



**Agreement No. CE 63/2016 (EP)
Environmental Monitoring and Audit
for Disposal Facility to the East of
Sha Chau (2017-2020) – Investigation**

**Monthly EM&A Report for Contaminated
Mud Pits to the East of Sha Chau and the
South of The Brothers – October 2018**

Revision 0

November 2018

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Civil Engineering and Development Department (CEDD)		0400720			
Summary:		Date:			
This document presents the Monthly EM&A Report for <i>Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau and the South of The Brothers.</i>		14 November 2018			
		Approved by:			
					
		Craig A. Reid Partner			
v0	Monthly EM&A Report for ESC CMPs and SB CMPs	CY	RC	CAR	14/11/18
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 at Sha Chau and to the South of The Brothers

Environmental Certification Sheet EP-312/2008/A & EP-427/2011/A

Reference Document/Plan

Document/ Plan to be Certified/ Verified:	Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau and the South of The Brothers - October 2018
Date of Report:	14 November 2018
Date prepared by ET:	14 November 2018
Date received by IA:	14 November 2018

Reference EP Condition

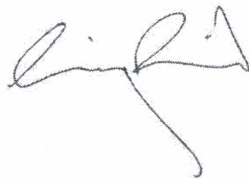
Environmental Permit Condition:

Condition 3.4 of EP-312/2008/A and Condition 4.4 of EP-427/2011/A:
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-312/2008/A and EP-427/2011/A

Craig Reid,
Environmental Team Leader:



Date: 14/11/2018

IA Verification

I hereby verify that the above referenced document/~~plan~~ complies with the above referenced condition of EP-312/2008/A and EP-427/2011/A

Dr Wang Wen Xiong,
Independent Auditor:



Date: 14/11/2018

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Agreement No. CE 63/2016 (EP)
Environmental Monitoring and Audit
for Disposal Facility to the East of Sha Chau (2017-2020) - Investigation

MONTHLY EM&A REPORT FOR OCTOBER 2018

1.1 BACKGROUND

1.1.1 The Civil Engineering and Development Department (CEDD) is managing a number of marine disposal facilities in Hong Kong waters, including the Contaminated Mud Pits (CMPs) to the South of The Brothers (SB) and to the East of Sha Chau (ESC) for the disposal of contaminated sediment, and open-sea disposal grounds located to the South of Cheung Chau (SCC), East of Tung Lung Chau (ETLC) and East of Ninepins (ENP) for the disposal of uncontaminated sediment. Two Environmental Permits (EPs), EP-312/2008/A and EP-427/2011/A, were issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 and 23 December 2011 for the Dredging, Management and Capping of Contaminated Sediment Disposal Facilities at ESC CMP V and SB CMPs, respectively.

1.1.2 Under the requirements of the two EPs for ESC CMP V and SB CMPs, EM&A programmes which encompass water and sediment chemistry, fisheries assessment, tissue and whole body analysis, sediment toxicity and benthic recolonisation studies as set out in the EM&A Manuals are required to be implemented. EM&A programmes have been continuously carried out during the operation of the CMPs at ESC and SB. A review of the collection and analysis of such environmental data from the monitoring programme demonstrated that there had not been any adverse environmental impacts resulting from disposal activities ⁽¹⁾ ⁽²⁾. The current programme will assess the impacts resulting from dredging, disposal and capping operations of CMP V as well as capping operations of SB CMPs.

1.1.3 The present EM&A programme under *Agreement No. CE 63/2016 (EP)* covers the dredging, disposal and capping operations of the ESC CMP V as well as the capping operations of the SB CMPs (see *Annex A* for the EM&A programme). Detailed works schedule for ESC CMP V and SB CMPs is shown in *Figure 1.1*. In October 2018, the following work was being undertaken:

- Disposal of contaminated mud at ESC CMP Vd.

(1) ERM (2013) Final Report. Submitted under Agreement No. CE 4/2009 (EP) Environmental Monitoring and Audit for Contaminated Mud Pit at East Sha Chau. For CEDD.

(2) ERM (2017) Final Report. Submitted under 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). For CEDD.

Figure 1.1 Works Schedule for ESC CMP V and SB CMPs

Pit	Operation	2017					2018					2019					2020					2021															
		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	M
ESC CMP V	Dredging																																				
	Disposal																																				
	Capping																																				
SB CMP 2	Dredging																																				
	Disposal																																				
	Capping																																				

1.2 REPORTING PERIOD

1.2.1 This *Monthly EM&A Report for October 2018* covers the EM&A activities for the reporting month of October 2018.

1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

1.3.1 The following monitoring activities were undertaken for ESC CMP V in October 2018:

- *Water Column Profiling of ESC CMP Vd;*
- *Routine Water Quality Monitoring of ESC CMPs; and*
- *Pit Specific Sediment Chemistry of ESC CMP Vd.*

1.3.2 No monitoring activities were scheduled to be undertaken for SB CMP in October 2018.

1.4 DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS

1.4.1 No outstanding sampling remained for October 2018.

1.4.2 The following laboratory analyses were still in progress during the preparation of this monthly report and hence is not presented in this monthly report:

- Laboratory analyses of sediment samples collected for *Pit Specific Sediment Chemistry of ESC CMP Vd* in October 2018.

1.5 BRIEF DISCUSSION OF THE MONITORING RESULTS FOR ESC CMP V

1.5.1 Brief discussion of the monitoring results of the following activities for ESC CMP V is presented in this *Monthly EM&A Report for October 2018*:

- *Water Column Profiling of ESC CMP Vd* in October 2018;
- *Routine Water Quality Monitoring of ESC CMPs* in October 2018;

- *Pit Specific Sediment Chemistry of ESC CMP Vd* in September 2018; and
- *Sediment Chemistry after a Major Storm of ESC CMP V* in September 2018.

1.5.2 **Water Column Profiling of ESC CMP Vd – October 2018**

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 3 October 2018. The monitoring results 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 2007 - 2016 from stations in the Northwestern Water Control Zone (WCZ), where the ESC CMPs are located ⁽¹⁾. For Salinity, the averaged value obtained from the Reference (Upstream) station 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 B1 of Annex B* for details).

In-situ Measurements

1.5.4 Analyses of results for October 2018 indicated that levels of Salinity and pH complied with the WQOs at both Downstream and Upstream stations and levels of DO were higher than the WQO (*Table B2 of Annex B*). Levels of DO and Turbidity at all stations complied with the Action and Limit Levels (*Tables B1 and B2 of Annex B*).

Laboratory Measurements for Suspended Solids (SS)

1.5.5 Analyses of results for October 2018 indicated that the SS levels complied with the WQO and the Action and Limit Level at both Downstream and Upstream stations (*Tables B1 and B2 of Annex B*).

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

1.5.6 **Routine Water Quality Monitoring of ESC CMP V – October 2018**

1.5.7 *Routine Water Quality Monitoring of ESC CMP V* was undertaken on 2 October 2018. The monitoring results have been assessed for compliance with the WQOs (see *Section 1.5.3* for details). The monitoring results are shown in *Tables B3 and B4 of Annex B* and *Figures 1 - 10 of Annex C*. A total of ten (10) monitoring stations were sampled in October 2018 as shown in *Figure 1.2*.

