



**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 – July 2017**

Revision 0

11 August 2017

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**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 - July 2017
Date of Report:	11 August 2017
Date prepared by ET:	11 August 2017
Date received by IA:	11 August 2017

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

Jovy Tam,
Environmental Team Leader:



Date: 11/8/2017

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: 11/8/2017

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Client: Civil Engineering and Development Department (CEDD)		Project No: 0400720			
Summary: 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>		Date: 11 August 2017			
		Approved by:  Craig A. Reid Partner			
v0	Monthly EM&A Report for ESC CMPs and SB CMPs	RC	JT	CAR	11/8/17
Revision	Description	By	Checked	Approved	Date
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Environmental Monitoring and Audit
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MONTHLY EM&A REPORT FOR JULY 2017

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⁾⁽³⁾⁽⁴⁾⁽⁵⁾. 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) ERM (2013) Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau. Final Report. For CEDD.
- (2) ERM (2014) Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau (2012 - 2017). Final First Annual Review Report. For CEDD.
- (3) ERM (2015) Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau (2012 - 2017). Final Second Annual Review Report. For CEDD.
- (4) ERM (2016) Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau (2012 - 2017). Final Third Annual Review Report. For CEDD.
- (5) ERM (2017) Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau (2012 - 2017). Final Fourth Annual Review Report. For CEDD.

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 July 2017, the following works were being undertaken:

- Dredging operation at ESC CMP Vb;
- Disposal of contaminated mud at ESC CMP Vd; and
- Capping operation at SB CMP 2.

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 July 2017 covers the EM&A activities for the reporting month of July 2017.

1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

1.3.1 The following monitoring activities were undertaken for ESC CMP V in July 2017:

- Demersal Trawling for ESC CMPs was undertaken on 5 and 6 July 2017;
- Pit Specific Sediment Chemistry of ESC CMP Vd was undertaken on 12 July 2017;
- Routine Water Quality Monitoring of ESC CMP V was undertaken on 13 July 2017;
- Water Column Profiling of ESC CMP Vd was undertaken on 14 July 2017;
- Sediment Chemistry after a Major Storm of ESC CMPs was undertaken on 25 July 2017; and
- Water Quality Monitoring during Dredging of ESC CMP Vb was undertaken on 31 July 2017.

1.3.2 No monitoring activities were scheduled to be undertaken for SB CMPs in July 2017.

1.4 *DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS*

1.4.1 No outstanding sampling remained for July 2017.

1.4.2 The following laboratory analyses are in progress during the preparation of this monthly report and will be presented in the next monthly report once the data are available:

- Laboratory analyses of sediment samples collected for *Sediment Chemistry after a Major Storm of ESC CMPs* in July 2017;

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

- Species identification of the biota samples collected from *Demersal Trawling for ESC CMPs* in July 2017.

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

1.5.1 Brief discussion of the monitoring results of the following activities for ESC CMPs is presented in this *Monthly EM&A Report for July 2017*:

- *Water Quality Monitoring During Dredging of ESC CMP Vb* in July 2017;
- *Water Column Profiling of ESC CMP Vd* in July 2017;
- *Routine Water Quality Monitoring of ESC CMP V* in July 2017;
- *Pit Specific Sediment Chemistry of ESC CMP Vd* in June and July 2017;
- *Cumulative Impact Sediment Chemistry of ESC CMPs* in June 2017; and
- *Sediment Chemistry after a Major Storm of ESC CMPs* in June 2017.

