

**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)**

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

Final (Revision 1)

7 October 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




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

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Summary:  This document presents the 36 <sup>th</sup> monthly progress report for Contaminated Mud Pits at the South of The Brothers and at East Sha Chau.		Date: 7 October 2015			
		Approved by:   Craig A. Reid Partner			
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v0	36 <sup>th</sup> Monthly Progress Report for ESC CMPs and SB CMPs	EL	JT	CAR	14/9/15
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>		<p>Distribution</p> <p><input type="checkbox"/> Internal</p> <p><input checked="" type="checkbox"/> Public</p> <p><input type="checkbox"/> Confidential</p>			
				 	

**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:	36 <sup>th</sup> Monthly Progress Report for Contaminated Mud Pits to the South of The Brothers and at East Sha Chau - August 2015
Date of Report:	14 September 2015
Date prepared by ET:	14 September 2015
Date received by IA:	14 September 2015

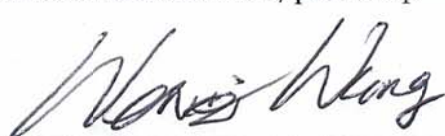
**Reference EP Condition**

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/ <del>plan</del> complies with the above referenced condition of EP-427/2011/A	
Craig A. Reid, Environmental Team Leader:	 Date: 14/9/2015

**IA Verification**

I hereby verify that the above referenced document/ <del>plan</del> complies with the above referenced condition of EP-427/2011/A	
Dr Wang Wen Xiong, Independent Auditor:	 Date: 14/9/2015

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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**

**36<sup>TH</sup> MONTHLY PROGRESS REPORT FOR AUGUST 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 <sup>(1)</sup> <sup>(2)</sup> 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 August 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	F
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 36<sup>th</sup> Monthly Progress Report covers the EM&A activities for the reporting month of August 2015.

## 1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

1.3.1 The following monitoring activities have been undertaken for ESC CMPs in August 2015:

- Benthic Recolonisation Studies of ESC CMPs was undertaken on 12 August 2015; and

- (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 *Water Quality Monitoring During Capping of ESC CMPs was undertaken on 18 August 2015.* The following monitoring activities have been undertaken for SB CMPs in August 2015:

- *Water Column Profiling* of CMP 2 was undertaken on 10 August 2015;
- *Routine Water Quality Monitoring* of CMP 2 was undertaken on 13 August 2015;
- *Pit Specific Sediment Chemistry* of CMP 2 was undertaken on 17 August 2015;
- *Demersal Trawling* for CMPs was undertaken on 19 and 20 August 2015;
- *Cumulative Impact Sediment Chemistry* of CMP 2 was undertaken on 19 and 21 August 2015;
- *Sediment Toxicity Test* of CMP 2 was undertaken on 19 and 21 August 2015;
- *Water Quality Monitoring During Capping* of CMP 1 was undertaken on 24 August 2015; and *Benthic Recolonisation Studies* of CMP 1 was undertaken on 26 August 2015.

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

1.4.1 No outstanding sampling remained for August 2015.

1.4.2 A summary of field activities conducted are presented in *Annex A*. 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 *Cumulative Impact Sediment Chemistry* of SB CMP 2 in August 2015; and
- Laboratory analyses of sediment samples collected for *Pit Specific Sediment Chemistry* of SB CMP 2 in August 2015.

1.4.3 The following laboratory analyses are in progress and will be presented in the corresponding quarterly report:

- Laboratory analyses of sediment samples collected for *Benthic Recolonisation Studies* of ESC CMPs and SB CMP 1 in August 2015;
- Taxonomic identification of fishery resources collected during *Demersal Trawling* for SB CMPs in July and August 2015; and
- Laboratory analyses for *Sediment Toxicity Test* of SB CMP 2 in August 2015.

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

1.5.1 Brief discussion of the monitoring results of the *Water Quality Monitoring during Capping of ESC CMPs* conducted in August 2015 is presented below. Graphical presentation of the monitoring results is provided in *Annex B*.

### **1.5.2 *Water Quality Monitoring during Capping of ESC CMPs – August 2015***

1.5.3 The monitoring results obtained during August 2015 sampling in the wet season have been assessed for compliance with the Water Quality Objectives (WQOs) set by Environmental Protection Department (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 (WCZ), 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). A total of ten (10) monitoring stations were sampled in August 2015 as shown in *Figure 1.2*.

#### *In-situ Measurements*

1.5.4 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in Figures 1-6 of Annex B. Levels of Dissolved Oxygen (DO) and pH at all stations in August 2015 complied with the WQO and the Action and Limit levels (*Table C1 of Annex C*). Level of Salinity at most station also complied with WQO, except for Ma Wan station. The higher Salinities recorded at Ma Wan station are likely to be caused by the larger separation distance to Pearl River mouth, which release a large amount of freshwater runoff in the area during flooding, when compared to the Reference stations.

#### *Laboratory Measurements for Suspended Solids (SS)*

Concentrations of SS complied with the WQO at all stations in August 2015, except for the Reference stations (*Figure 7 of Annex B; Table C2 of Annex C*). However, concentrations of SS at all stations complied with the Action and Limit Levels. 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 Brief discussion of the monitoring results of the following activities for SB CMPs is presented in this 36<sup>th</sup> *Monthly Progress Report*:

- *Water Quality Monitoring During Capping of CMP 1 in August 2015;*

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



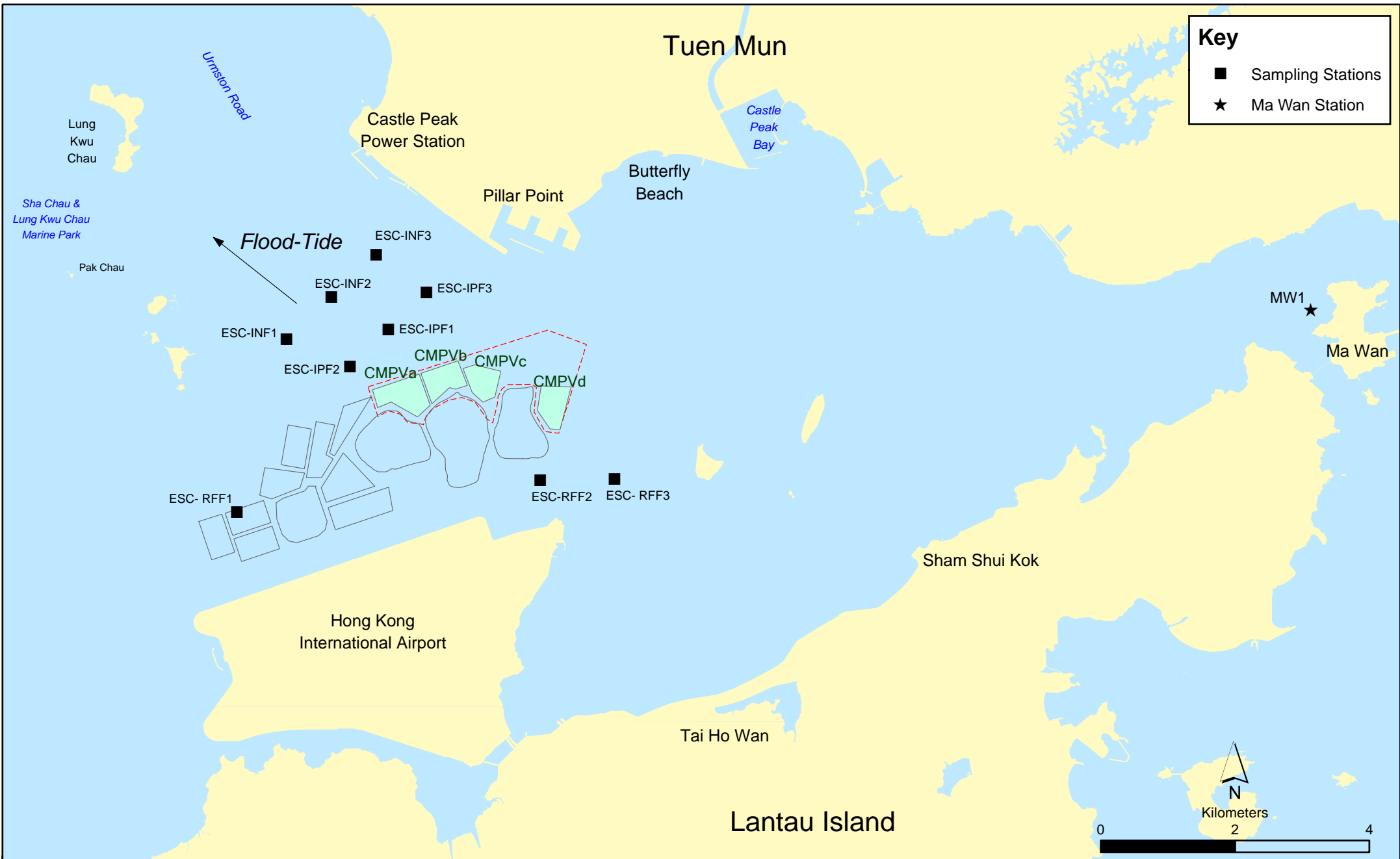


Figure 1.2

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

File: T:\GIS\CONTRACT\0103262\mxd\CMPV\0103262\_R\_C\_WQMS\_flood.mxd  
Date: 27/3/2014

Environmental  
Resources  
Management



- *Water Column Profiling* of CMP 2 in August 2015; and
- *Routine Water Quality Monitoring* of CMP 2 in August 2015.

## 1.6.2 **Water Quality Monitoring during Capping of SB CMP 1 – August 2015**

1.6.3 The monitoring results obtained during August 2015 sampling in the wet season have been assessed for compliance with the WQOs (see *Section 1.5.3* for details). Levels of DO and Turbidity were also assessed for compliance with the Action and Limit Levels (see *Table C3* of *Annex C* for details). A total of fourteen (14) monitoring stations were sampled in August 2015 as shown in *Figure 1.3*. Graphical presentation of the monitoring results is provided in *Annex B*.

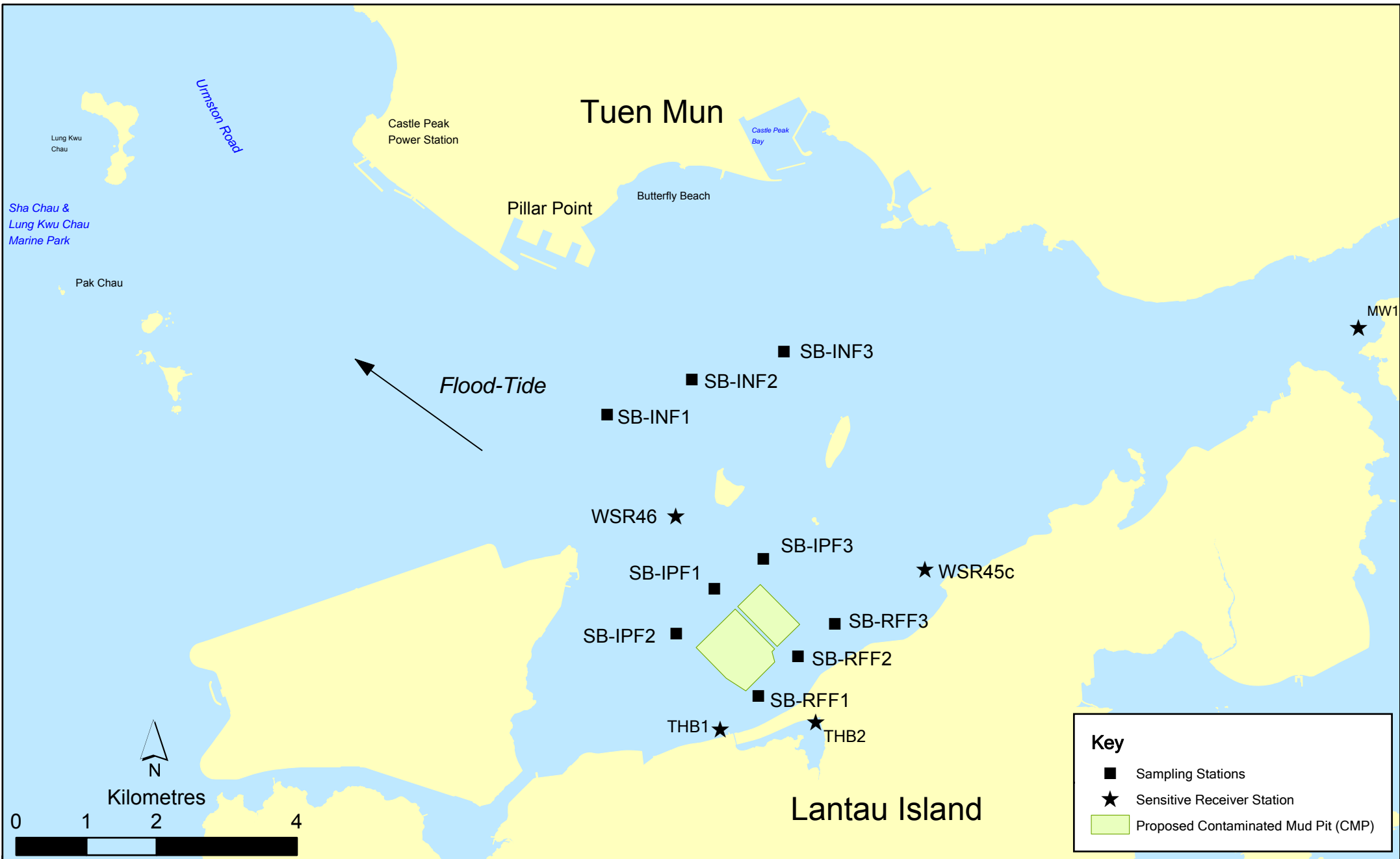
### *In-situ Measurements*

1.6.4 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 8-13* of *Annex B*. Levels of pH at all stations in August 2015 complied with the WQO. DO at most stations complied with the WQO and the Action and Limit levels except at Sham Shui Kok station in August 2015 (*Table C3* of *Annex C*). The exceedance of WQO and the Action and Limit levels at Sham Shui Kok station was unlikely to be caused by the capping operation at SB as the levels of DO complied with the WQO and the Action and Limit levels at all other stations, including Impact stations which are located closer to CMP 1. In addition, the levels of Turbidity complied with the Action and Limit levels at all stations in August 2015 (*Table C3* and *C4* of *Annex C*).