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

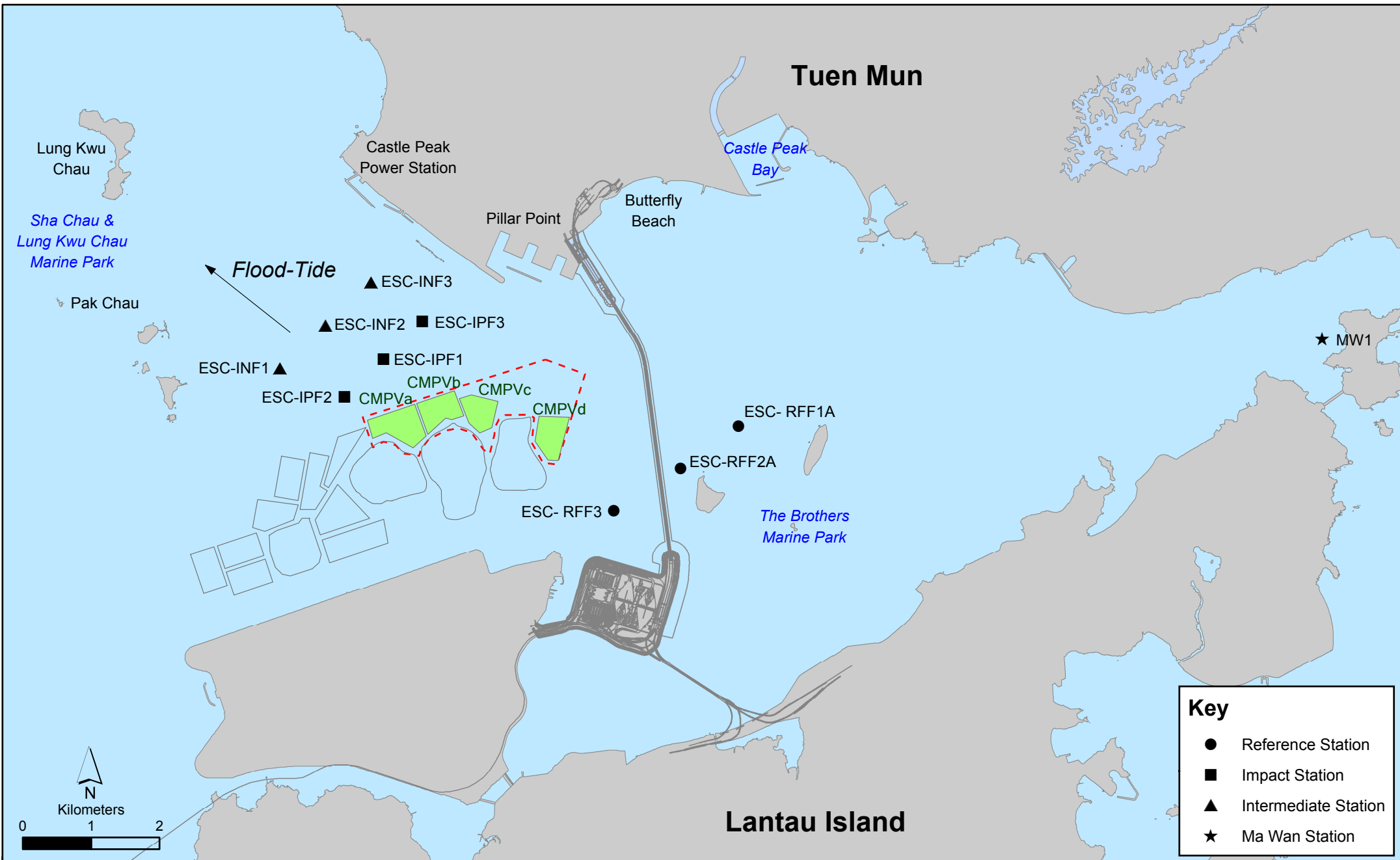


Figure 1.2

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

In-situ Measurements

- 1.5.8 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 1 - 6 of Annex C*. Analyses of results for October 2018 indicated that the levels of pH, Salinity and DO complied with the WQOs at all stations (Impact, Intermediate, Reference and Ma Wan stations) in October 2018.
- 1.5.9 The levels of DO and Turbidity also complied with the Action and Limit Levels at all stations (*Table B3 of Annex B; Figures 3 and 6 of Annex C*).
- 1.5.10 Overall, *in-situ* measurement results of the *Routine Water Quality Monitoring* indicated that the disposal operation at ESC CMP Vd did not appear to cause any unacceptable impacts in water quality in October 2018.

Laboratory Measurements

- 1.5.11 Laboratory analysis of October 2018 results indicated that concentrations of Cadmium, Chromium, Silver and Mercury were below their limit of reporting at all stations. Arsenic, Nickel, Lead, Copper and Zinc were detected in October 2018 samples at most stations and the concentrations of these metals and metalloids were similar amongst the stations (*Table B4 of Annex B; Figure 7 of Annex C*).
- 1.5.12 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at most stations in October 2018 were higher than the WQO, except at Ma Wan station (0.5 mg/L) (*Table B4 of Annex B; Figure 8 of Annex C*). It should be noted that due to the effect of the Pearl River, the North Western WCZ has historically experienced higher levels of TIN⁽¹⁾. Therefore, the exceedances of TIN WQO at these stations are unlikely to be caused by the disposal operation at ESC CMP Vd. Concentrations of Ammonia Nitrogen (NH₃-N) and 5-day Biochemical Oxygen Demand (BOD₅) were generally similar amongst the stations in October 2018 (*Table B4 of Annex B; Figure 8 and 9 of Annex C*).
- 1.5.13 Analyses of results for October 2018 indicated that the SS levels at most stations were lower than the WQO (10.8 mg/L for wet season), except the exceedance of SS recorded at the Impact stations. However, the SS levels complied with the Action and Limit Levels at all stations (*Tables B1 and B4 of Annex B; Figure 10 of Annex C*).
- 1.5.14 Overall, results of the *Routine Water Quality Monitoring* indicated that the disposal operation at ESC CMP Vd did not appear to cause any unacceptable deterioration in water quality in October 2018. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

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

- 1.5.15 ***Pit Specific Sediment Chemistry of ESC CMP Vd – September 2018***
- 1.5.16 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vd* are shown in *Figure 1.3*. A total of six (6) monitoring stations were sampled on 6 September 2018.
- 1.5.17 The concentrations of all inorganic contaminants were lower than the Lower Chemical Exceedance Level (LCEL) at all stations in September 2018 (*Figures 11 and 12 of Annex C*).
- 1.5.18 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were generally similar in September 2018, except higher concentrations of TOC were recorded at the Active-Pit station ESC-NPAA (*Figure 13 of Annex C*). The concentration of Tributyltin (TBT) was generally similar amongst stations in September 2018 (*Figure 14 of Annex C*). Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs), Total Polychlorinated Biphenyls (PCBs), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) concentrations were below the limit of reporting at most stations in September 2018, except High Molecular Weight PAHs were detected at Pit-Edge station ESC-NEAA (*Figure 15 of Annex C*).
- 1.5.19 Overall, there is no evidence indicating any unacceptable environmental impacts to sediment quality as a result of the contaminated mud disposal operations at ESC CMP Vd in September 2018. Statistical analysis will be undertaken and presented in the corresponding quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.
- 1.5.20 ***Sediment Chemistry after a Major Storm of ESC CMP V – September 2018***
- 1.5.21 Sampling for Sediment Chemistry after a Major Storm Event was conducted at nine (9) monitoring stations (*Figure 1.4*) on 20 September 2018 after the visit of tropical cyclone Mangkhut, which led to the issue of No. 10 Hurricane Signal on 16 September 2018. The track of Mangkhut are shown in *Figures 1.5*.