- 1.5.2 ***Impact Water Quality Monitoring during Dredging Operations of ESC CMP Vb - July 2017***
- 1.5.3 Dredging activities for ESC CMP Vb commenced on 29 July 2017 and water quality monitoring was conducted three times per week during the reporting period starting from 31 July 2017. During each survey day, monitoring was conducted during both mid-ebb and mid-flood tides at two Reference (Upstream) stations and five Impact (Downstream) stations around the dredging operations at ESC CMP Vb. Monitoring was also conducted at one Sensitive Receiver station situated in Ma Wan. A total of eight (8) stations were monitored and locations of the sampling stations are shown in *Figure 1.2*. Levels of Dissolved Oxygen (DO), Turbidity and Suspended Solid (SS) were assessed for compliance with the Action and Limit Levels (see *Table B1* of *Annex B* for details) set in the *Baseline Monitoring Report* ⁽¹⁾.
- 1.5.4 Monitoring results are presented in *Table B2* of *Annex B*. Daily dredging volume in July 2017 is reported in *Annex C*. Levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations.
- 1.5.5 The results indicated that the dredging operations at ESC CMP Vb did not appear to cause any unacceptable deterioration in water quality during this reporting period. Therefore, no further action, except for those recommended in the Environmental Permit (*EP-312/2008/A*), are considered necessary for the dredging operations.

(1) ERM - Hong Kong, Ltd (2009) Baseline Monitoring Report. For the Civil Engineering & Development Department, Hong Kong SAR Government.