1.6.5 Levels of Salinity at most stations complied with the WQO except at Intermediate, Sham Shui Kok, Tai Ho Bay 2 and Ma Wan stations. The lower Salinities recorded at Tai Ho Bay 2 and Reference stations are likely due to the close proximity of the nearby streams, which release large amount of freshwater runoff in the area during flooding. The Salinities at other stations were higher or above the WQO as they were located further away from the Tai Ho Bay and Reference stations which experienced less freshwater runoff from the nearby streams.

### *Laboratory Measurements*

1.6.6 Concentrations of SS complied with the WQO (11.6 mg/L for wet season) at Intermediate, Ma Wan, Tai Ho Bay 2 and Tai Mo To stations, but not at Reference, Impact, Tai Ho Bay 1 and Sham Shui Kok stations in August 2015 (*Figure 14* of *Annex B*). However, SS at all stations complied with the Action and Limit Levels in August 2015 (*Table C3* and *C4* of *Annex C*).



**Key**

- Sampling Stations
- ★ Sensitive Receiver Station
- Proposed Contaminated Mud Pit (CMP)

Figure 1.3

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

- 1.6.7 For nutrients, concentrations of Ammonia (NH<sub>3</sub>) were relatively similar amongst most stations except a slightly lower value was recorded at Tai Ho Bay 2 station (*Figures 15 of Annex B*). Total Inorganic Nitrogen (TIN) at Impact, Reference, Tai Ho Bay 1 and Tai Mo To stations exceeded the WQO of 0.5 mg/L in August 2015 (*Figure 16 of Annex B*). It should be noted that the North Western WCZ has historically experienced higher levels of TIN and the exceedances of TIN WQO at these stations are unlikely to be caused by the capping operation at CMP 1.
- 1.6.8 Concentrations of Biochemical Oxygen Demand (BOD<sub>5</sub>) were similar at most stations except higher values were recorded at Reference stations in August 2015 (*Figures 17 of Annex B*).
- 1.6.9 Statistical analysis will be undertaken and presented in the quarterly report to investigate whether the capping operations at CMP 1 is causing any unacceptable impacts in water quality of the area.
- 1.6.10 ***Routine Water Quality Monitoring of SB CMP 2 - August 2015***
- 1.6.11 The monitoring results for the Routine Water Quality Monitoring conducted in August 2015 in the wet season have been assessed for compliance with the WQOs (see *Section 1.5.3* for details). Levels of Dissolved Oxygen (DO) and Turbidity were also assessed for compliance with the Action and Limit Levels (see *Table C3 of Annex C* for details). The monitoring results are shown in *Figures 18-28 of Annex B* and *Tables C5 and C6 of Annex C*. A total of twenty (20) monitoring stations were sampled in August 2015 as shown in *Figure 1.4*.
- In-situ Measurements*
- 1.6.12 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 18-23 of Annex B*. Analyses of results for August 2015 indicated that the levels of pH and DO complied with the WQOs at all stations (Impact, Intermediate, Reference and Water Sensitive Receiver stations) in August 2015 (*Figures 18 – 20 of Annex B*).
- 1.6.13 The levels of Salinity at Impact, Intermediate and Water Sensitive Receiver stations exceeded the WQO range in August 2015 (*Figure 22 of Annex B*). The lower Salinities recorded at these stations, which lead to exceedance of the WQO, 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.
- 1.6.14 The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (*Figures 19 and 22 of Annex B; Table C5 of Annex C*).
- 1.6.15 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 August 2015.

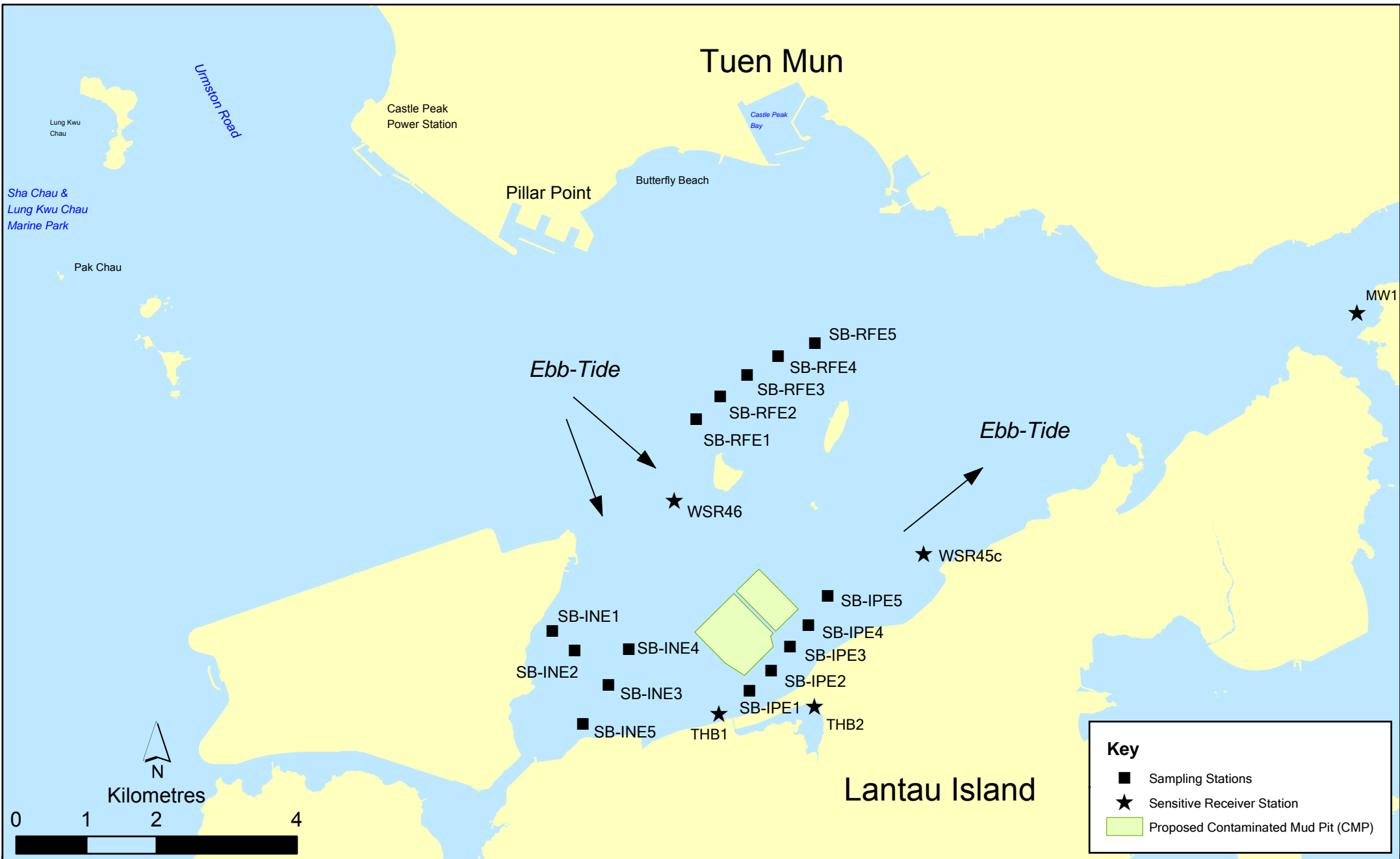


Figure 1.4

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

### *Laboratory Measurements*

- 1.6.16 Laboratory analysis of August 2015 results indicated that concentrations of Cadmium, Chromium, Silver and Mercury were below their limit of reporting at all stations. Arsenic, Copper, Lead, Nickel and Zinc were detected in August 2015 samples and the concentrations were similar amongst stations (Figures 24-25 of Annex B). Results of laboratory analysis were shown in Table C6 of Annex C.
- 1.6.17 For nutrients, concentrations of TIN at all stations in August 2015 exceeded the WQO (0.5mg/L) (Figure 26 of Annex B). As discussed in Section 1.6.7, the North Western WCZ has historically experienced higher levels of TIN and the exceedances of TIN WQO at all stations in August 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 (Figure 26 of Annex B). Levels of 5-day Biochemical Oxygen Demand (BOD<sub>5</sub>) appear to be higher at Tai Ho Bay 1 and Shum Shui Kok stations in August 2015 (Figure 27 of Annex B).
- 1.6.18 Concentrations of SS complied the WQO (11.6 mg/L for wet season) at all stations, except Reference stations in August 2015. Concentrations of SS complied with the Action and Limit Levels at all stations in August 2015 (Figure 28 of Annex B; Table C6 of Annex C).
- 1.6.19 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 August 2015. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

### **1.6.20 *Water Column Profiling of CMP 2 – August 2015***

- 1.6.21 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 10 August 2015. The water quality monitoring results have been assessed for compliance with the WQOs as discussed in Section 1.5.3. The monitoring results were also compared with the Action and Limit Levels set in *Baseline Monitoring Report* (see Table C3 of Annex C for details).

### *In-situ Measurements*

- 1.6.22 Analyses of results for August 2015 indicated that levels of Salinity, DO and pH complied with the WQOs at both Downstream and Upstream stations (Table C7 of Annex C). In addition, DO and Turbidity at all stations complied with the Action and Limit Levels (Tables C3 and C7 of Annex C).

### *Laboratory Measurements for SS*



1.6.23 Analyses of results for August 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 C3 and C7 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.

## **1.7** *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

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

- *Pit Specific Sediment Chemistry of CMP 2; and*
- *Water Column Profiling of CMP 2.*

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

- *Impact Monitoring during Dredging Operations of 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 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																																												
	SB-IPE2	4 times per year																																												
	SB-IPE3	4 times per year																																												
	SB-IPE4	4 times per year																																												
	SB-IPE5	4 times per year																																												
Intermediate Stations Downcurrent																																														
	SB-INE1	4 times per year																																												
	SB-INE2	4 times per year																																												
	SB-INE3	4 times per year																																												
	SB-INE4	4 times per year																																												
	SB-INE5	4 times per year																																												
Reference Stations Upcurrent																																														
	SB-RFE1	4 times per year																																												
	SB-RFE2	4 times per year																																												
	SB-RFE3	4 times per year																																												
	SB-RFE4	4 times per year																																												
	SB-RFE5	4 times per year																																												
Sensitive Receiver Stations																																														
	MW1	4 times per year																																												
	THB1	4 times per year																																												
	THB2	4 times per year																																												
	WSR45C	4 times per year																																												
	WSR46	4 times per year																																												
<i>Flood Tide</i>																																														
Impact Stations Downcurrent																																														
	SB-IPF1	4 times per year																																												
	SB-IPF2	4 times per year																																												
	SB-IPF3	4 times per year																																												
Intermediate Stations Downcurrent																																														
	SB-INF1	4 times per year																																												
	SB-INF2	4 times per year																																												
	SB-INF3	4 times per year																																												
Reference Stations Upcurrent																																														
	SB-RFF1	4 times per year																																												
	SB-RFF2	4 times per year																																												
	SB-RFF3	4 times per year																																												
Sensitive Receiver Stations																																														
	MW1	4 times per year																																												
	THB1	4 times per year																																												
	THB2	4 times per year																																												
	WSR45C	4 times per year																																												
	WSR46	4 times per year																																												
<b>Benthic Recolonisation Studies</b>																																														
Capped Contaminated Mud Pits																																														
	SB-CPA	2 times per year																																												
	SB-CPB	2 times per year																																												
Reference Stations																																														
	RBA	2 times per year																																												
	RBB	2 times per year																																												
	RBC	2 times per year																																												