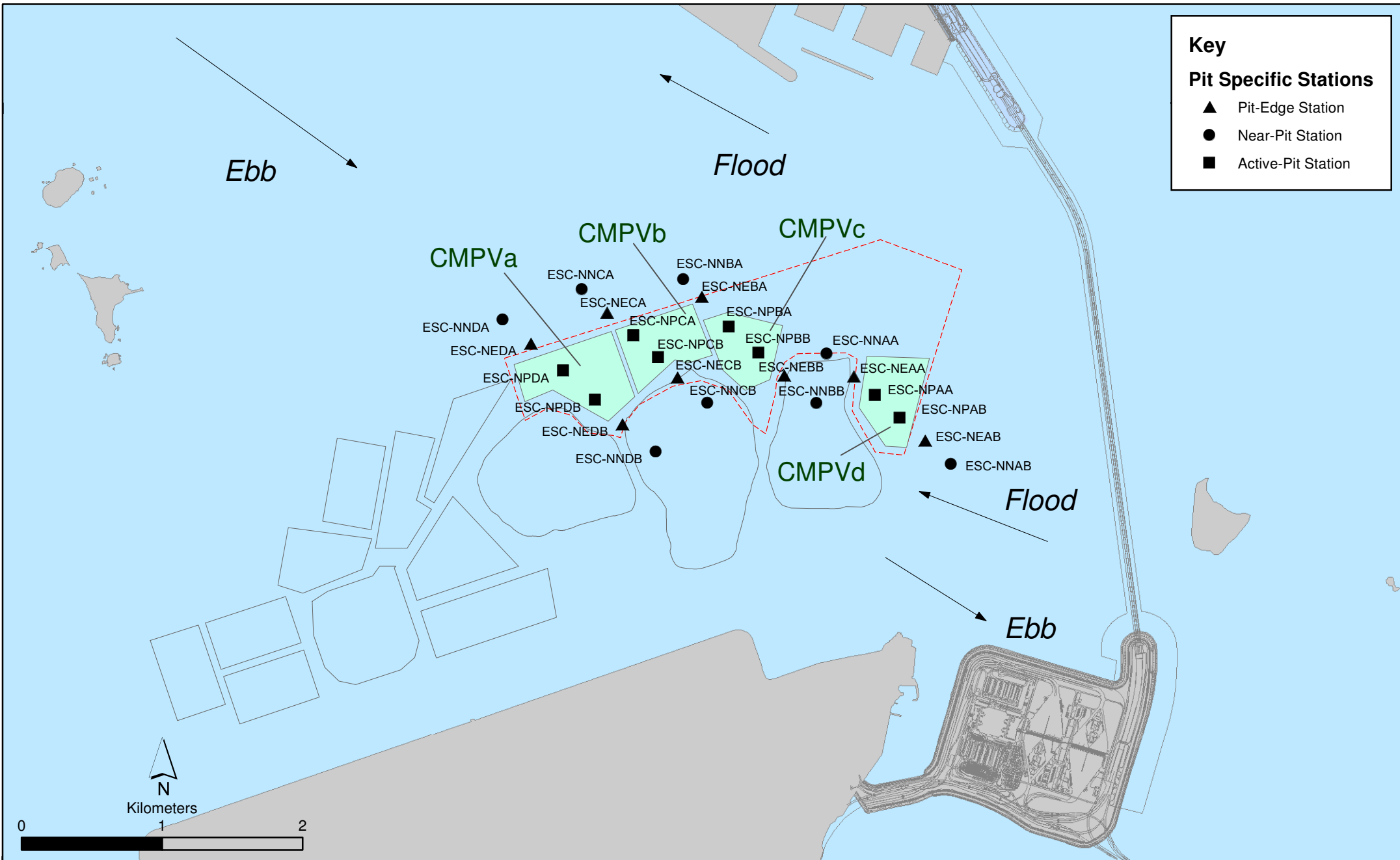


Figure 1.3

Pit Specific Sediment Quality Monitoring Stations for CMPV

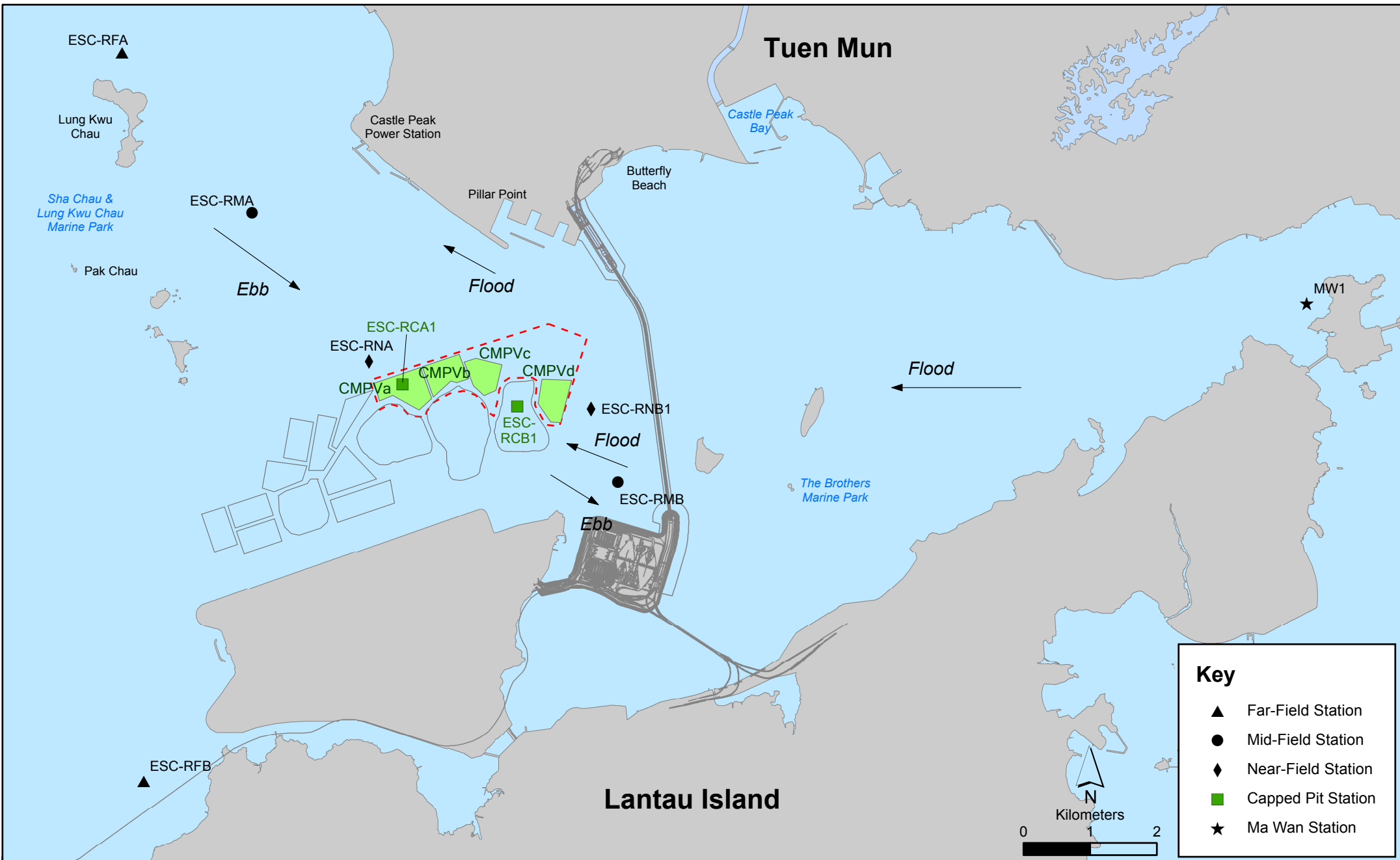


Figure 1.4

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

Figure 1.5 Track of Tropical Cyclone Mangkhut (Source: Hong Kong Observatory)



- 1.5.22 Analyses of results for the *Sediment Chemistry after a Major Storm* indicated that the concentrations of most inorganic contaminants were below the LCEL, except Arsenic at Capped Pit station ESC-RCB and Mid-field stations ESC-RMA and ESC-RMB in September 2018 (*Figures 16 and 17 of Annex C*).
- 1.5.23 Whilst the average concentration of Arsenic in the Earth's crust is generally ~2mg/kg, significantly higher Arsenic concentrations (median = 14 mg/kg) have been recorded in Hong Kong's onshore sediments ⁽¹⁾. It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments ⁽²⁾, and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the slight exceedances of LCEL for Arsenic are unlikely to be caused by the disposal of contaminated mud at ESC CMPs but rather as a result of naturally occurring deposits.
- 1.5.24 Overall, there appeared to be no evidence showing the failure of ESC CMP V in retaining disposed mud or causing contamination of sediments after the major storm event in September 2018.

1.6 *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

1.6.1 The following monitoring activities will be conducted in the next monthly period of November 2018 for ESC CMP V (see *Annex A* for the sampling schedule):

- *Water Column Profiling of ESC CMP Vd;*
- *Routine Water Quality Monitoring of ESC CMPs; and*
- *Pit Specific Sediment Chemistry of ESC CMP Vd.*

1.6.2 No monitoring activities are scheduled to be undertaken in the next monthly period of November 2018 for SB CMPs.

1.7 *STUDY PROGRAMME*

1.7.1 A summary of the Study Programme is presented in *Annex D*.

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

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

Annex A

Sampling Schedule

Pit Specific Sediment Chemistry	Code	Frequency	2017				2018				2019				2020				2021																
			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
Active-Pit	ESC-NPAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
	ESC-NPAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
Pit-Edge	ESC-NEAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
	ESC-NEAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
Near-Pit	ESC-NNAAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
	ESC-NNAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
Cumulative Impact Sediment Chemistry			A	M	J	J	A	S	O	N	D	J	F	2018				2019				2020				2021									
Near-field Stations	ESC-RNA	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
	ESC-RNB1	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
Mid-field Stations	ESC-RMA	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
	ESC-RMB	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
Capped Pit Stations	ESC-RCA1	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
	ESC-RCB1	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
Far-Field Stations	ESC-RFA	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
	ESC-RFB	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
Ma Wan Station	MW1	4 times per year			12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
					12	12			12	12			12	12			12	12			12	12			12	12			12	12			12	12	
Sediment Toxicity Tests			A	M	J	J	A	S	O	N	D	J	F	2018				2019				2020				2021									
Near-Pit Stations	ESC-TDA	2 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
	ESC-TDB1	2 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
Reference Stations	ESC-TRA	2 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
	ESC-TRB	2 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
Ma Wan Station	MW1	2 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
					5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
Tissue/Whole Body Sampling			A	M	J	J	A	S	O	N	D	J	F	2018				2019				2020				2021									
Near-Pit Stations	ESC-INA	2 times per year			+	+			+	+			+	+			+	+			+	+			+	+			+	+			+	+	
	ESC-INB	2 times per year			+	+			+	+			+	+			+	+			+	+			+	+			+	+			+	+	
Reference North	TNA	2 times per year			+	+			+	+			+	+			+	+			+	+			+	+			+	+			+	+	
	TNB	2 times per year			+	+			+	+			+	+			+	+			+	+			+	+			+	+			+	+	
Reference South	TSA	2 times per year			+	+			+	+			+	+			+	+			+	+			+	+			+	+			+	+	
	TSB	2 times per year			+	+			+	+			+	+			+	+			+	+			+	+			+	+			+	+	
Demersal Trawling			A	M	J	J	A	S	O	N	D	J	F	2018				2019				2020				2021									
Near Pit Stations	ESC-INA	4 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
	ESC-INB	4 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
Reference North	TNA	4 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
	TNB	4 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
Reference South	TSA	4 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
	TSB	4 times per year			5	5			5	5			5	5			5	5			5	5			5	5			5	5			5	5	
Capping			A	M	J	J	A	S	O	N	D	J	F	2018				2019				2020				2021									
Ebb Tide																																			
Impact Station Downcurrent	ESC-IP1A	4 times per year																																	
	ESC-IP2A	4 times per year																																	
	ESC-IP3	4 times per year																																	
	ESC-IP4	4 times per year																																	
	ESC-IP5	4 times per year																																	
Intermediate Station Downcurrent	ESC-INE1A	4 times per year																																	
	ESC-INE2A	4 times per year																																	
	ESC-INE3A	4 times per year																																	
	ESC-INE4A	4 times per year																																	
	ESC-INE5A	4 times per year																																	
Reference Station Upcurrent	ESC-RFE1	4 times per year																																	
	ESC-RFE2	4 times per year																																	
	ESC-RFE3	4 times per year																																	
	ESC-RFE4	4 times per year																																	
	ESC-RFE5	4 times per year																																	
Ma Wan Station	MW1	4 times per year																																	
Flood Tide																																			
Impact Station Downcurrent	ESC-IPF1	4 times per year																																	
	ESC-IPF2	4 times per year																																	
	ESC-IPF3	4 times per year																																	
Intermediate Station Downcurrent	ESC-INF1	4 times per year																																	
	ESC-INF2	4 times per year																																	
	ESC-INF3	4 times per year																																	
Reference Station Upcurrent	ESC-RFF1A	4 times per year																																	
	ESC-RFF2A	4 times per year																																	

Annex A2 - Environmental Monitoring and Audit Sampling Schedule for South of The Brothers (April 2017 - December 2018)

			2017												2018											
			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D			
Capping Water Quality Monitoring																										
<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																								
Benthic Recolonisation Studies																										
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:
 The number shown in each cell represents the numbers of replicates per monitoring station
 Capping works are planned to be conducted between May and December 2017.