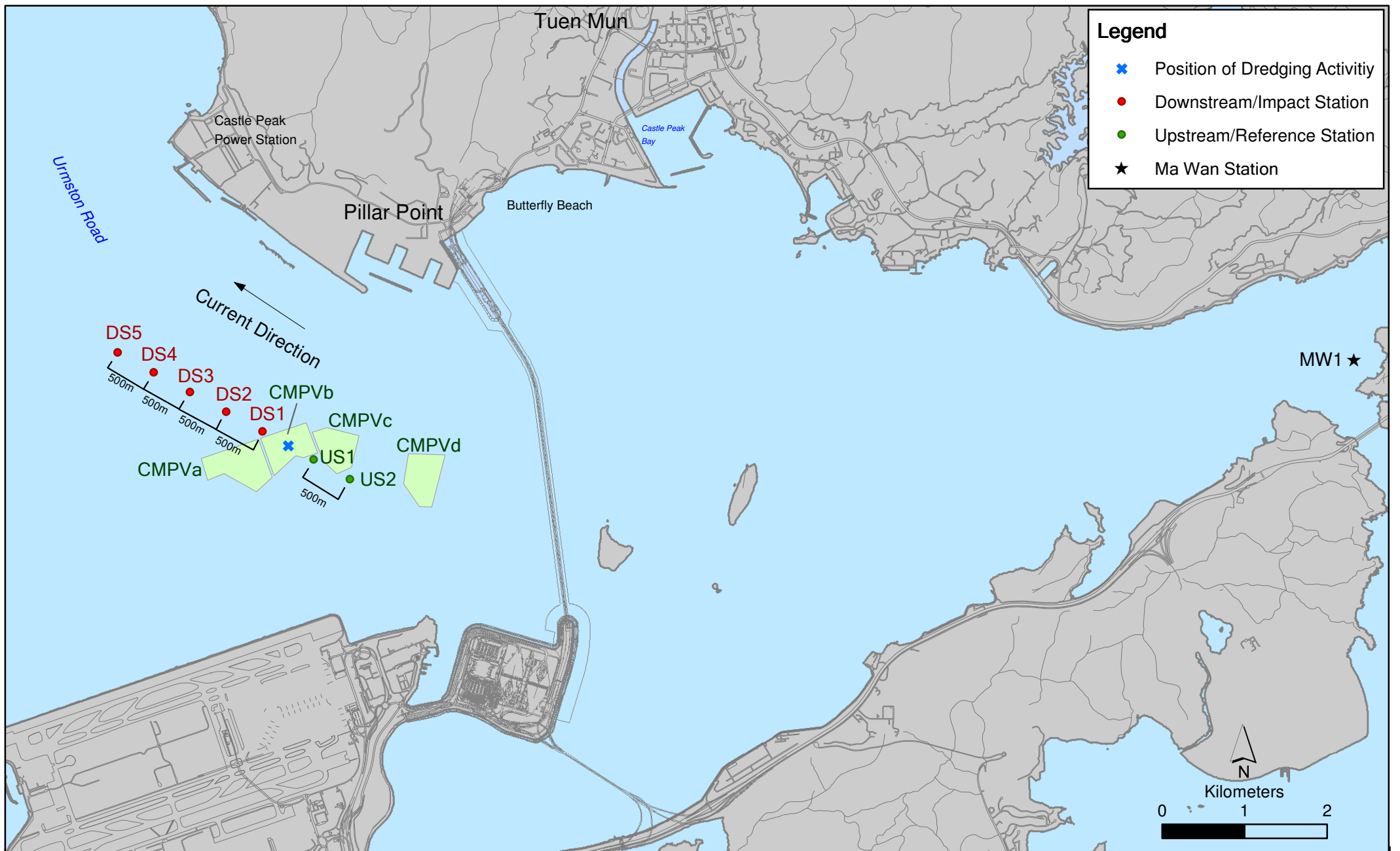


Figure 1.2

Indicative Dredging Impact Sampling Stations for CMPV

Note: The locations of sampling stations will be determined on site based on current direction and position of dredging activities.

1.5.6 *Water Column Profiling of ESC CMP Vd - July 2017*

1.5.7 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 14 July 2017. 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 2006 - 2015 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

1.5.8 Analyses of results for July 2017 indicated that levels of DO and pH complied with the WQOs at both Downstream and Upstream stations (*Table B3 of Annex B*). In addition, levels of DO and Turbidity at all stations complied with the Action and Limit Levels (*Tables B1 and B3 of Annex B*). Levels of Salinity at Downstream station were higher than the WQO. The higher salinity recorded at Downstream station is likely to be caused by its larger separation distance from the Pearl River mouth, which is a key source of freshwater inputs in the area, when compared to the Upstream station.

Laboratory Measurements for Suspended Solids (SS)

1.5.9 Analyses of results for July 2017 indicated that the SS levels complied with the WQO and the Action and Limit Levels at both Upstream and Downstream stations (*Tables B1 and B3 of Annex B*).

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

1.5.11 ***Routine Water Quality Monitoring of ESC CMP V – July 2017***

1.5.12 *Routine Water Quality Monitoring of ESC CMP V* was undertaken on 13 July 2017. 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 B4 and B5 of Annex B* and *Figures 1 - 10 of Annex D*. A total of sixteen (16) monitoring stations were sampled in July 2017 as shown in *Figure 1.3*.

In-situ Measurements

1.5.13 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 1 - 6 of Annex D*. Analyses of results for July 2017 indicated that the levels of pH, Salinity and DO complied with the WQOs at all stations (Impact, Intermediate, Reference and Ma Wan stations) in July 2017 (*Table B4 of Annex B; Figures 1, 3 and 5 of Annex D*).

1.5.1 The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (*Table B4 of Annex B; Figures 3 and 6 of Annex D*).

1.5.2 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 July 2017.

Laboratory Measurements

1.5.3 Laboratory analysis of July 2017 results indicated that concentrations of Cadmium, Silver and Mercury were below their limit of reporting at all stations. Arsenic, Chromium, Nickel, Lead, Copper and Zinc were detected in July 2017 samples and the concentrations of these metals and metalloids were similar amongst stations (*Table B5 of Annex B; Figure 7 of Annex D*).

1.5.4 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at all stations in July 2017 were higher than the WQO (0.5 mg/L) (*Table B5 of Annex B; Figure 8 of Annex D*). It should be noted that due to the effect of 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) were relatively similar amongst all stations in July 2017 (*Table B5 of Annex B; Figure 8 of Annex D*). Levels of 5-day Biochemical Oxygen Demand (BOD₅) were higher at Ma Wan station in July 2017 (*Table B5 of Annex B; Figure 9 of Annex D*).

1.5.5 Analyses of results for July 2017 indicated that the SS levels at Impact station were higher than the WQO (11.0 mg/L for wet season), however the concentrations of SS were below the Action and Limit Levels at all stations (*Tables B1 and B4 of Annex B; Figure 10 of Annex D*).