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

Annex B

## Graphical Presentations

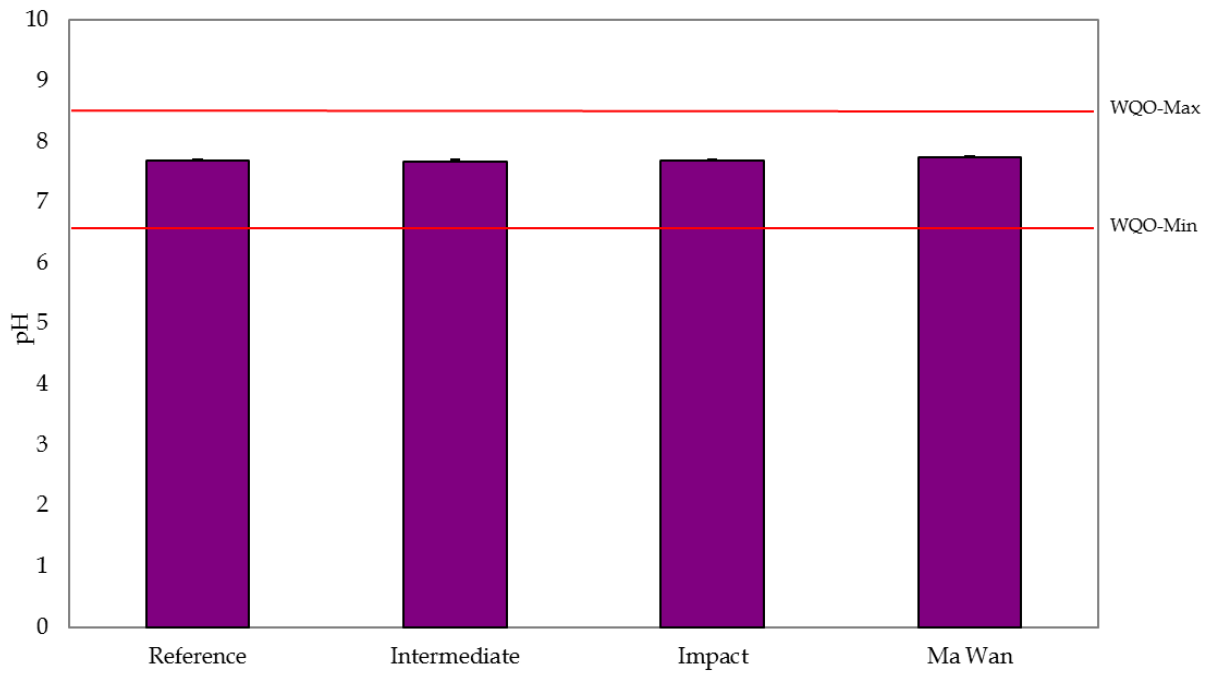


Figure 1: Levels of pH (mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.

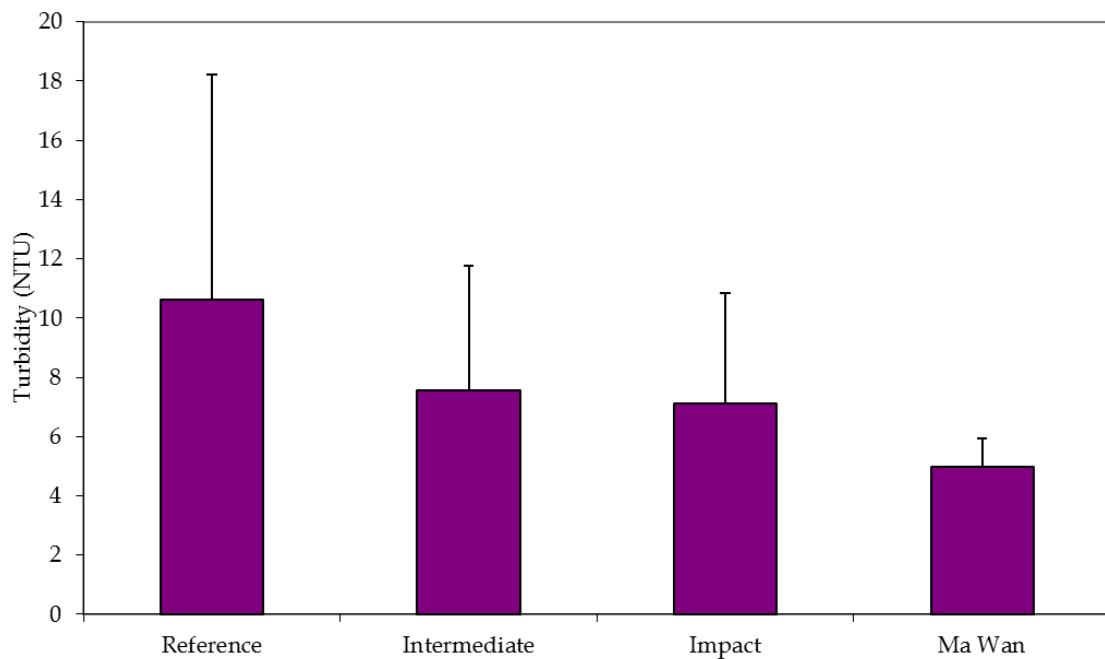


Figure 2: Levels of Turbidity (NTU; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.

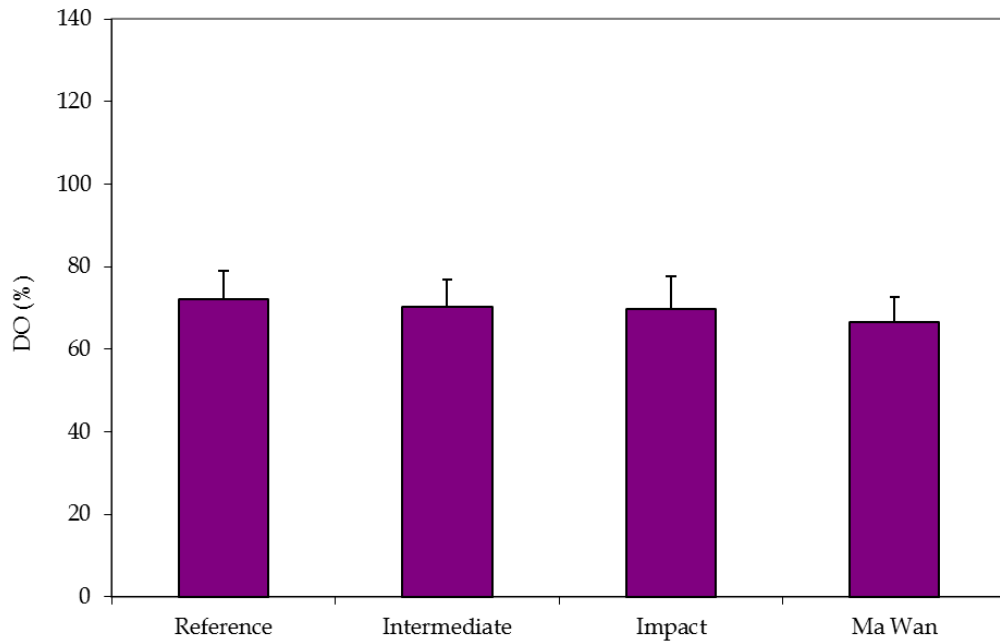


Figure 3: Levels of Dissolved Oxygen (% saturation; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.

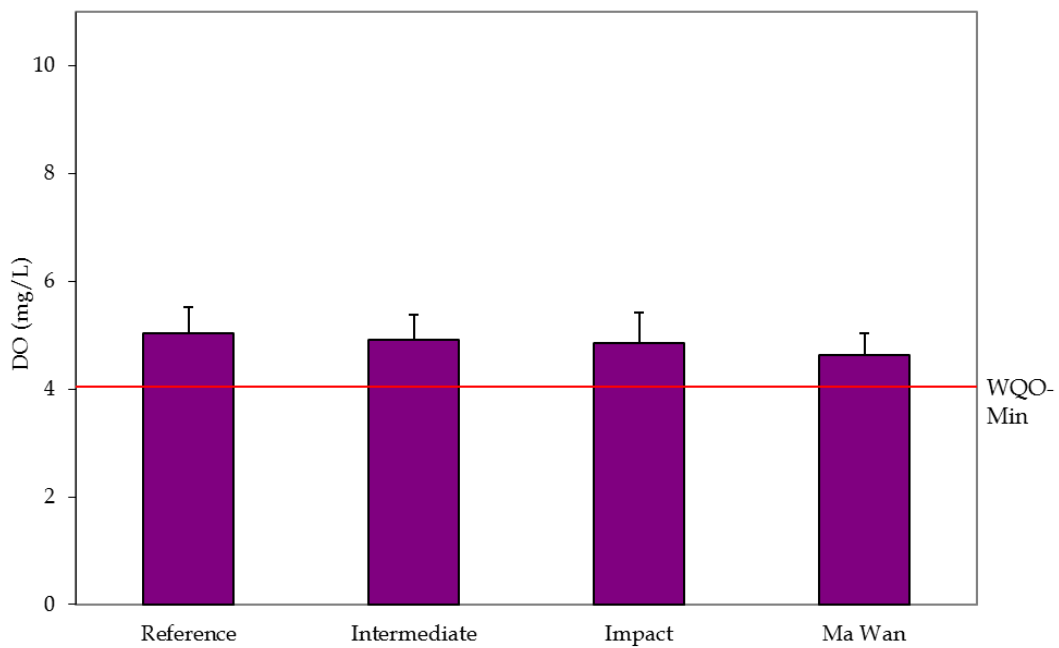


Figure 4: Levels of Dissolved Oxygen (mg/L; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.



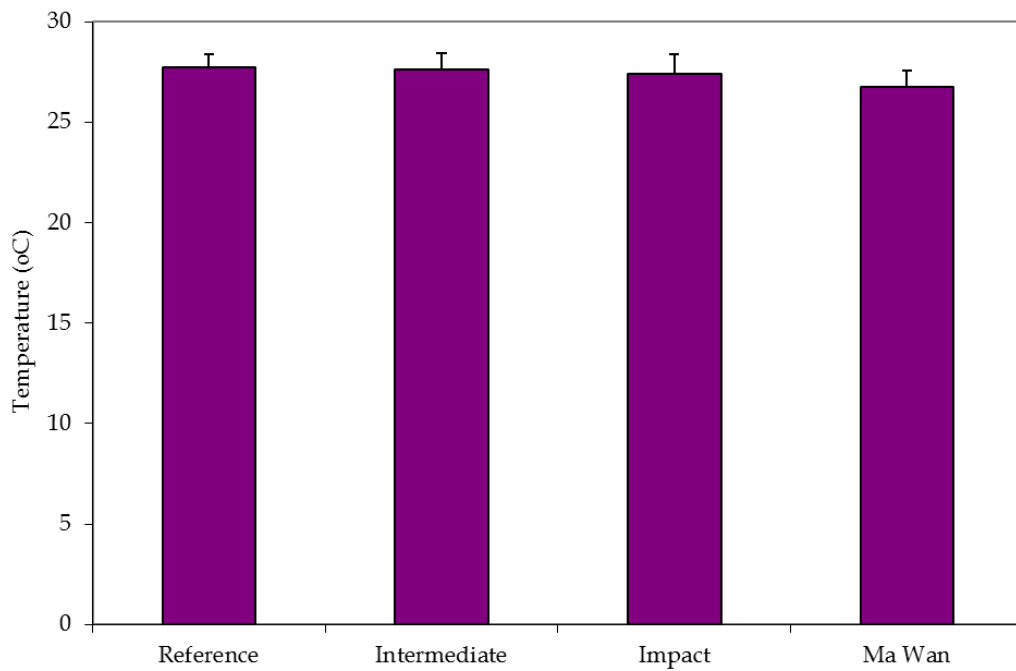


Figure 5: Levels of Temperature (°C; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.

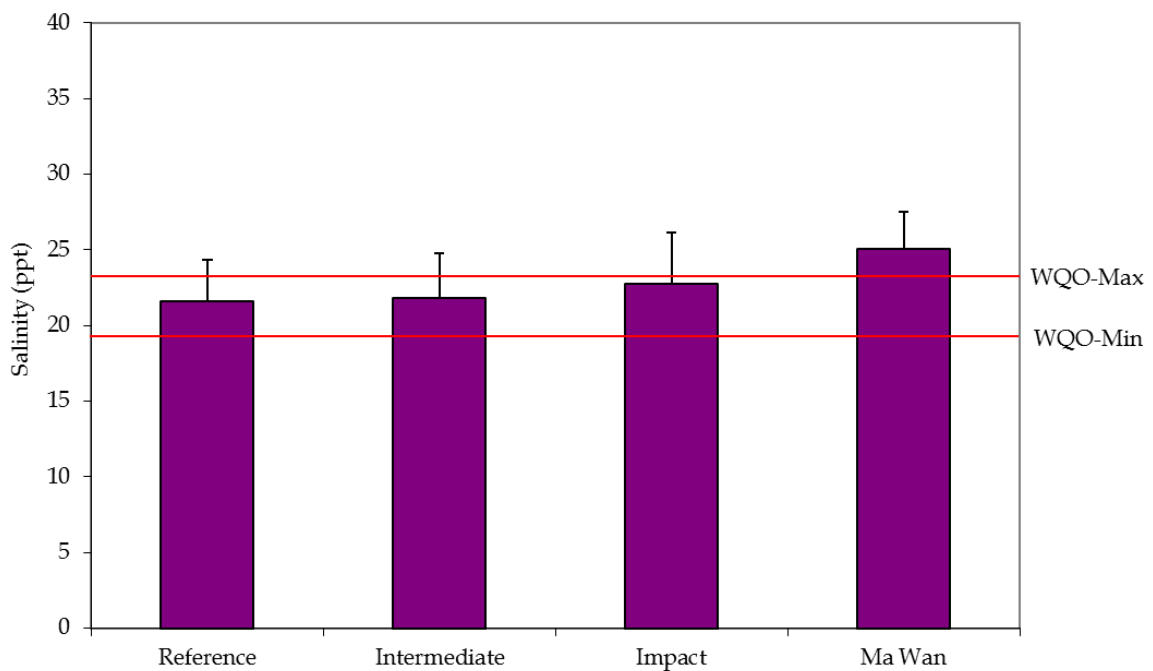


Figure 6: Levels of Salinity (ppt; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.