Annex B

Water Quality Monitoring Results

Table B1 *Action and Limit Levels of Water Quality for Dredging, Disposal and Capping Activities at ESC CMP V*

Parameter	Action Level	Limit Level
Dissolved Oxygen (DO) ⁽¹⁾	<u>Surface and Mid-depth</u> ⁽²⁾ 5%-ile of baseline data for surface and middle layer = 3.76 mg L⁻¹	<u>Surface and Mid-depth</u> ⁽²⁾ 1%-ile of baseline data for surface and middle layer = 3.11 mg L⁻¹ ⁽³⁾
	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)
	<u>Bottom</u> 5%-ile of baseline data for bottom layers = 2.96 mg L⁻¹	<u>Bottom</u> The average of the impact station readings are <2 mg/L⁻¹
	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) ^{(4) (5)}	95%-ile of baseline data for depth average = 37.88 mg L⁻¹	99%-ile of baseline data for depth average = 61.92 mg L⁻¹
	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) ^{(4) (5)}	95%-ile of baseline data = 28.14 NTU	99%-ile of baseline data = 38.32 NTU
	and	and
	120% of control station's Tby at the same tide of the same day	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) Given the Action Level for DO for Surface & Middle layers has already been lower than 4 mg L⁻¹, it is proposed to set the Limit Level at 3.11 mg L⁻¹ 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 B2 *Water Column Profiling Results for ESC CMP Vd in October 2018*

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L ⁻¹)	pH	Suspended Solids (mg L ⁻¹)
WCP 1 (Downstream)	27.70	27.57	13.62	75.11	5.07	7.94	8.60
WCP 2 (Upstream)	27.66	27.96	8.64	74.47	5.02	7.93	8.23
WQO (Wet Season)	N/A	25.17-30.76 [#]	N/A	N/A	>4	6.5-8.5	10.8

Note:

[#]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 B3 *In-situ Monitoring Results for Routine Water Quality Monitoring of ESC CMPs in October 2018*

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L ⁻¹)	pH (mg L ⁻¹)
October 2018	RFF (Reference)	27.60	27.16	7.47	79.66	5.40	8.02
	IPF (Impact)	27.64	27.00	7.91	80.15	5.43	7.99
	INF (Intermediate)	27.65	26.66	6.80	79.39	5.39	7.95
	Ma Wan	27.47	28.77	5.30	73.52	4.95	7.99
	WQO	N/A	24.45 – 29.88 [#]	N/A	N/A	>4	6.5-8.5

Notes:

[#]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 B4 *Laboratory Results for Routine Water Quality Monitoring of ESC CMPs in October 2018*

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 ₃ (mg/L)	TIN (mg/L)	BOD ₅ (mg/L)	SS (mg/L)
October 2018	RFE	1.86	<0.50	<1.0	8.95	1.33	<0.50	1.32	<1.0	17.25	0.05	0.56	1.37	9.12
	IPE	1.68	<0.50	<1.0	7.58	1.18	<0.50	1.73	<1.0	12.39	0.03	0.54	1.10	11.54
	INE	1.74	<0.50	<1.0	8.53	2.04	<0.50	1.73	<1.0	12.90	0.05	0.56	1.57	8.74
	Ma Wan	1.71	<0.50	<1.0	6.06	<1.0	<0.50	1.28	<1.0	17.34	0.07	0.40	1.29	8.23

WQO of TIN: 0.5 mg/L

Wet Season WQO of SS : 10.8 mg/L

Notes:

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

Cell shaded grey indicate value exceeding the WQO.

Annex C

Graphical Presentations

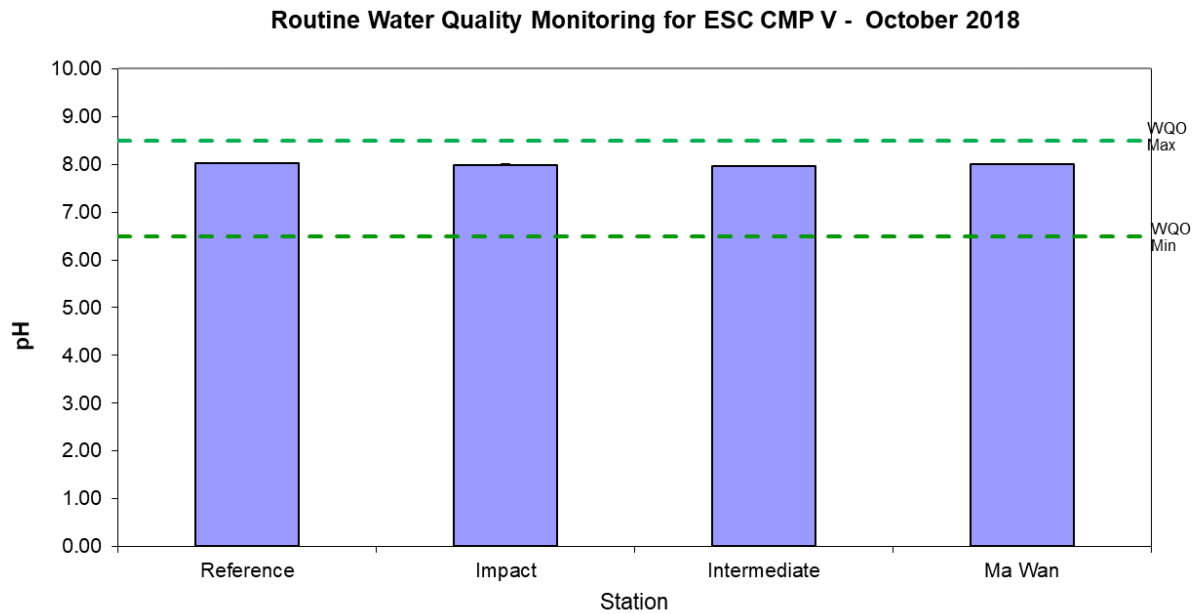


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

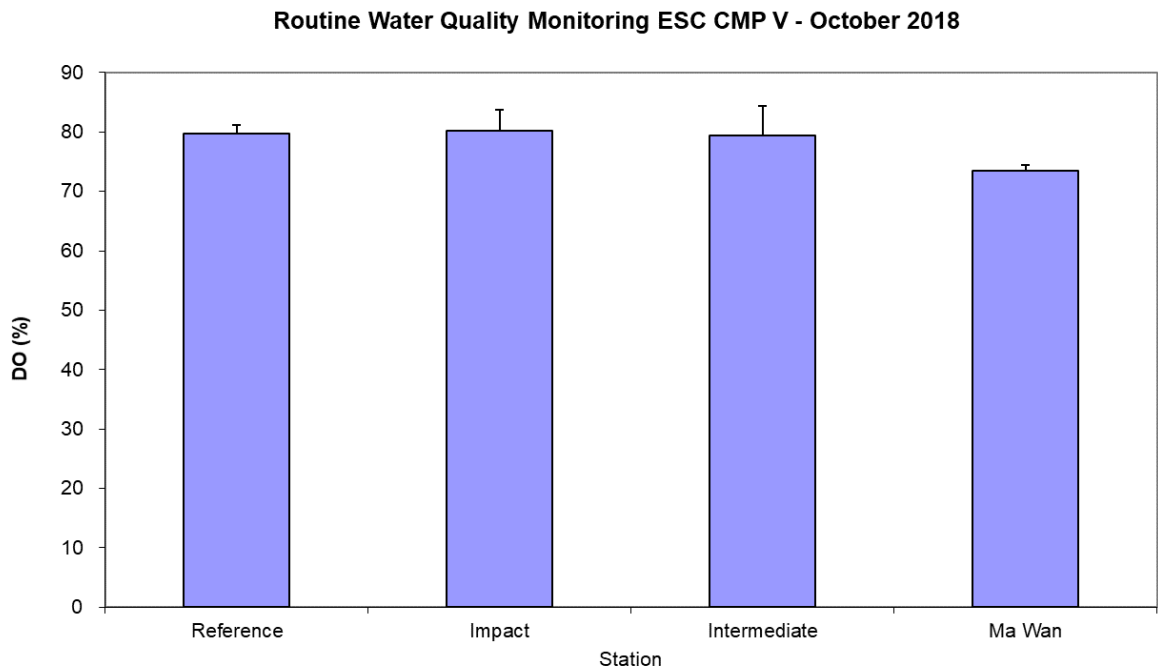


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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Routine Water Quality Monitoring for ESC CMP V - October 2018