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

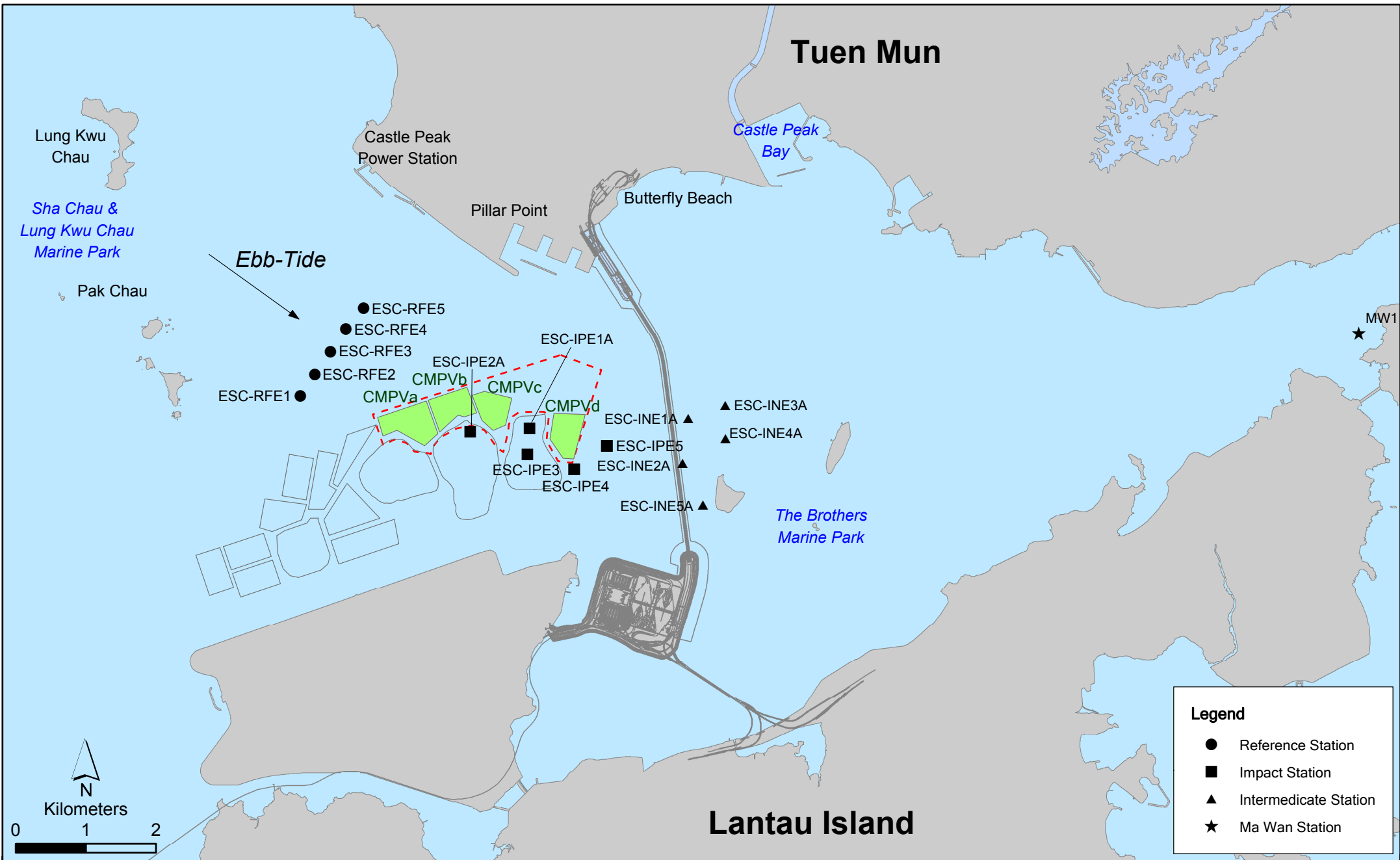


Figure 1.3

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

1.5.6 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 July 2017. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