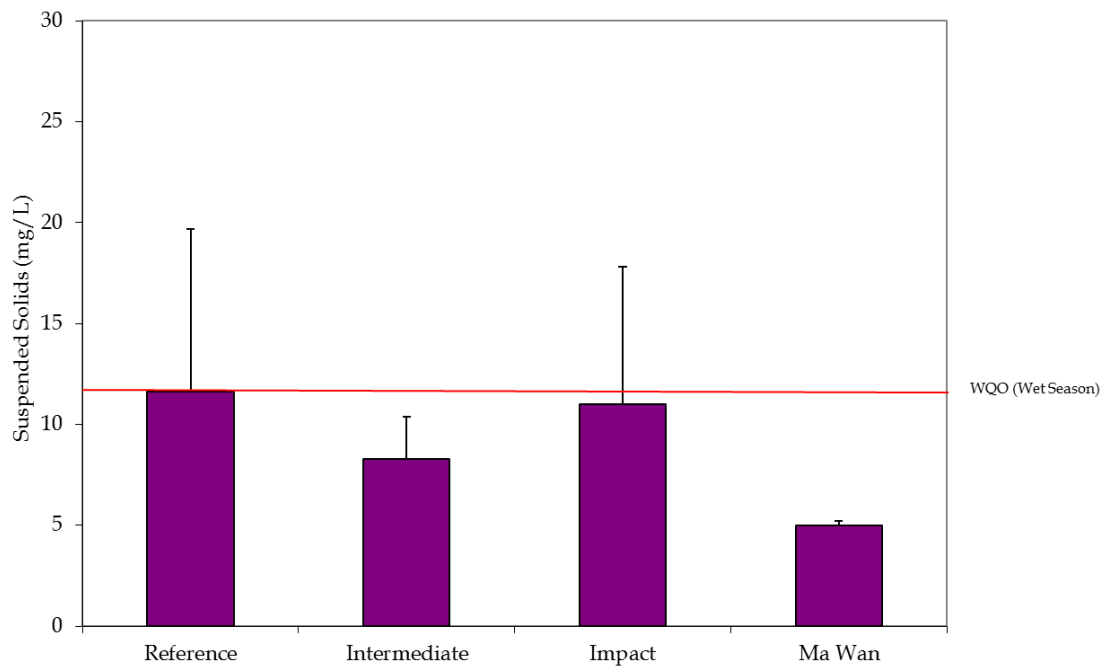


Figure 7: Levels of Suspended Solids (mg/L; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in August 2015.

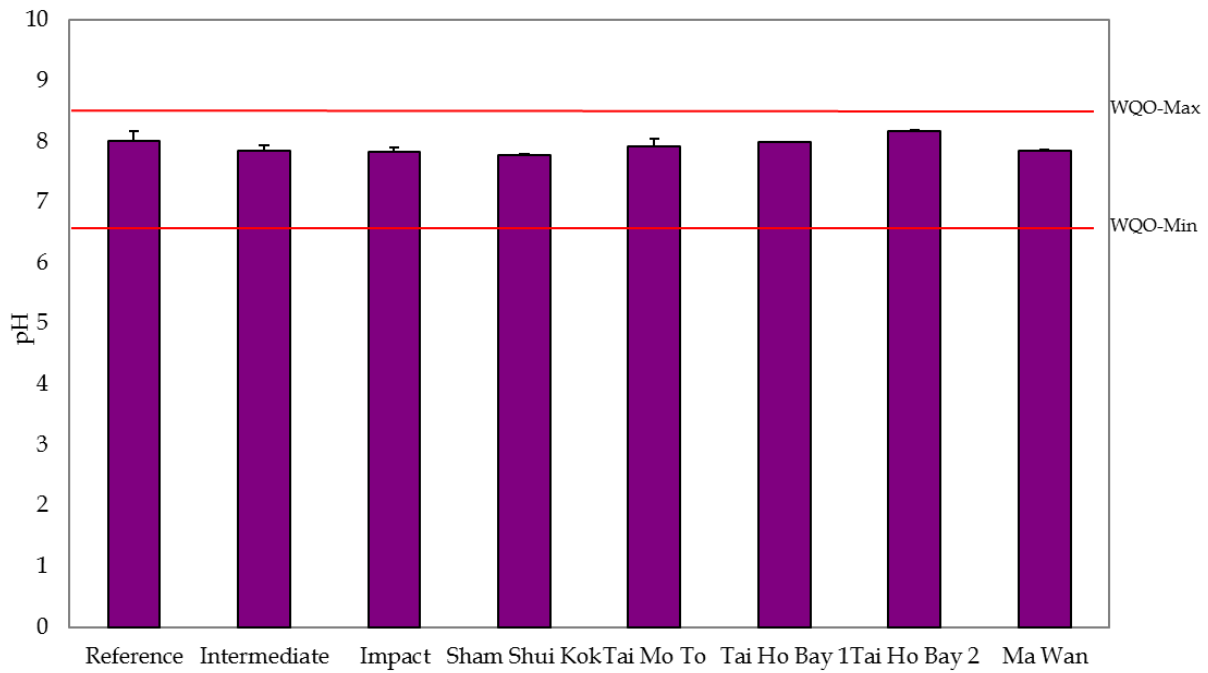


Figure 8: Levels of pH (mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

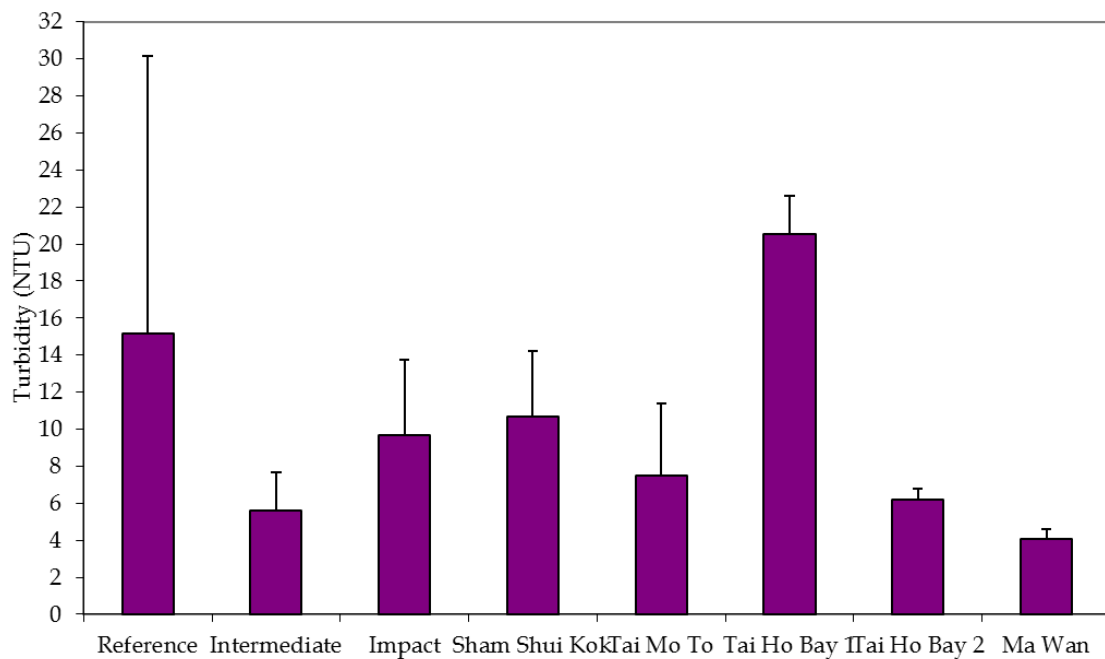


Figure 9: Levels of Turbidity (NTU; mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

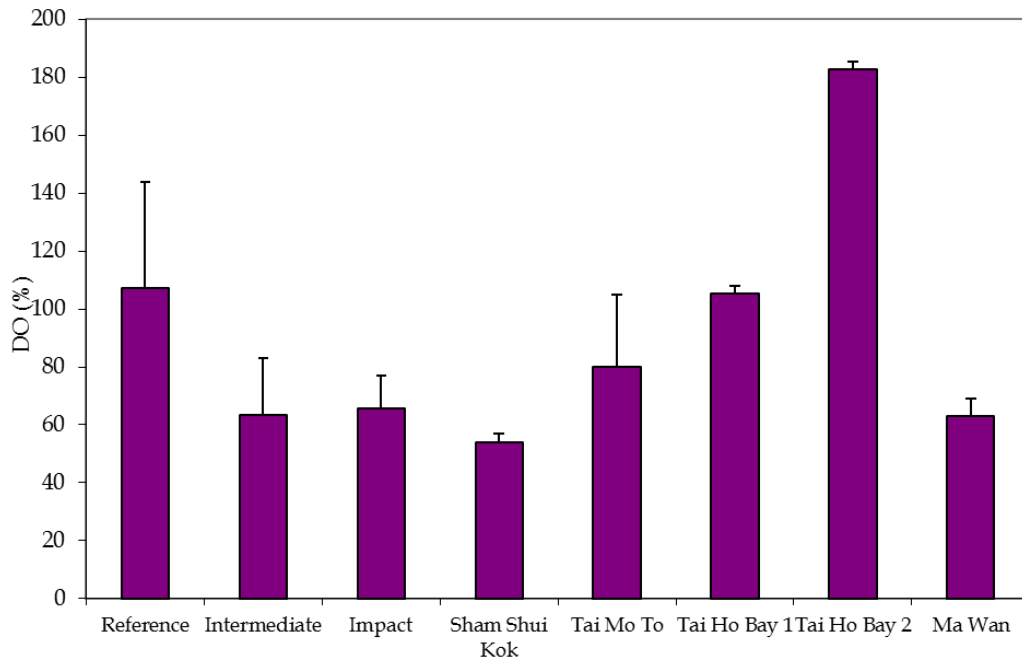


Figure 10: Levels of Dissolved Oxygen (% saturation; mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

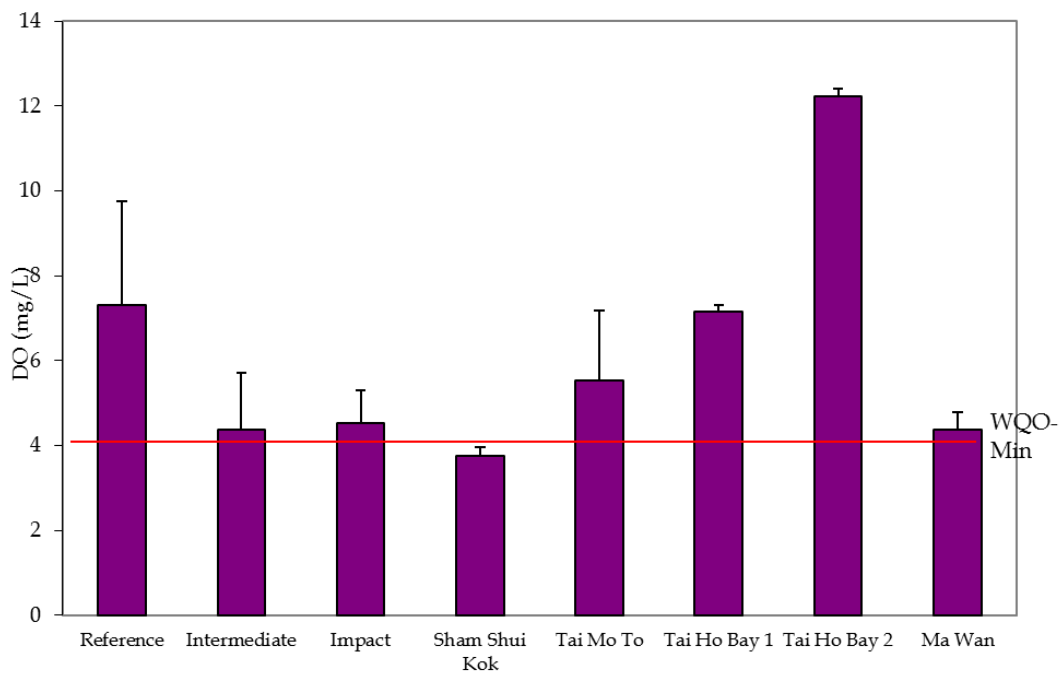


Figure 11: Levels of Dissolved Oxygen (mg/L; mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