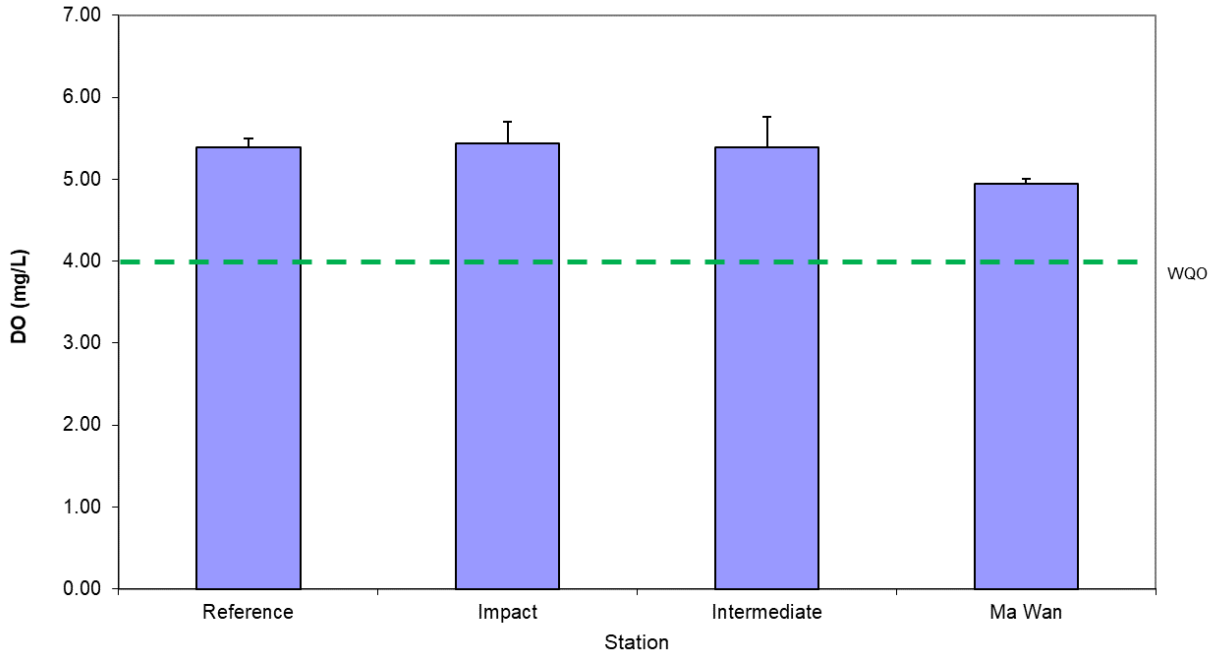


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

Routine Water Quality Monitoring for ESC CMP V - October 2018

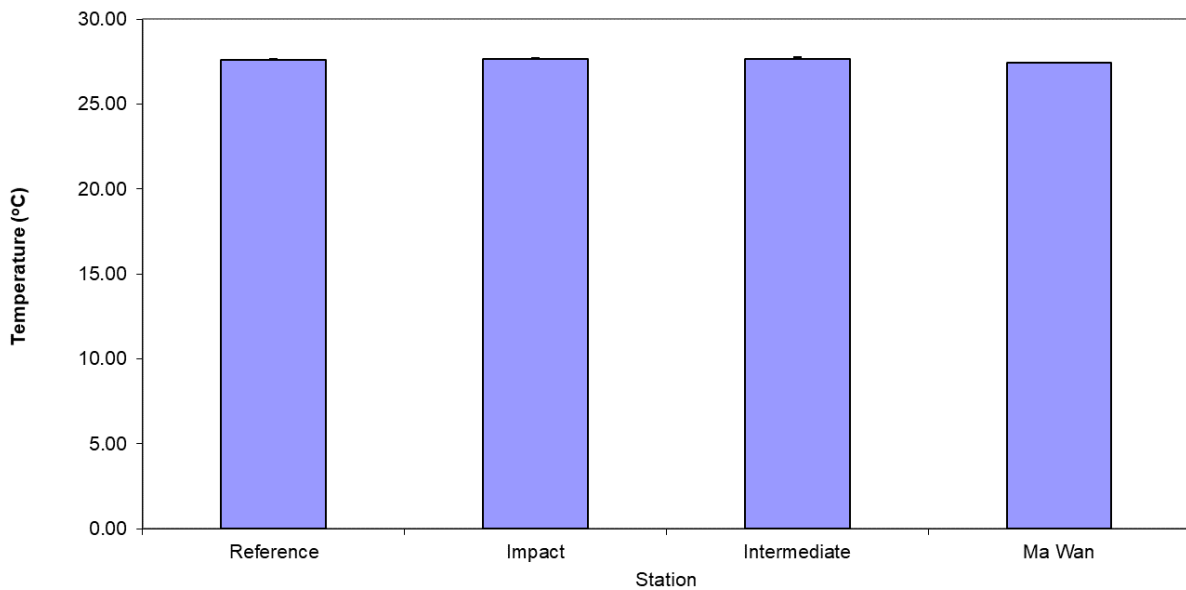


Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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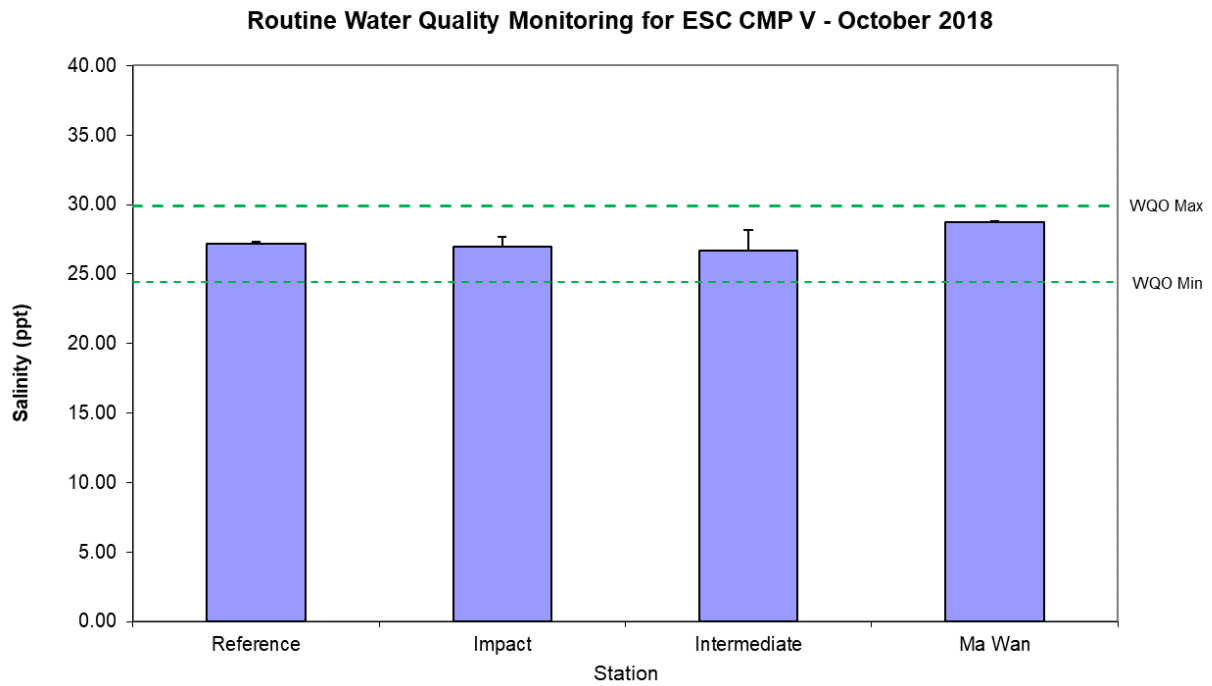


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

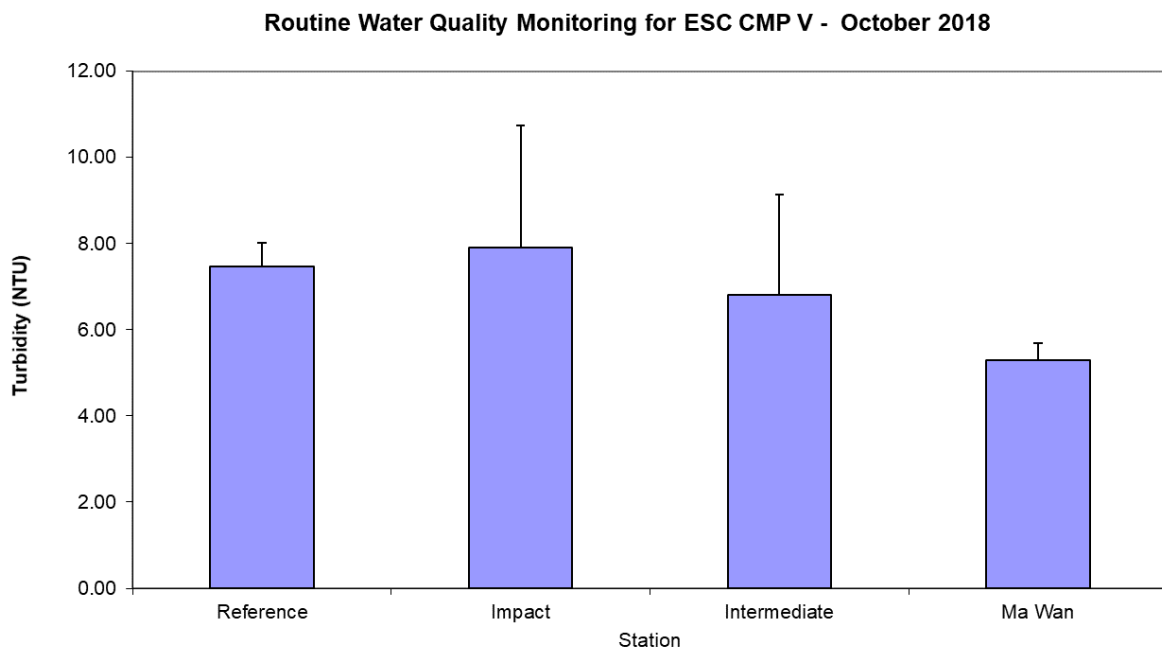


Figure 6: Levels of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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**Routine Water Quality Monitoring for ESC CMP V
October 2018**