- 1.5.7 ***Pit Specific Sediment Chemistry of ESC CMP Vd – June and July 2017***
- 1.5.8 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vd* are shown in *Figure 1.4*. A total of six (6) monitoring stations were sampled in June and July 2017.
- 1.5.9 The concentrations of all inorganic contaminants were lower than the Lower Chemical Exceedance Level (LCEL) at all stations in June and July 2017, except Silver and Zinc in July 2017 (*Figures 11, 12, 15 and 16 of Annex D*). In July 2017, concentrations of Silver, Copper and Zinc exceeded the LCEL at Active Pit station ESC-NPAA (*Figure 15 of Annex D*).
- 1.5.10 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were similar amongst the stations in June and July 2017 (*Figures 13 and 17 of Annex D*). The concentrations of Tributyltin (TBT) were higher at Active Pit stations ESC-NPAA and ESC-NPAB in June and July 2017 (*Figures 14 and 18 of Annex D*). 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 all stations in June and July 2017.
- 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 ESC CMP Vd in June and July 2017. 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.
- 1.5.12 ***Cumulative Impact Sediment Chemistry of ESC CMPs – June 2017***
- 1.5.13 Monitoring locations for *Cumulative Impact Sediment Chemistry for ESC CMPs* are shown in *Figure 1.5*. A total of nine (9) monitoring stations were sampled in June 2017.
- 1.5.14 Analyses of results for the *Cumulative Impact Sediment Chemistry Monitoring* indicated that the concentrations of all inorganic contaminants were below the LCEL in June 2017 (*Figures 19 and 20 of Annex D*).
- 1.5.15 For organic contaminants, concentrations of TOC and TBT were recorded to be higher at Ma Wan station (*Figures 21 and 22 of Annex D*). Low and High Molecular Weight PAHs, PCBs, DDT and DDE concentrations were recorded below the limit of reporting at all stations.
- 1.5.16 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 June 2017. 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.