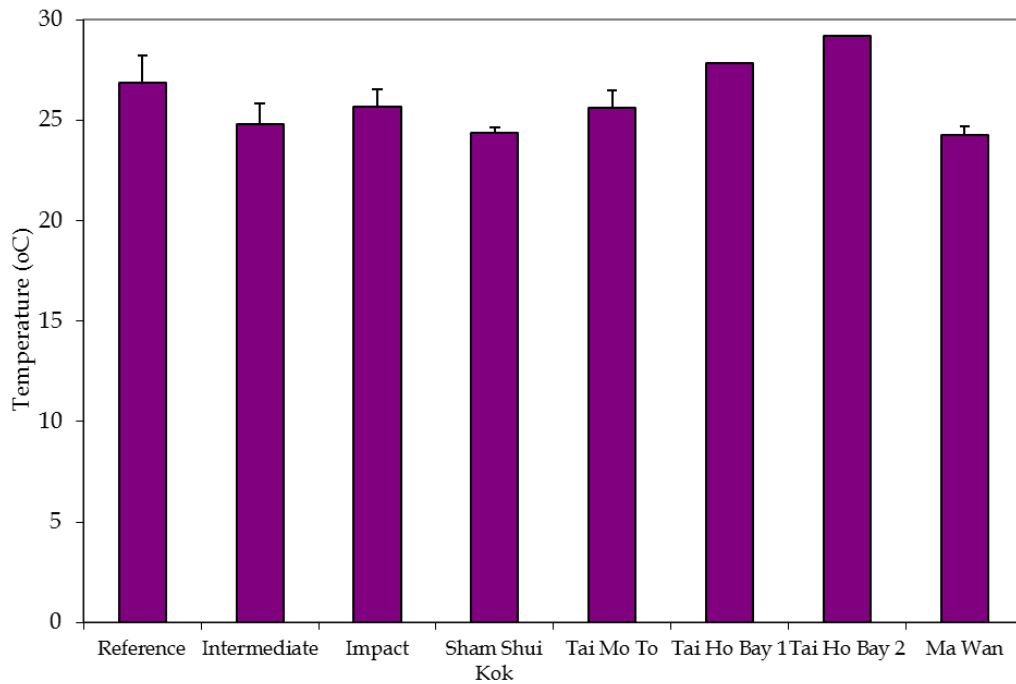


Figure 12: Levels of Temperature ( $^{\circ}\text{C}$ ; mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

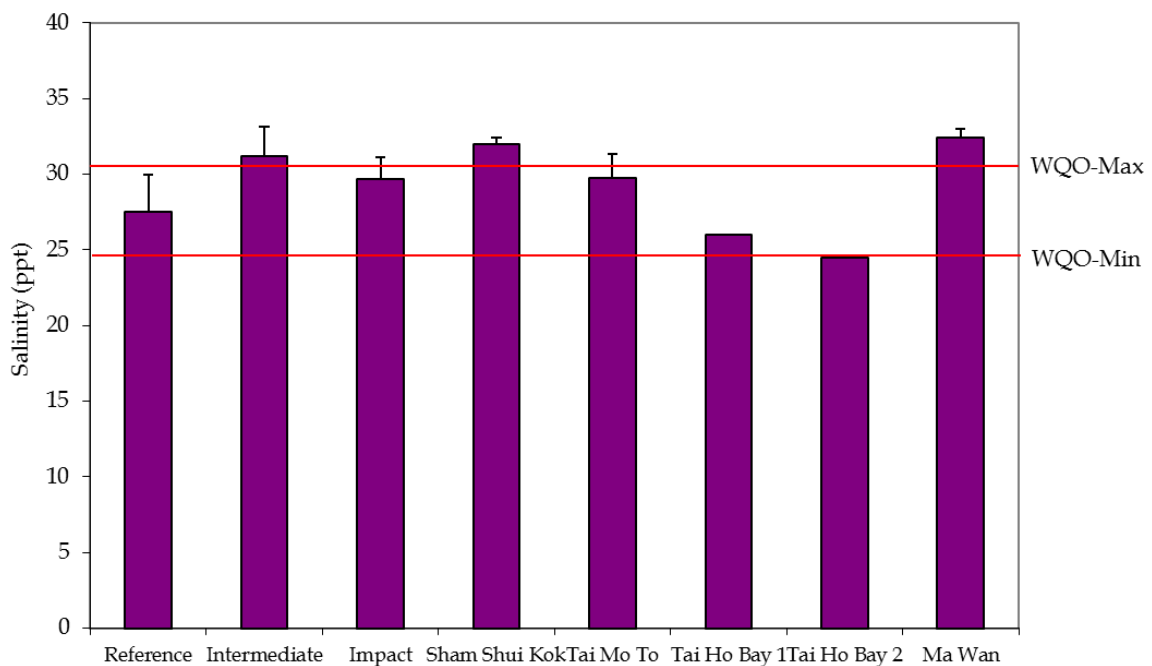


Figure 13: Levels of Salinity (ppt; mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

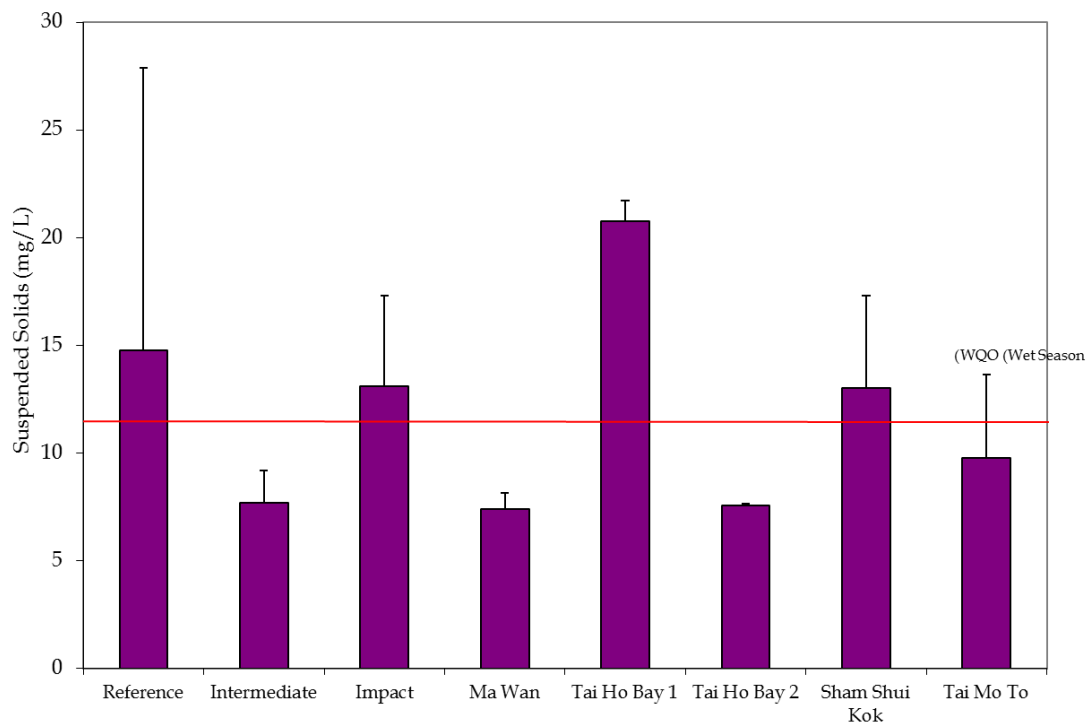


Figure 14 Levels of Suspended Solids (mg/L; mean +SD) recorded from Water Quality Monitoring during Capping of SB CMP 1 in August 2015.

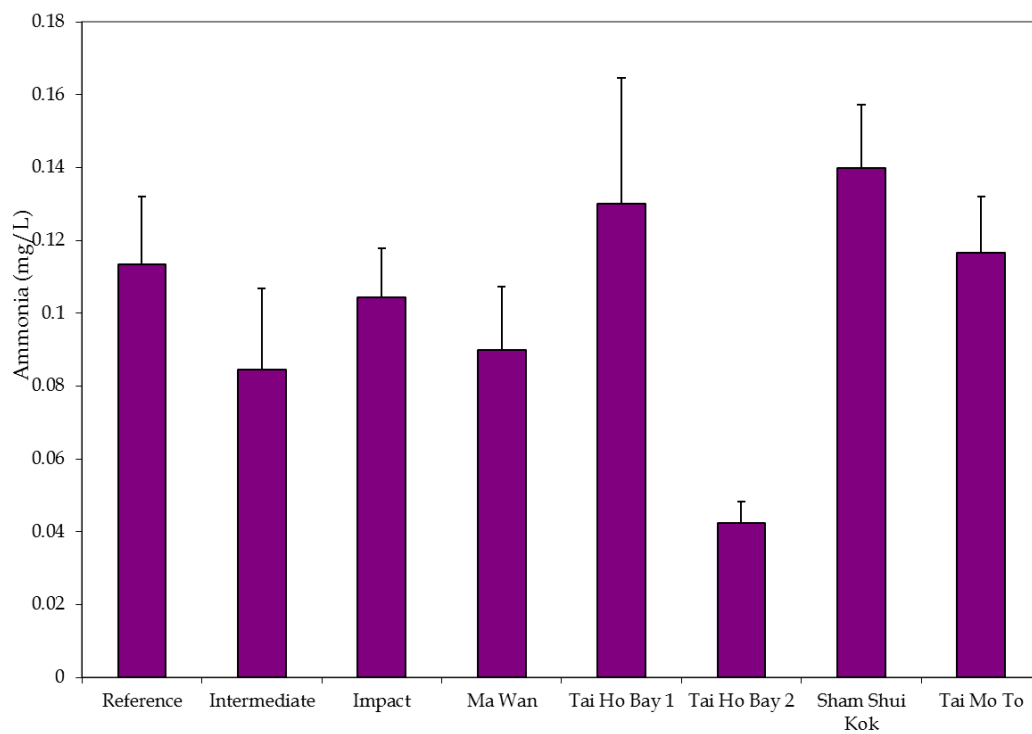


Figure 15 Level of Ammonia (mg/L; mean + SD) recorded from Water Quality Monitoring during Capping for SB CMP 1 in August 2015.

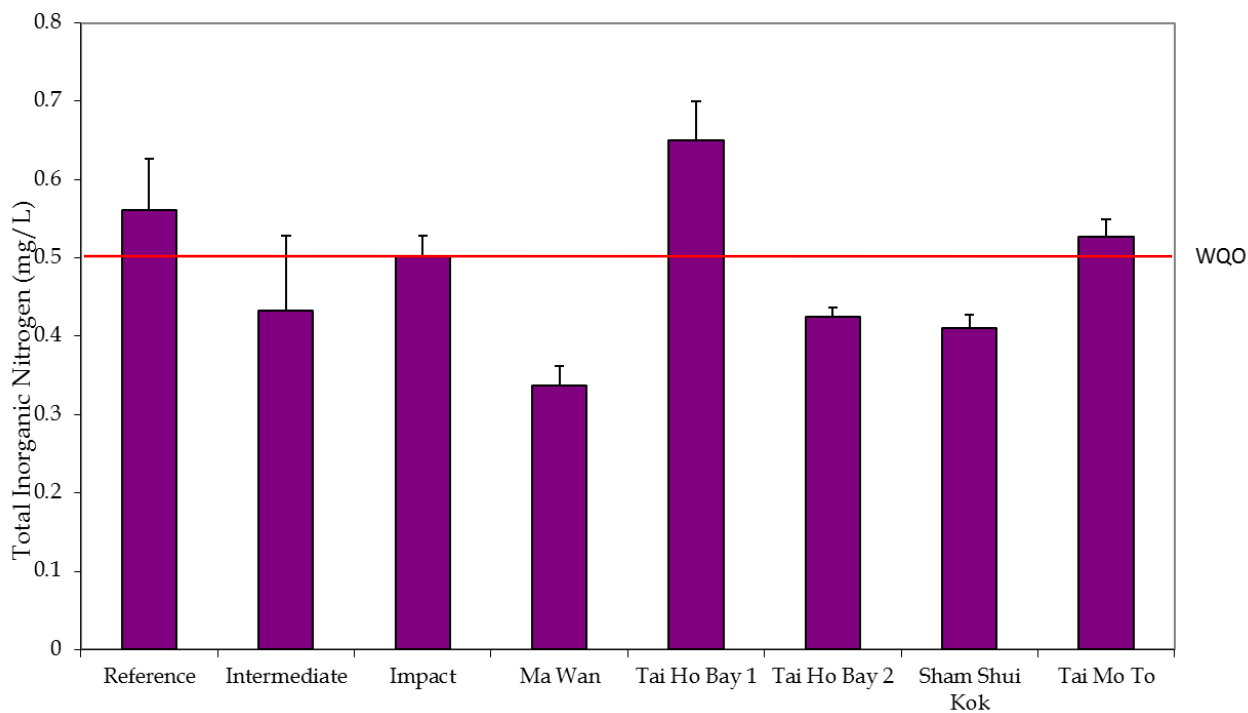


Figure 16: Level of TIN (mg/L; mean + SD) recorded from Water Quality Monitoring during Capping for SB CMP 1 in August 2015