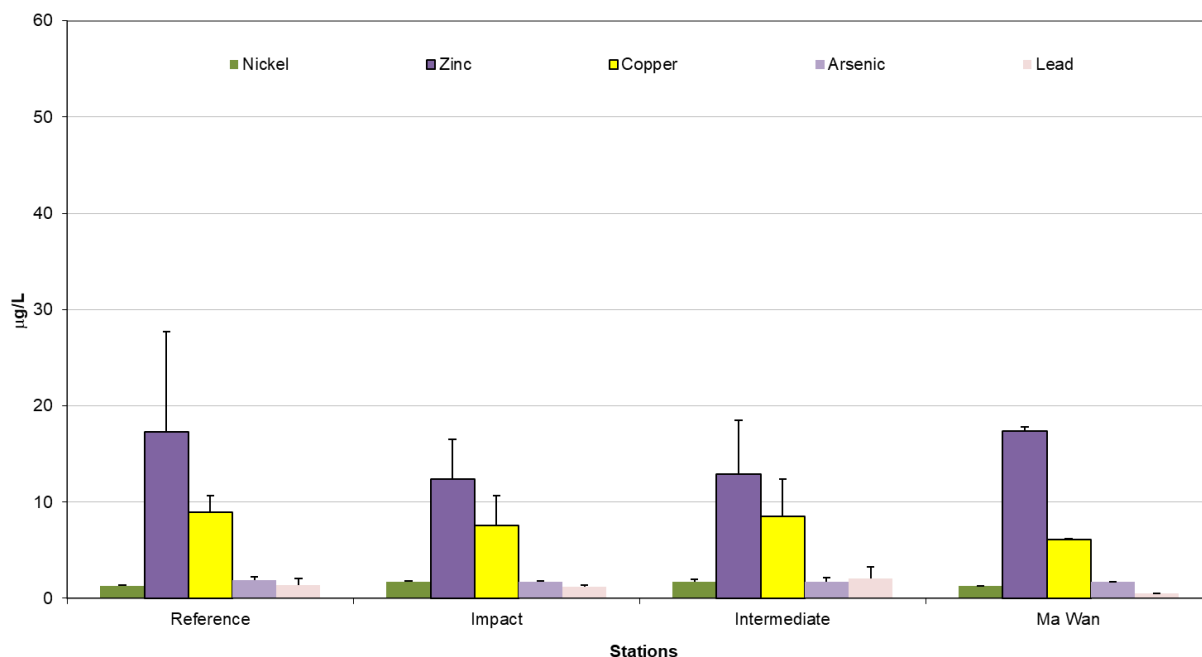


Figure 7: Concentration of Arsenic, Nickel, Lead, Copper and Zinc ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

**Routine Water Quality Monitoring Results for Nutrients
October 2018**

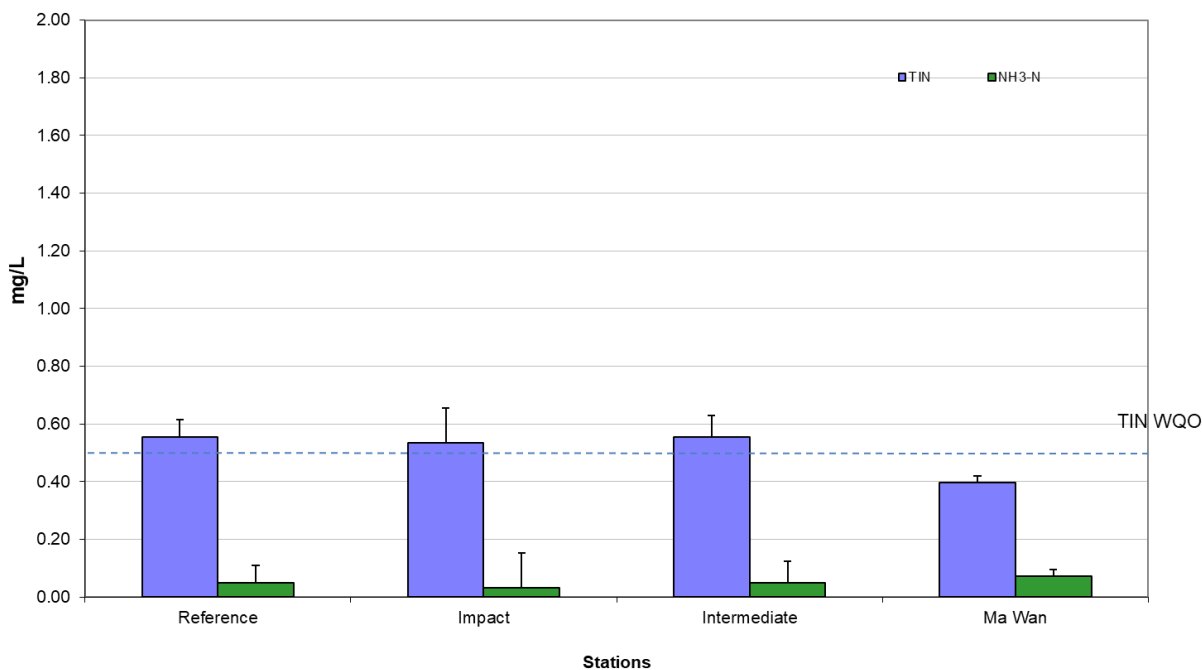


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen ($\text{NH}_3\text{-N}$) ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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**Routine Water Quality Monitoring Results for Biochemical Oxygen Demand (BOD₅)
October 2018**

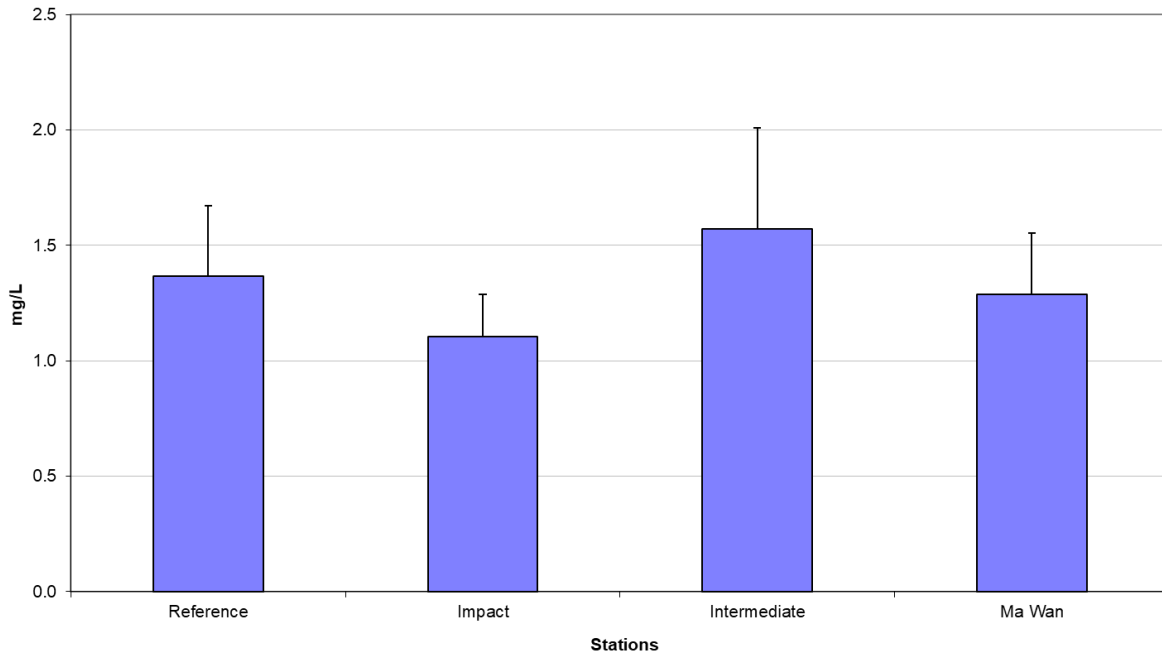


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

**Routine Water Quality Monitoring for Suspended Solids
October 2018**

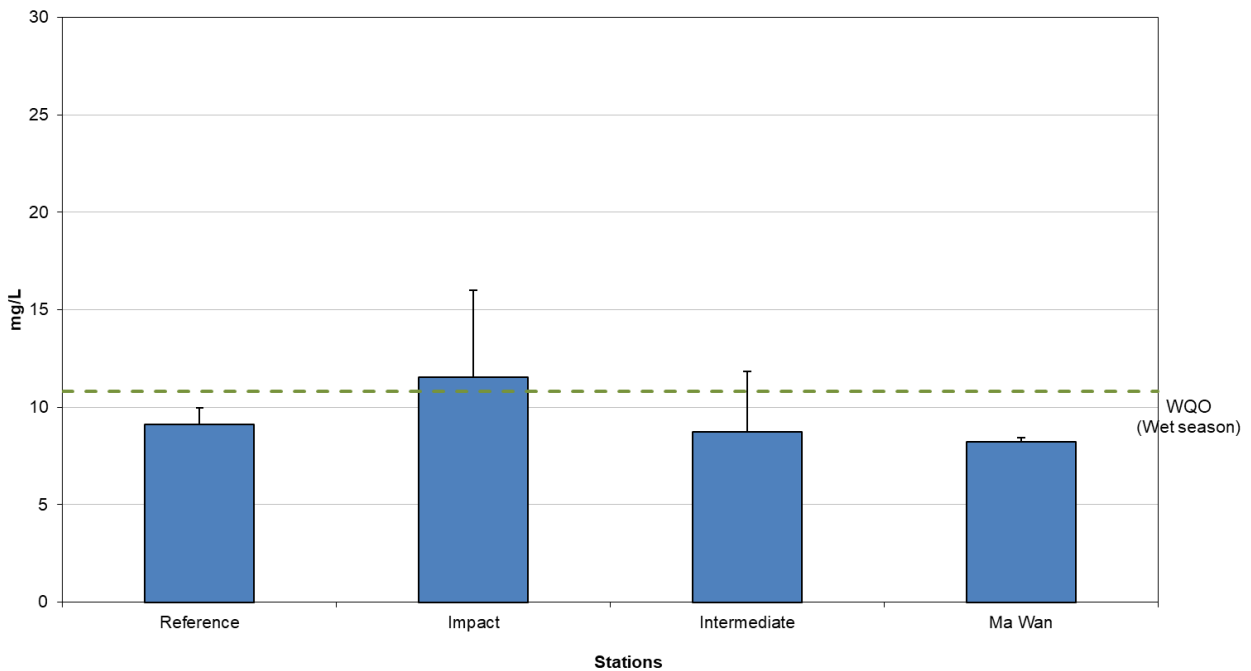


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in October 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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**Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMP Vd
September 2018**