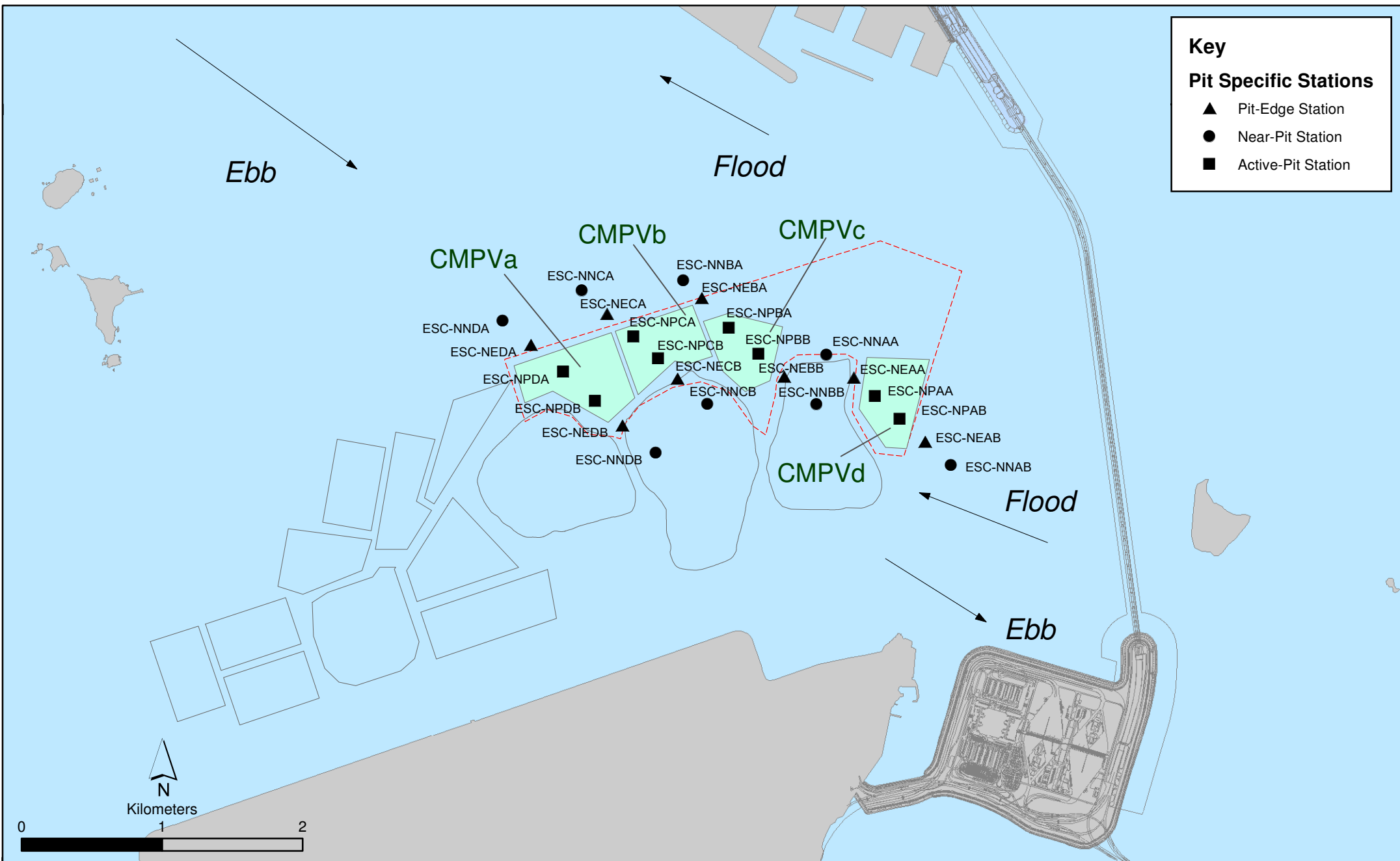


Figure 1.4

Pit Specific Sediment Quality Monitoring Stations for CMPV

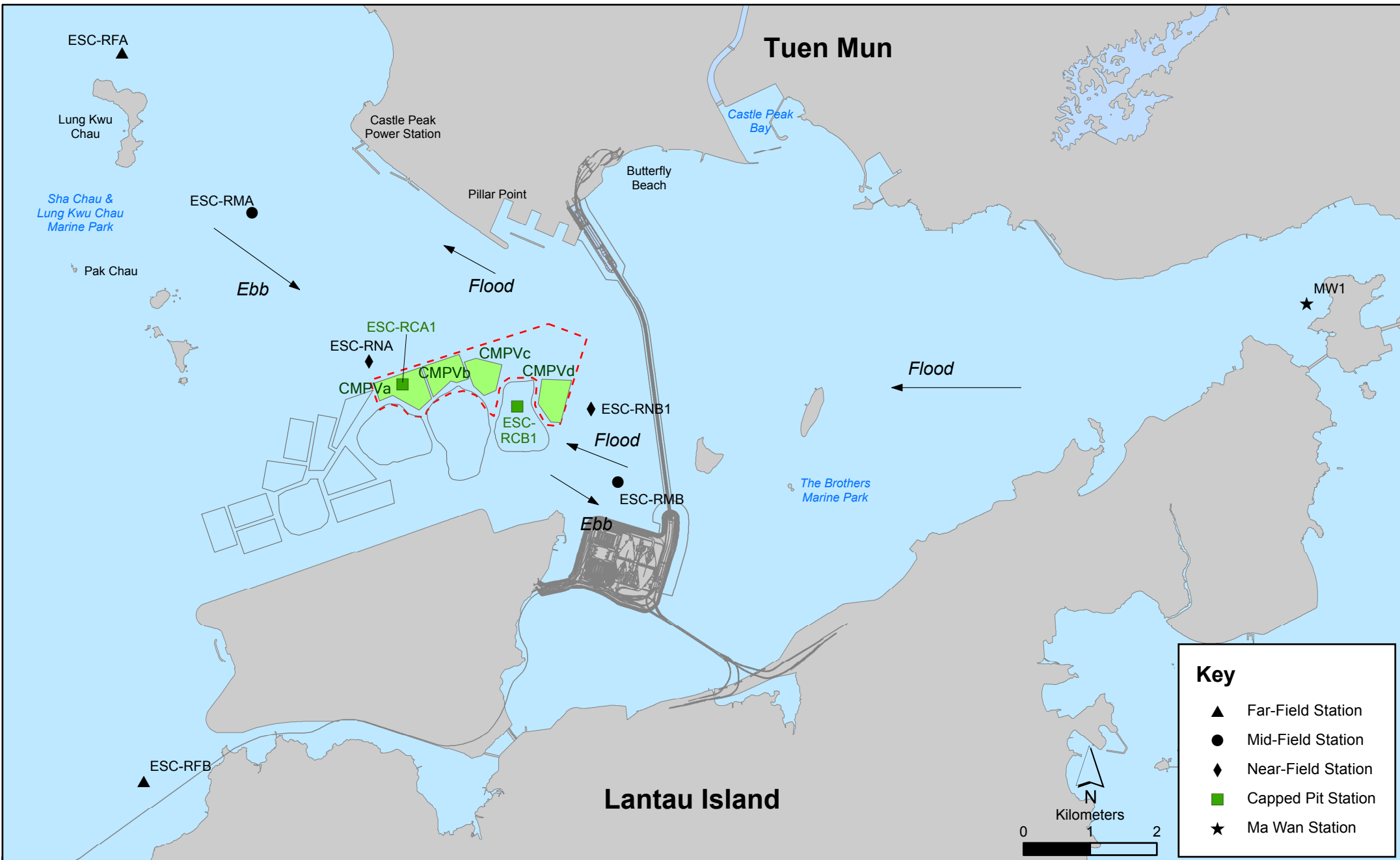


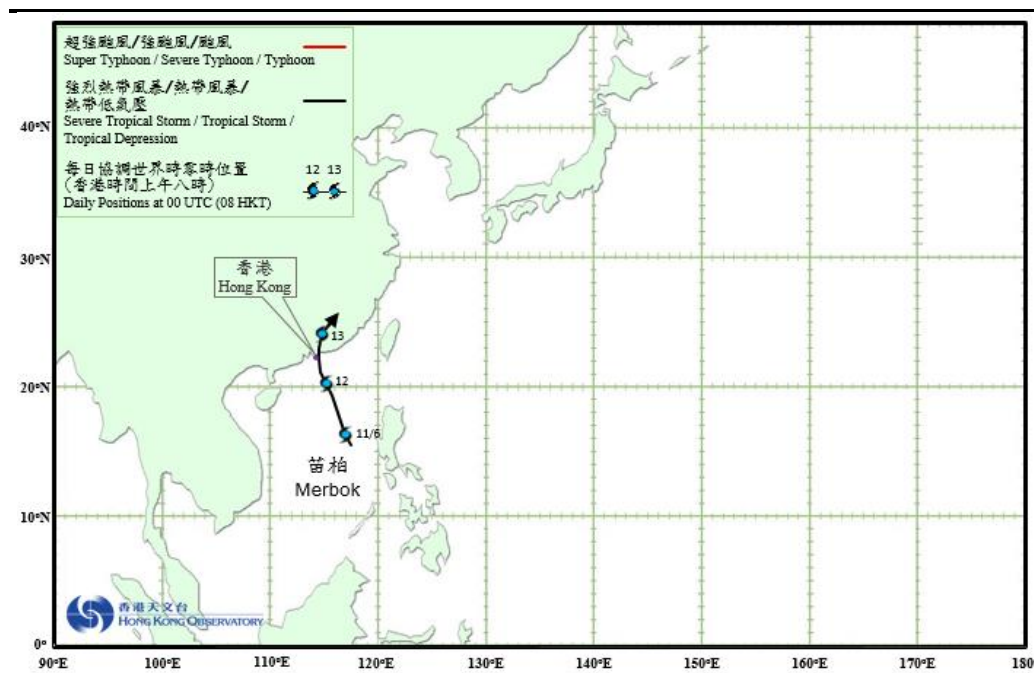
Figure 1.5

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

1.5.17 *Sediment Chemistry after a Major Storm of ESC CMPs – June 2017*

1.5.18 Sampling for Sediment Chemistry after a Major Storm Event was conducted at nine (9) monitoring stations (*Figure 1.5*) on 19 June 2017 after the visit of tropical cyclone Merbok, which led to the issue of Gale or Storm Wind Signal No.8 on 12 June 2017. The track of Merbok is shown in *Figure 1.6*.

Figure 1.6 *Track of Tropical Cyclone Merbok from 11 to 13 June 2017 (Source: Hong Kong Observatory)*



1.5.19 Analyses of results for the *Sediment Chemistry after a Major Storm* indicated that the concentrations of all inorganic contaminants were below the LCEL (*Figures 23 and 24 of Annex D*).

1.5.20 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 June 2017.

1.6 *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

1.6.1 The following monitoring activities will be conducted in the next monthly period of August 2017 for ESC CMP V (see *Annex A* for the sampling schedule):

- *Water Quality Monitoring During Dredging of ESC CMP Vb;*
- *Water Column Profiling of ESC CMP Vd;*
- *Routine Water Quality Monitoring of ESC CMP Vd;*
- *Pit Specific Sediment Chemistry of ESC CMP Vd;*