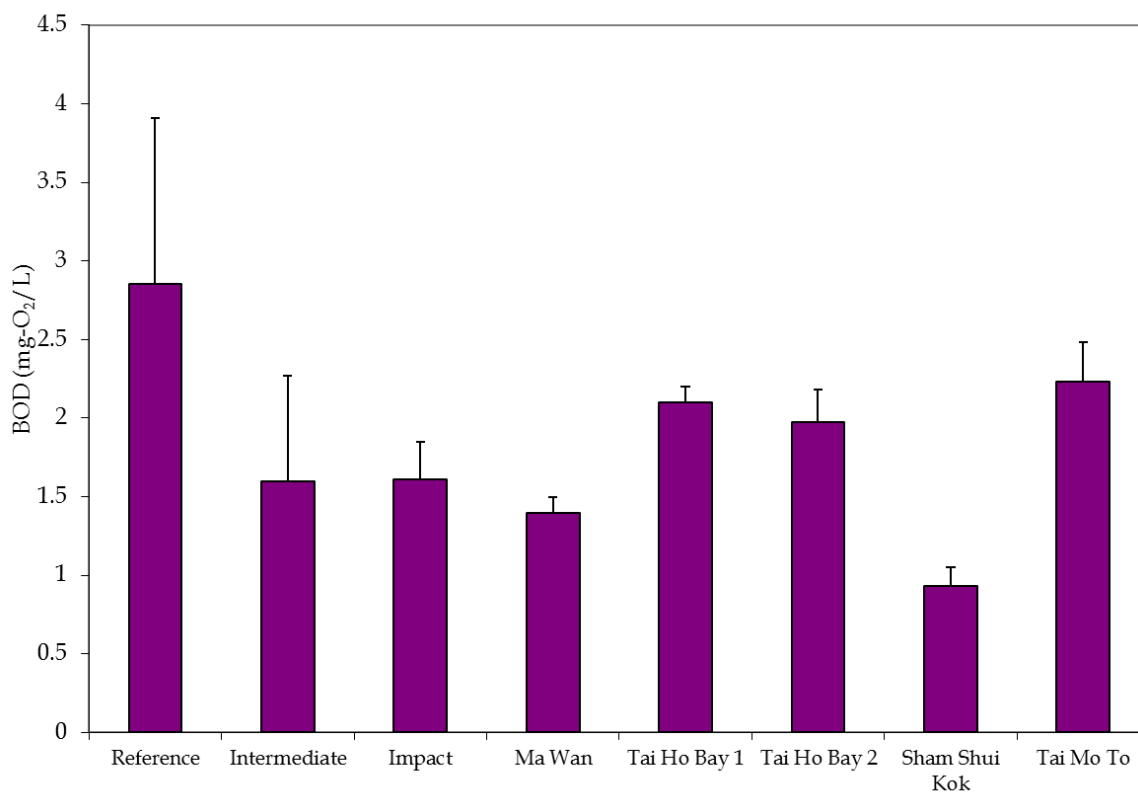


Figure 17: Level of BOD<sub>5</sub> (mg-O<sub>2</sub>/L; mean + SD) recorded from Water Quality Monitoring during Capping for SB CMP 1 in August 2015.

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

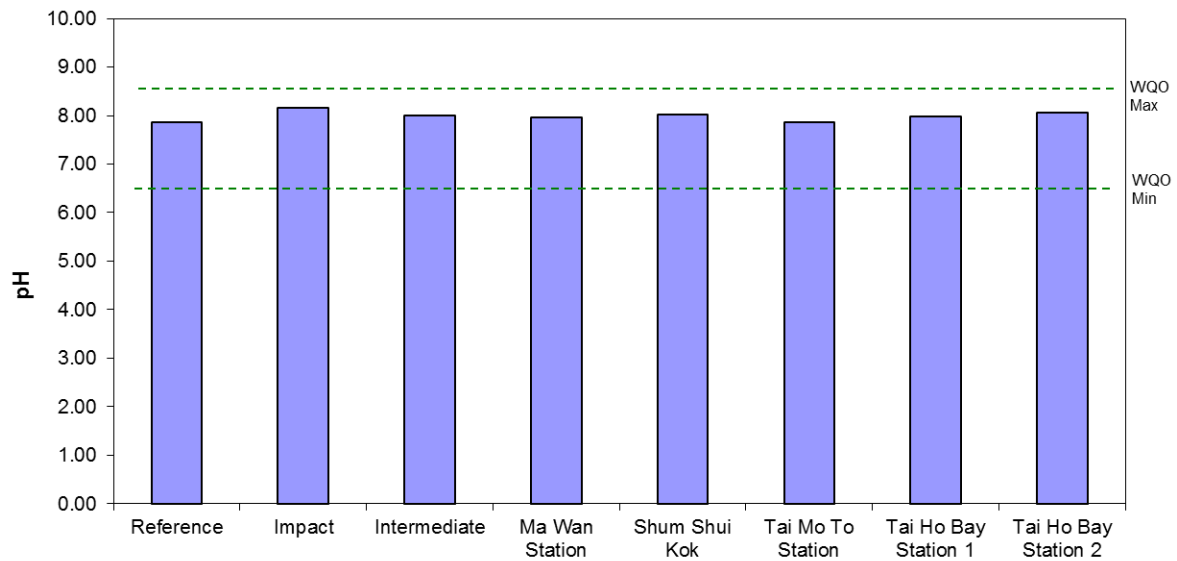


Figure 18: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

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

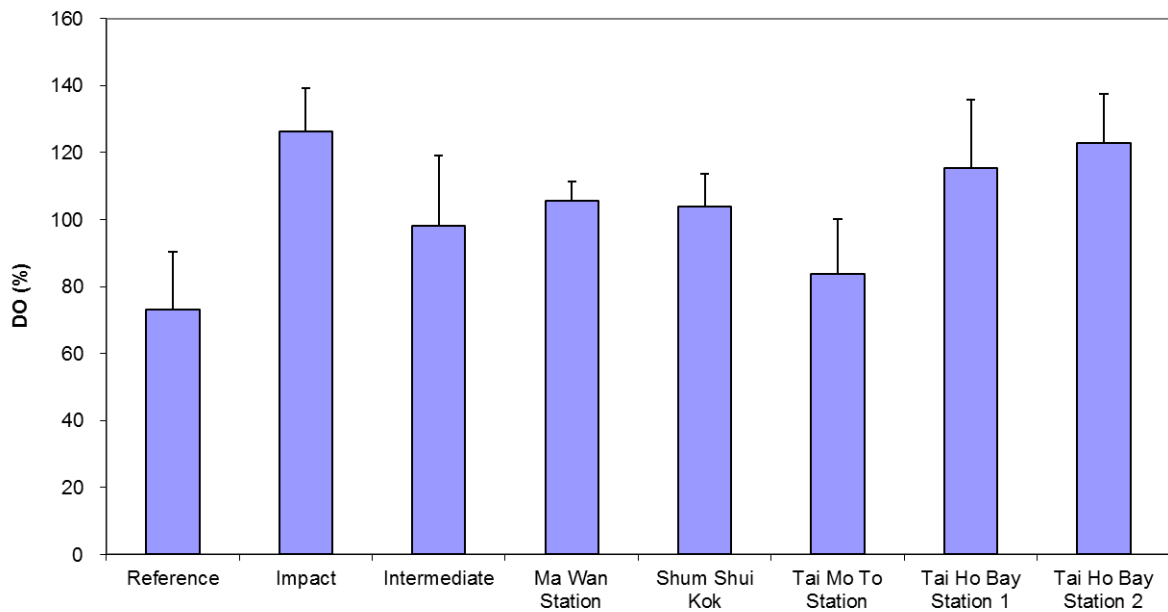


Figure 19: Level of Dissolved Oxygen (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.



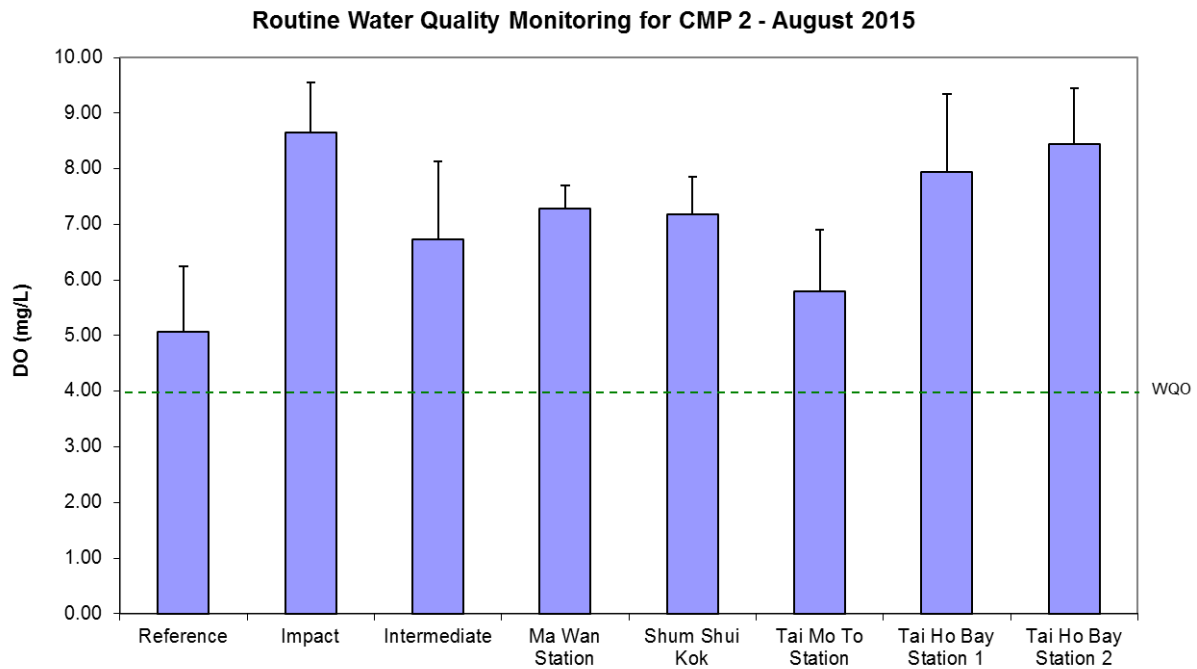


Figure 20: Concentration of Dissolved Oxygen (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