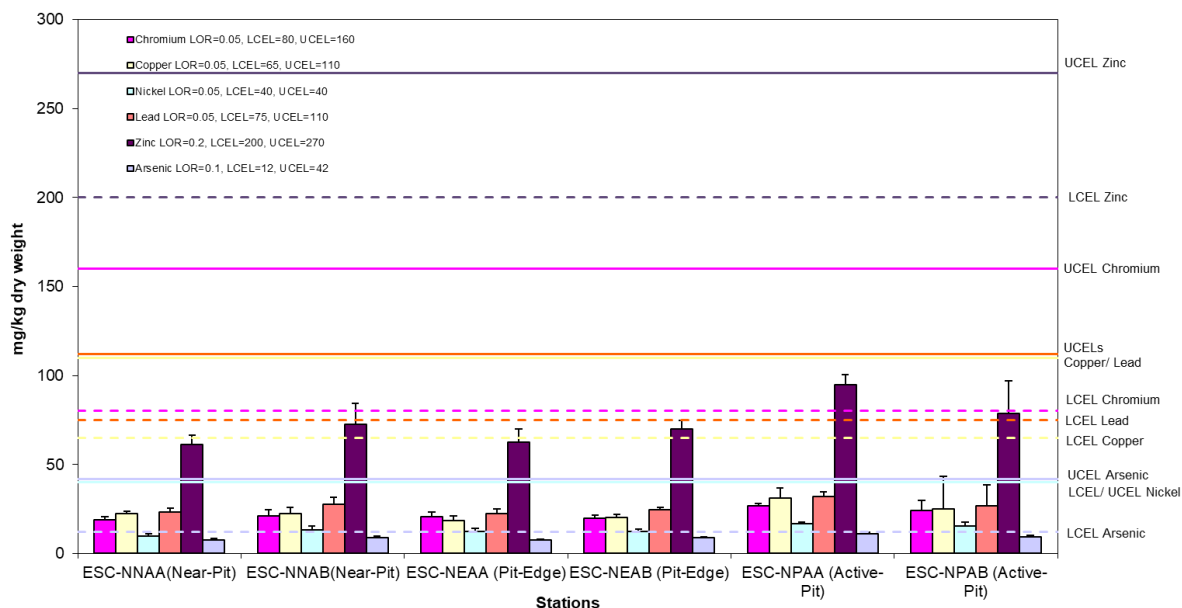


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2018.

**Pit Specific Sediment Chemistry for Metal Contaminants at ESC CMP Vd
September 2018**

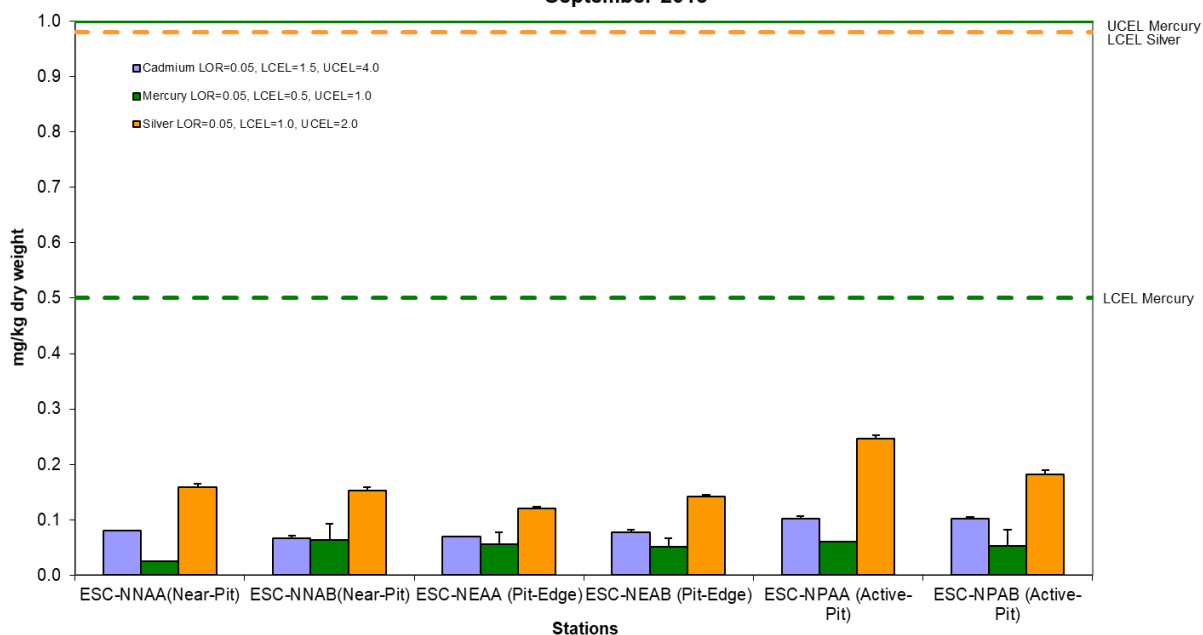


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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**Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vd
September 2018**

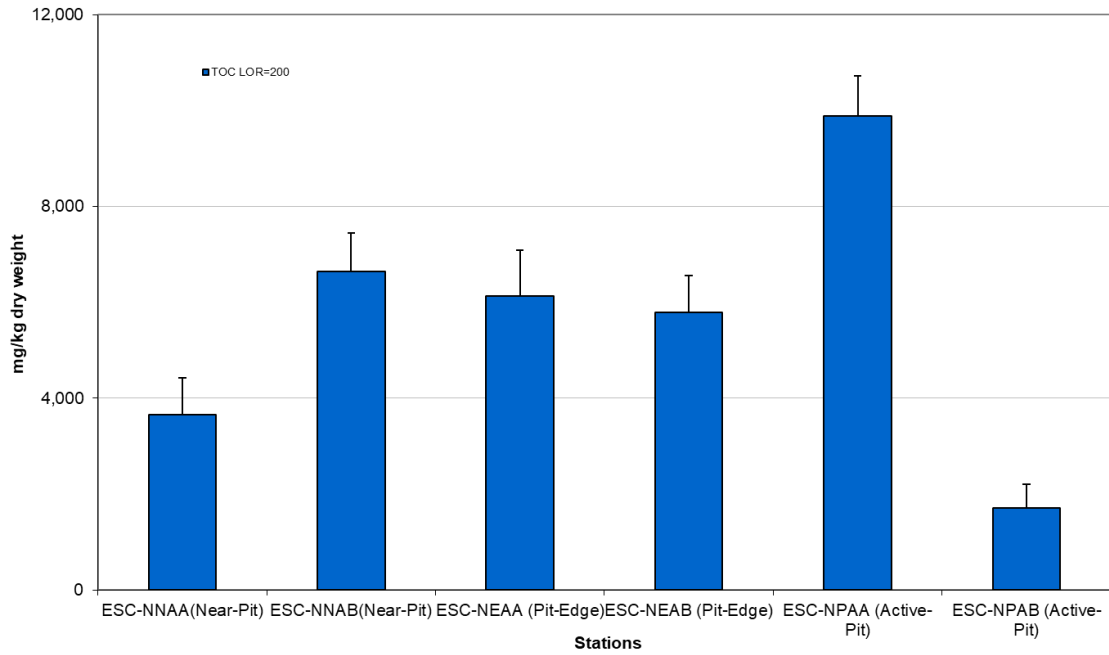


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2018.

**Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vd
September 2018**

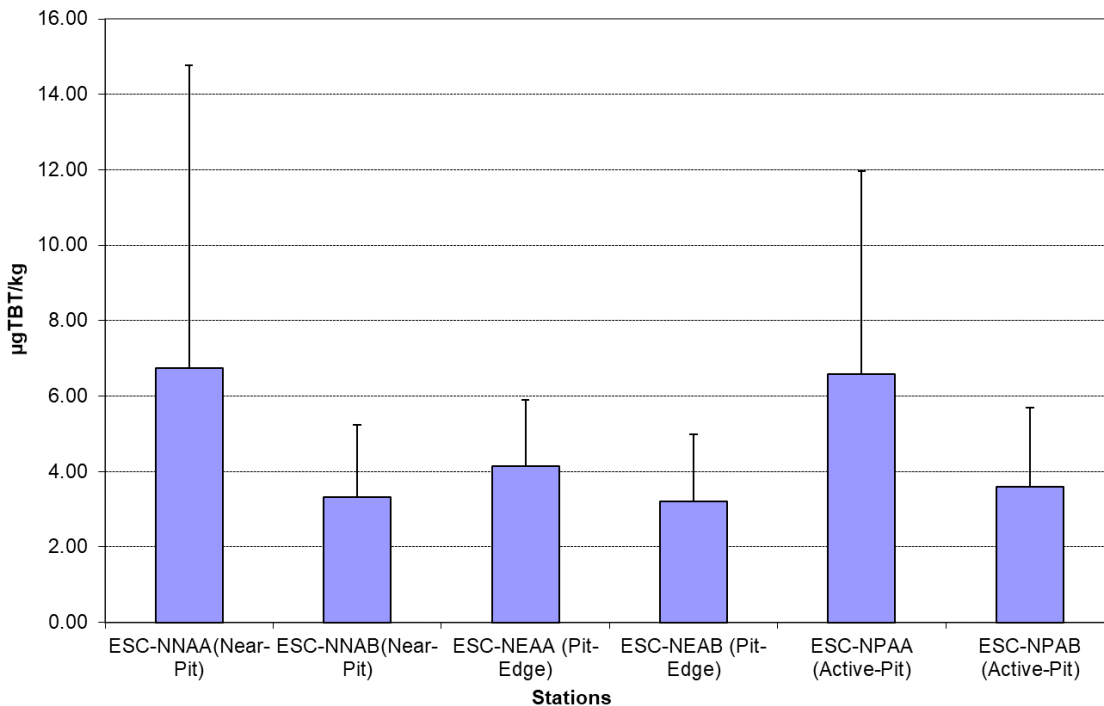


Figure 14: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)

