH <sub>3</sub> (mg/L)	TIN (mg/L)	BOD <sub>5</sub> (mg/L)	SS (mg/L)
July 2015	RFF	2.54	<LOR	<LOR	31.29	1.24	0.89	1.68	<LOR	37.89	0.07	0.55	1.30	18.97
	IPF	2.36	<LOR	<LOR	5.56	1.54	1.02	1.75	<LOR	21.38	0.04	0.98	1.02	14.92
	INF	2.61	<LOR	<LOR	9.41	1.34	0.80	1.61	<LOR	18.58	0.07	0.94	1.65	17.92
	Ma Wan	2.28	<LOR	<LOR	11.77	0.57	0.71	0.58	<LOR	16.28	0.05	0.74	1.00	7.13
	Shum Shui Kok	2.52	<LOR	<LOR	3.08	<LOR	0.74	0.73	<LOR	8.04	0.04	0.89	1.51	9.05
	Tai Mo To	2.30	<LOR	<LOR	30.18	1.27	0.61	1.67	<LOR	29.88	0.04	0.81	1.06	10.18
	Tai Ho Bay 1	2.89	<LOR	<LOR	12.14	1.00	0.48	1.63	<LOR	17.75	0.07	0.95	2.56	9.35
	Tai Ho Bay 2	2.17	<LOR	<LOR	1.93	<LOR	0.73	1.13	<LOR	6.61	0.07	0.85	1.76	6.29
														WQO of TIN: 0.5 mg/L Wet Season WQO of SS : 11.6 mg/L

**Note:** Cell shaded yellow / red indicate value exceeding the Action/Limit levels.

Cell shaded grey indicate value exceeding the WQO.

**Table C4 Water Column Profiling Results for SB CMP 2 on 7 July 2015**

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen		pH (mg L <sup>-1</sup> )	Suspended Solids (mg L <sup>-1</sup> )
				(%)	(mg L <sup>-1</sup> )		
WCP 1 (Downstream)	26.41	26.45	6.73	52.14	3.62	7.81	8.58
WCP 2 (Upstream)	27.58	23.45	12.55	66.76	4.62	7.81	9.95
WQO (wet season)	N/A	22.45-25.79#	N/A	N/A	>4	6.5-8.5	11.6

**Note:** # Not exceeding 2°C of change of the results from the Reference Station.

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

Cell shaded grey indicate value exceeding the WQO.

Annex D

## Study Programme