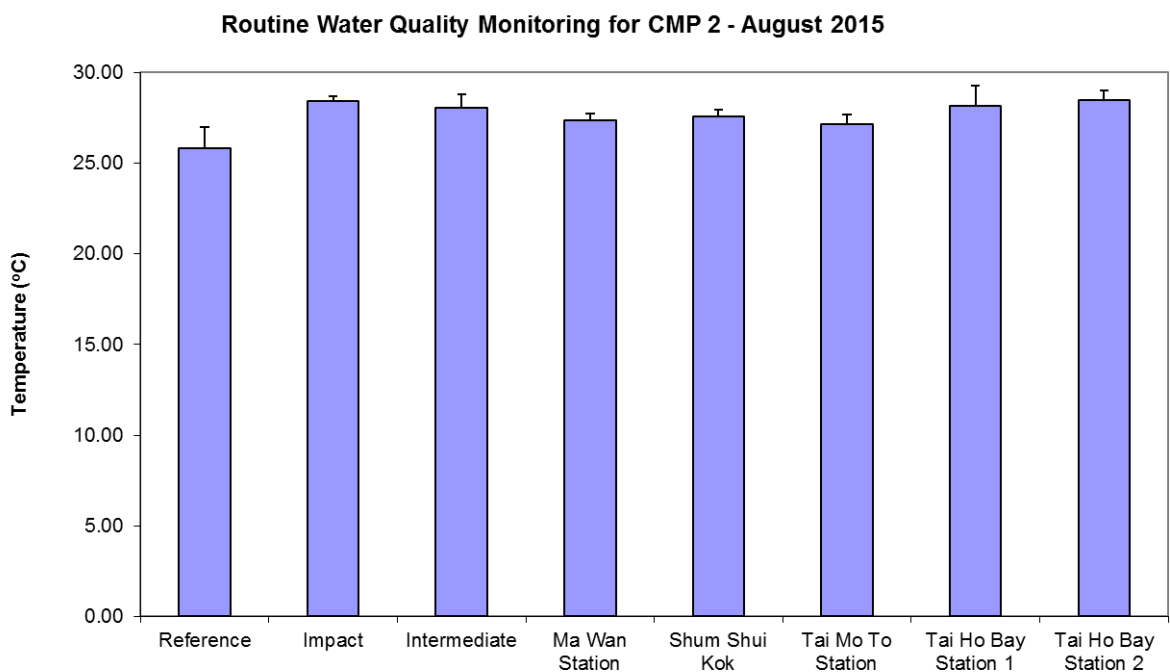


Figure 21: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

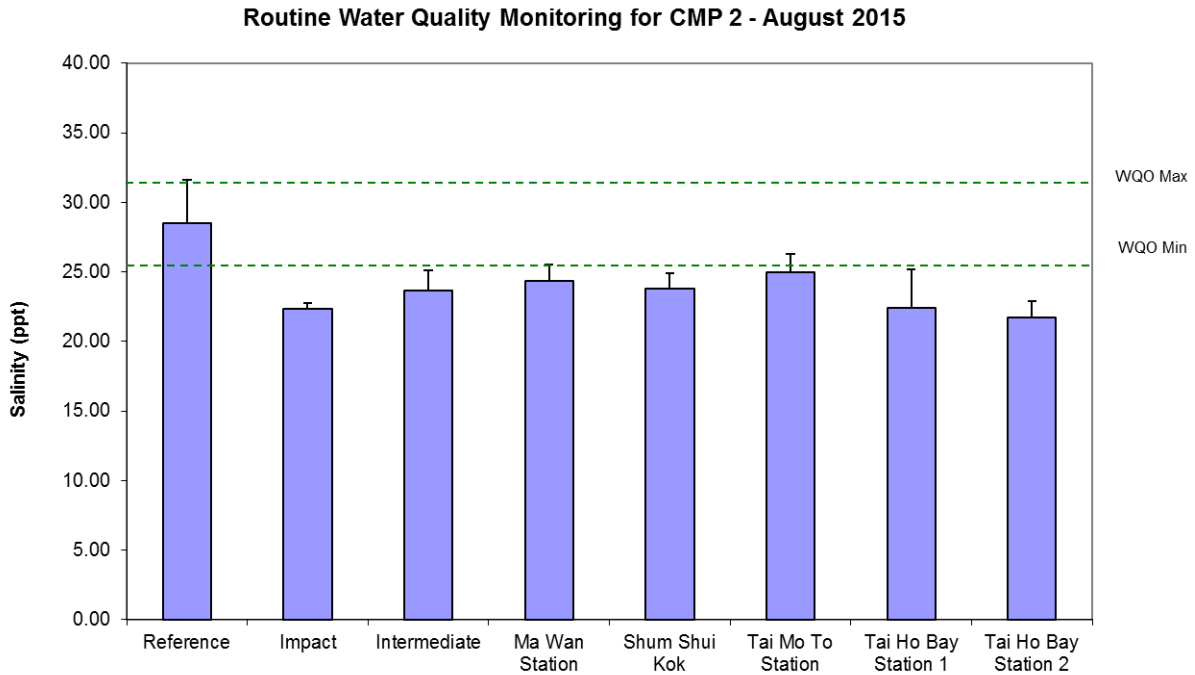


Figure 22: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

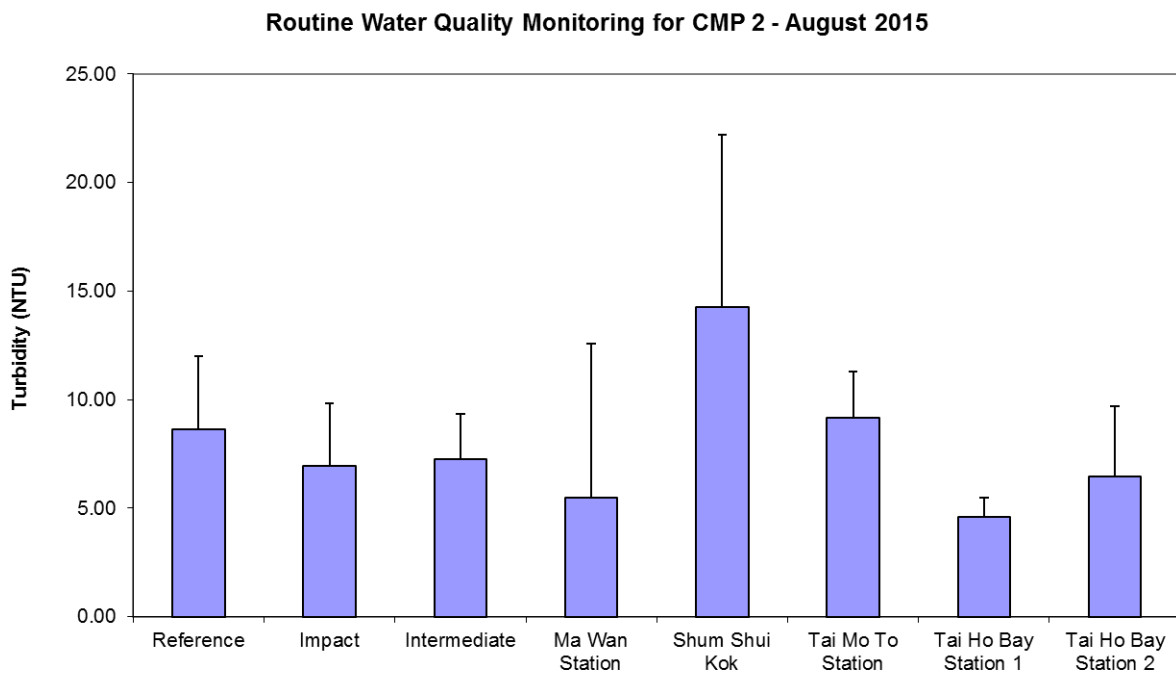


Figure 23: Levels of Turbidity (NTU; ,mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

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

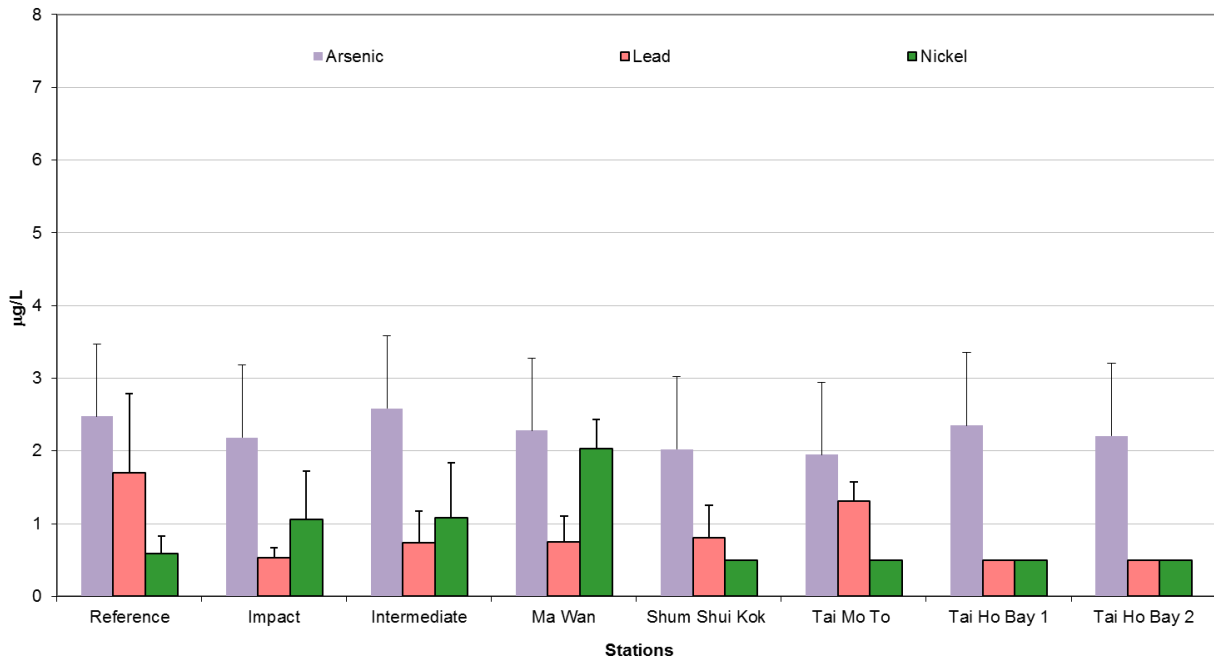


Figure 24: Concentration of Arsenic, Lead, Nickel ( $\mu\text{g/L}$ ; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

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

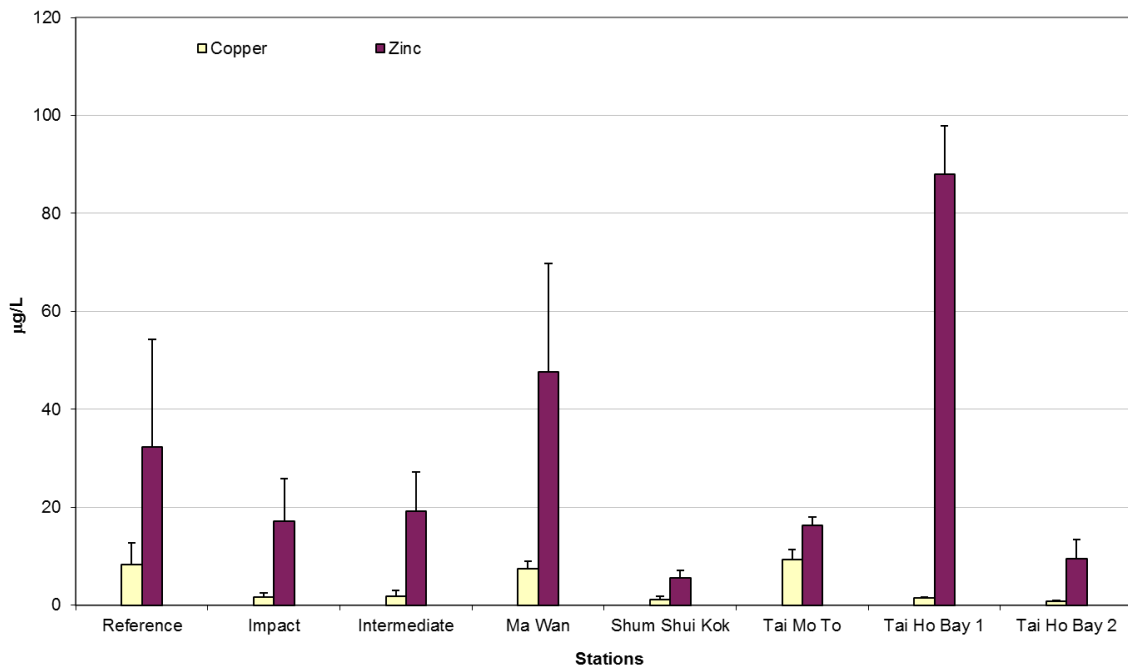


Figure 25: Concentration of Copper and Zinc ( $\mu\text{g/L}$ ; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

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

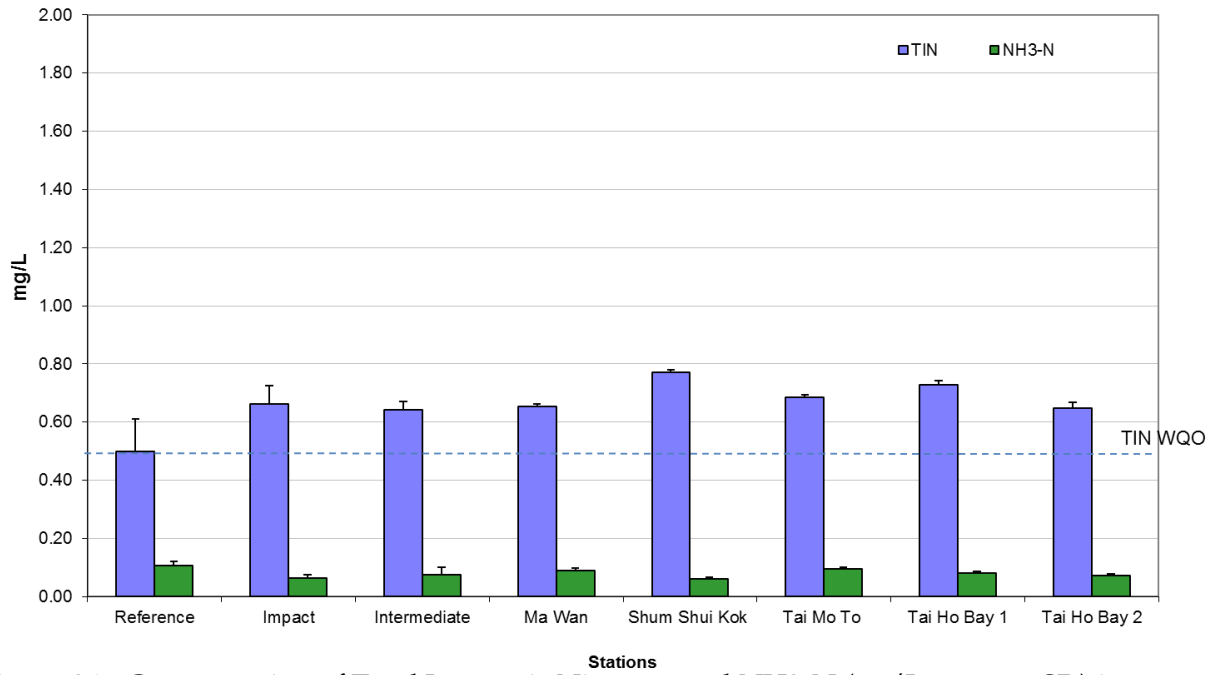


Figure 26: Concentration of Total Inorganic Nitrogen and NH<sub>3</sub>-N ( $\mu\text{g/L}$ ; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