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Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vd in September 2018

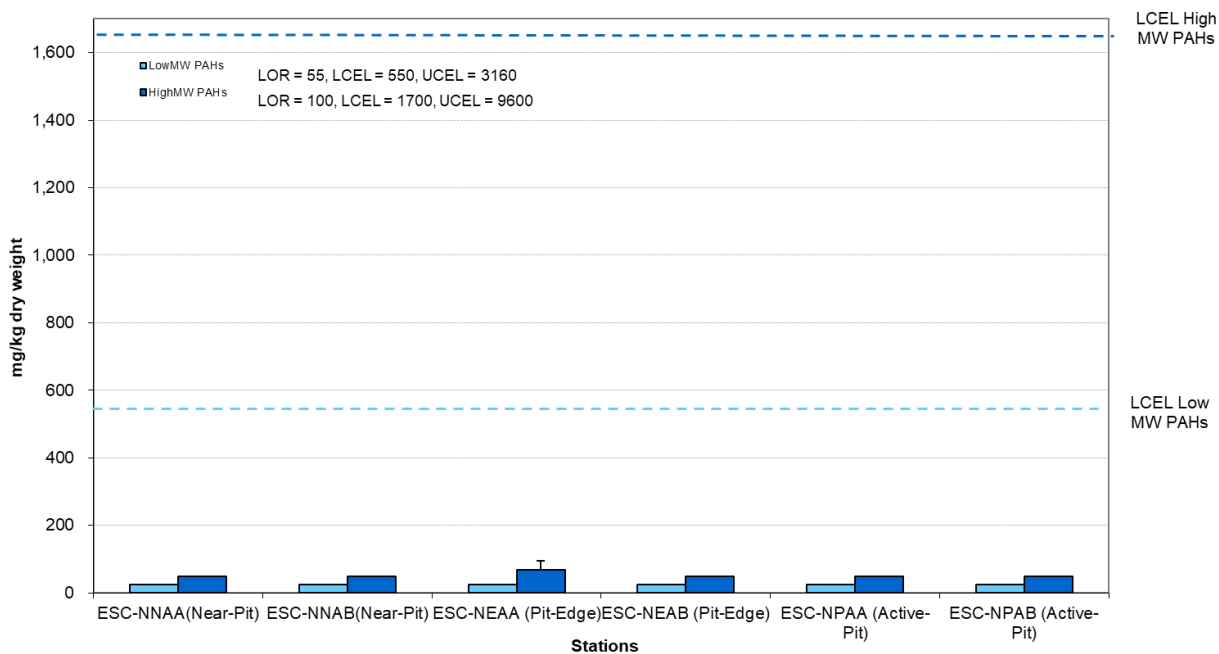


Figure 15: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2018.

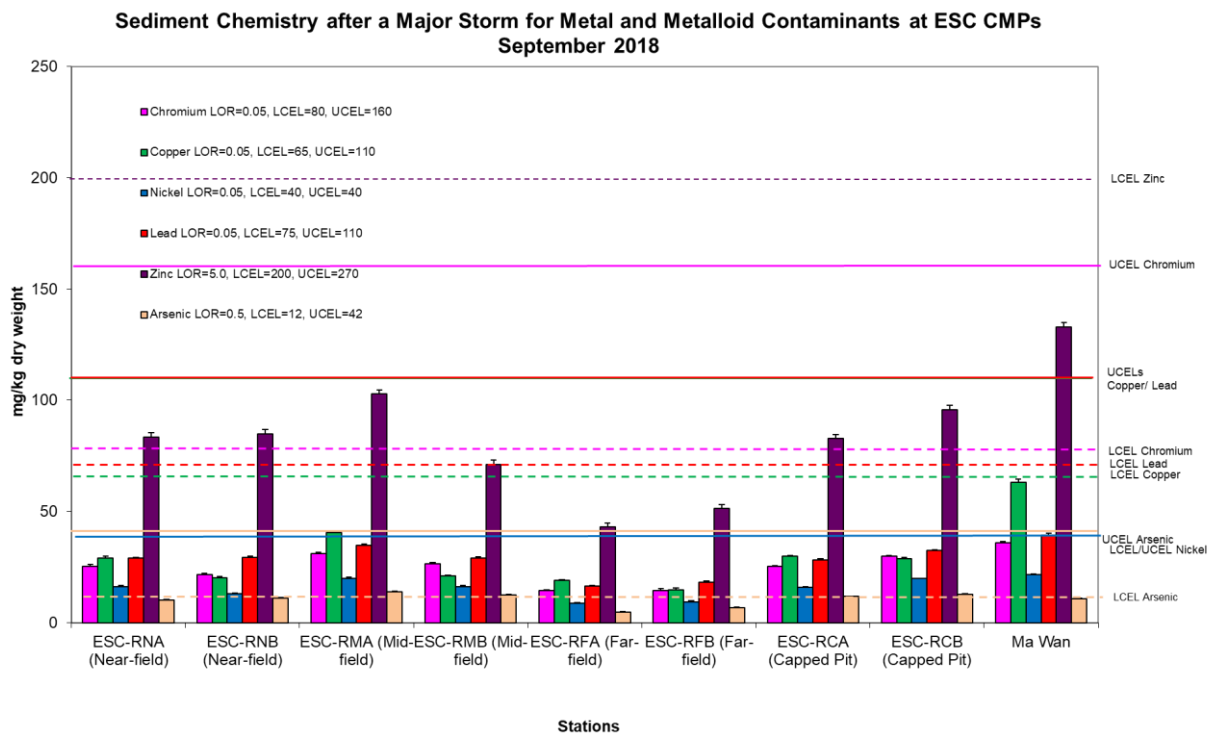


Figure 16: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in September 2018.

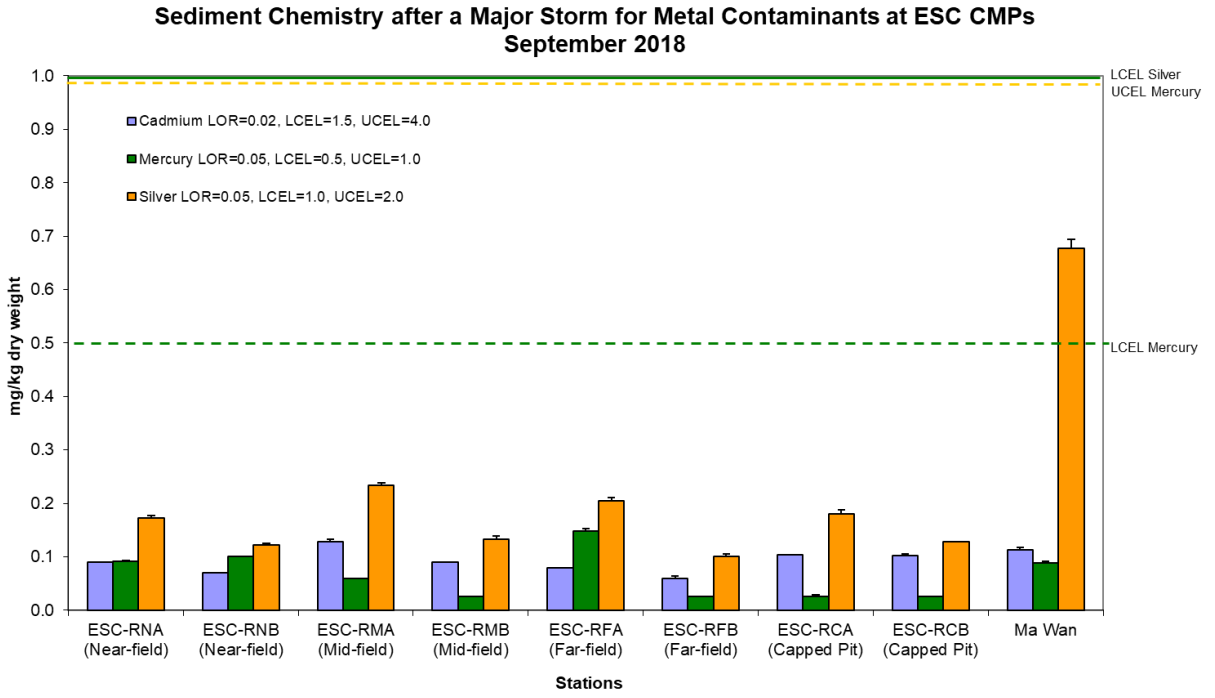


Figure 17: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in September 2018.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\October 2018)
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Annex D

Study Programme