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

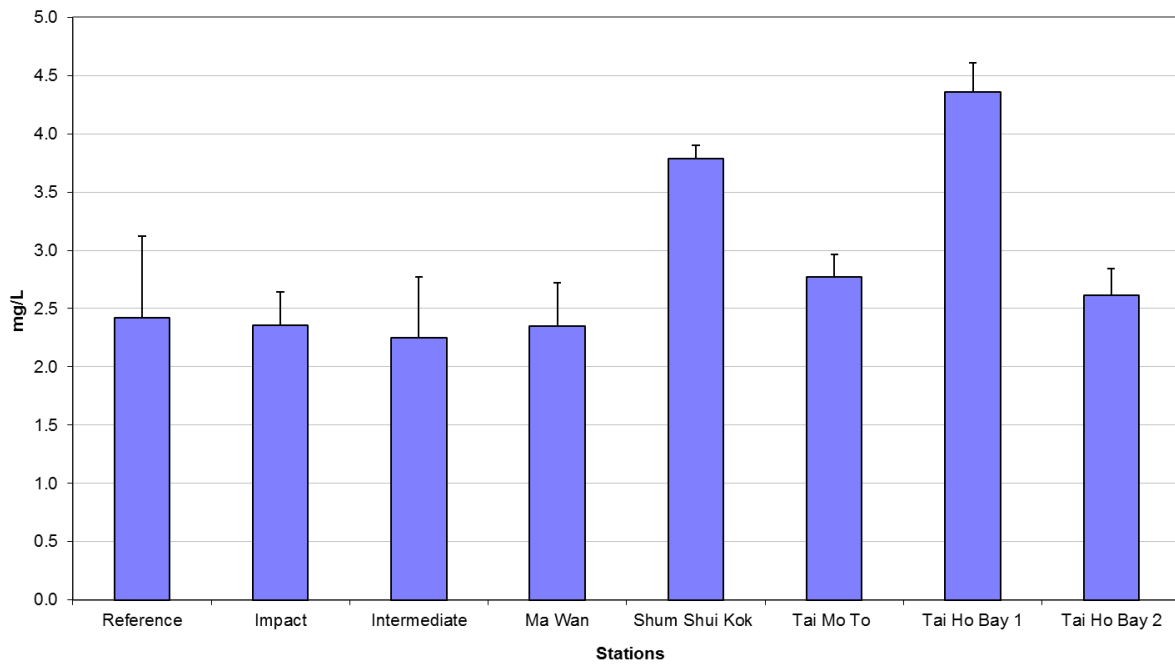


Figure 27: Level of Biochemical Oxygen Demand (BOD<sub>5</sub>) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

Source: H:\Team\EM\GMS Projects\0175086 CEDD EM&A for South Brothers\02 Deliverable\07 CMP Monthly Report\36th (August 2015)

Date: 14/9/2015

**Environmental  
Resources  
Management**



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

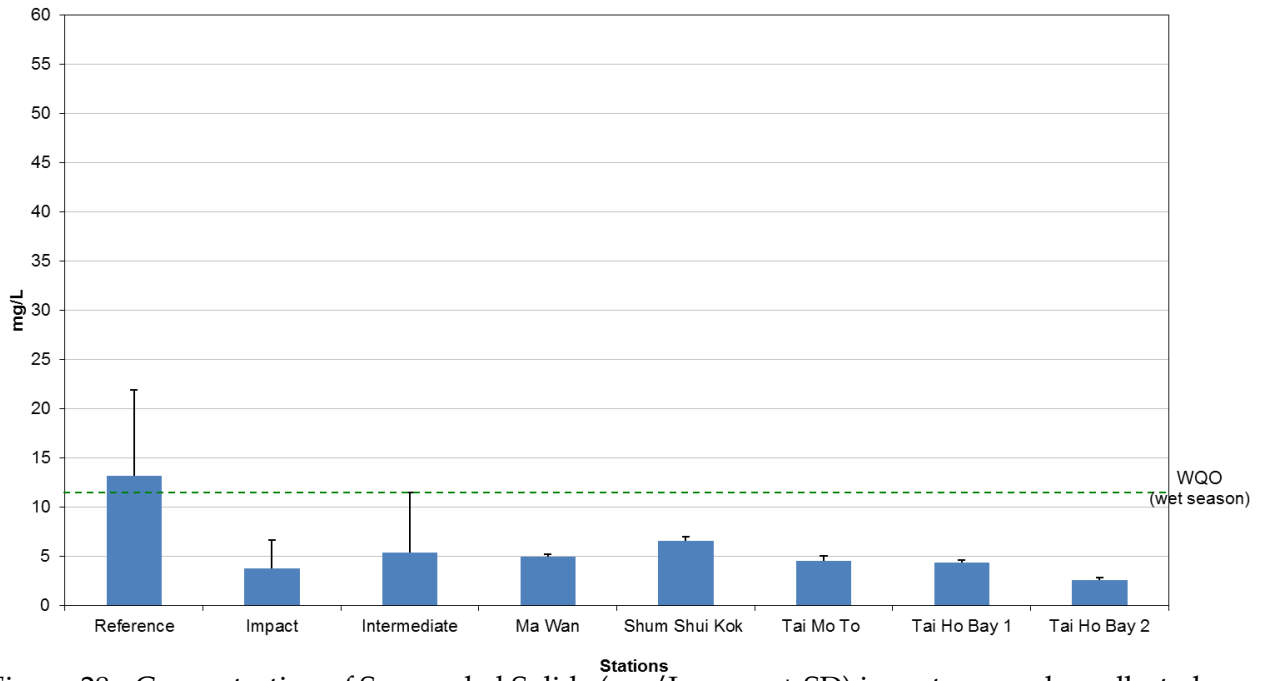


Figure 28: Concentration of Suspended Solids (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at CMP 2 in August 2015.

Annex C

## Water Quality Monitoring Results

**Table C1** *Action and Limit Levels of Water Quality for Dredging, Backfilling and Capping Activities for ESC CMP V*

<b>Parameter</b>	<b>Action Level</b>	<b>Limit Level</b>
Dissolved Oxygen (DO) <sup>(1)</sup>		
Surface and Middle Depth Averaged <sup>(2)</sup>	5%-ile of baseline data for surface and middle layer = 3.76 mg L <sup>-1</sup>	1%-ile of baseline data for surface and middle layer = 3.11 mg L <sup>-1</sup> <sup>(3)</sup>
	and	and
	Significantly less than the reference stations mean DO (at the same tide of the same day)	Significantly less than the reference stations mean DO (at the same tide of the same day)
Bottom	5%-ile of baseline data for bottom layers = 2.96 mg L <sup>-1</sup>	The average of the impact station readings are <2 mg/L
	and	and
	Significantly less than the reference stations mean DO (at the same tide of the same day)	Significantly less than the reference stations mean DO (at the same tide of the same day)
Depth-averaged Suspended Solids (SS) <sup>(4) (5)</sup>	95%-ile of baseline data for depth average = 37.88 mg L <sup>-1</sup>	99%-ile of baseline data for depth average = 61.92mg L <sup>-1</sup>
	and	and
	120% of control station's SS at the same tide of the same day	130% of control station's SS at the same tide of the same day
Depth-averaged Turbidity (Tby) <sup>(4) (5)</sup>	95%-ile of baseline data = 28.14 NTU	99%-ile of baseline data = 38.32 NTU
	and	and
	120% of control station's turbidity at the same tide of the same day	130% of control station's turbidity 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) Given the Action Level for DO for Surface & Middle layers has already been lower than 4 mg L<sup>-1</sup>, it is proposed to set the Limit Level at 3.11 mg L<sup>-1</sup> which is the first percentile of the baseline data.
- (4) "Depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.
- (5) For turbidity and SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.

**Table C2**      *Monitoring Results for Water Quality Monitoring during Capping of ESC on 18 August 2015*

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L <sup>-1</sup> )	pH (mg L <sup>-1</sup> )	SS (mg L <sup>-1</sup> )
August 2015	RFF (Reference)	27.71	21.58	10.63	72.25	5.04	7.69	11.63
	IPF (Impact)	27.41	22.76	7.13	69.62	4.85	7.69	11.01
	INF (Intermediate)	27.64	21.83	7.55	70.32	4.90	7.67	8.27
	Ma Wan	26.76	25.09	4.98	66.52	4.62	7.74	5
	WQO	N/A	19.42-23.74*	N/A	N/A	>4	6.5-8.5	11.6

**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 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 C4** *Monitoring Results for Water Quality Monitoring during Capping of SB CMP 1 on 24 August 2015*

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	pH (mg L <sup>-1</sup> )	SS (mg L <sup>-1</sup> )	NH3 (mg L <sup>-1</sup> )	TIN (mg L <sup>-1</sup> )	BOD <sub>5</sub> (mg L <sup>-1</sup> )	
August 2015	RFF (Reference)	26.87	27.52	15.18	107.28	7.32	8.00	14.78	0.11	0.56	2.86
	IPF (Impact)	25.69	29.69	9.66	65.74	4.53	7.83	13.09	0.10	0.50	1.61
	INF (Intermediate)	24.78	31.21	5.61	63.28	4.39	7.84	7.71	0.08	0.43	1.60
	Ma Wan	24.28	32.39	4.08	62.96	4.38	7.84	7.40	0.09	0.34	1.40
	Sham Shui Kok	24.38	32.00	10.66	53.95	3.76	7.77	13.02	0.14	0.41	0.93
	Tai Mo To	25.61	29.75	7.48	80.15	5.53	7.92	9.77	0.12	0.53	2.23
	Tai Ho Bay 1	27.83	25.97	20.56	105.45	7.16	7.98	20.77	0.13	0.65	2.10
	Tai Ho Bay 2	29.18	24.50	6.20	182.80	12.24	8.16	7.55	0.04	0.43	1.98
WQO	N/A	24.77-30.27*	N/A	N/A	>4	6.5-8.5	11.6	N/A	0.50	N/A	

**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 C5** *In-situ Monitoring Results for Routine Water Quality Monitoring of CMP 2 in August 2015*

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	pH (mg L <sup>-1</sup> )	
August 2015	RFF (Reference)	25.84	28.48	8.61	73.24	5.07	7.86
	IPF (Impact)	28.45	22.34	6.94	126.16	8.65	8.15
	INF (Intermediate)	28.04	23.63	7.26	98.18	6.73	8.00
	Ma Wan	27.36	24.33	5.48	105.49	7.29	7.95
	Sham Shui Kok	27.56	23.76	14.27	103.84	7.17	8.01
	Tai Mo To	27.12	24.99	9.15	83.89	5.80	7.87
	Tai Ho Bay 1	28.17	22.39	4.61	115.32	7.95	7.98
	Tai Ho Bay 2	28.48	21.71	6.47	122.82	8.45	8.06
WQO	N/A	25.63 – 31.33#	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 C6 Laboratory Results for Routine Water Quality Monitoring of CMP 2 in August 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)
August 2015	RFF	2.47	<LOR	<LOR	8.23	1.70	<LOR	<LOR	<LOR	32.24	0.11	0.50	2.42	13.20
	IPF	2.18	<LOR	<LOR	1.71	0.53	<LOR	1.05	<LOR	17.20	0.06	0.66	2.36	3.75
	INF	2.59	<LOR	<LOR	1.84	0.73	<LOR	1.09	<LOR	19.15	0.08	0.64	2.25	5.40
	Ma Wan	2.28	<LOR	<LOR	7.50	0.75	<LOR	2.03	<LOR	47.64	0.09	0.65	2.35	5.00
	Shum Shui Kok	2.02	<LOR	<LOR	1.14	0.80	<LOR	<LOR	<LOR	5.57	0.06	0.77	3.79	6.61
	Tai Mo To	1.95	<LOR	<LOR	9.26	1.31	<LOR	<LOR	<LOR	16.34	0.10	0.69	2.78	4.58
	Tai Ho Bay 1	2.35	<LOR	<LOR	1.48	0.50	<LOR	<LOR	<LOR	88.01	0.08	0.73	4.36	4.36
Tai Ho Bay 2	2.20	<LOR	<LOR	0.73	0.50	<LOR	<LOR	<LOR	9.47	0.07	0.65	2.61	2.61	

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 C7 Water Column Profiling Results for SB CMP 2 in August 2015**

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L <sup>-1</sup> )	pH (mg L <sup>-1</sup> )	Suspended Solids (mg L <sup>-1</sup> )
WCP 1 (Downstream)	29.13	19.89	9.47	160.49	11.03	8.34	10.08
WCP 2 (Upstream)	28.93	18.80	4.52	145.36	10.09	8.29	10.70
WQO (wet season)	N/A	17.41-20.68 <sup>#</sup>	N/A	N/A	>4	6.5-8.5	11.6

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

<sup>#</sup>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