- *Cumulative Impact Sediment Chemistry of ESC CMPs;*
- *Sediment Toxicity Tests of ESC CMPs; and*
- *Demersal Trawling of ESC CMPs.*

1.6.2 The following monitoring activities will be conducted in the next monthly period of August 2017 for SB CMPs (see *Annex A* for the sampling schedule):

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

1.7 STUDY PROGRAMME

1.7.1 A summary of the Study programme is presented in *Annex E*.

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
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
Pit-Edge	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
	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
Near-Pit	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
	ESC-NNAA	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
	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
		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

Notes:
 The number shown in each cell represents the numbers of replicates per monitoring station
 Impact Monitoring for Dredging will be scheduled when dredging operations commence.
 Benthic Recolonisation Studies for CMP V will be scheduled when capping operation for CMP V is completed.

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-IP1	4 times per year																								
	SB-IP2	4 times per year	3	3			3				3															
	SB-IP3	4 times per year	3	3			3				3															
	SB-IP4	4 times per year	3	3			3				3															
	SB-IP5	4 times per year	3	3			3				3															
Intermediate Stations Downcurrent	SB-INE1	4 times per year																								
	SB-INE2	4 times per year	3	3			3				3															
	SB-INE3	4 times per year	3	3			3				3															
	SB-INE4	4 times per year	3	3			3				3															
	SB-INE5	4 times per year	3	3			3				3															
Reference Stations Upcurrent	SB-RFE1	4 times per year																								
	SB-RFE2	4 times per year	3	3			3				3															
	SB-RFE3	4 times per year	3	3			3				3															
	SB-RFE4	4 times per year	3	3			3				3															
	SB-RFE5	4 times per year	3	3			3				3															
Sensitive Receiver Stations	MW1	4 times per year	3	3			3				3															
	THB1	4 times per year	3	3			3				3															
	THB2	4 times per year	3	3			3				3															
	WSR45C	4 times per year	3	3			3				3															
	WSR46	4 times per year	3	3			3				3															
<i>Flood Tide</i>																										
Impact Stations Downcurrent	SB-IPF1	4 times per year																								
	SB-IPF2	4 times per year	3	3			3				3															
	SB-IPF3	4 times per year	3	3			3				3															
Intermediate Stations Downcurrent	SB-INF1	4 times per year																								
	SB-INF2	4 times per year	3	3			3				3															
	SB-INF3	4 times per year	3	3			3				3															
Reference Stations Upcurrent	SB-RFF1	4 times per year																								
	SB-RFF2	4 times per year	3	3			3				3															
	SB-RFF3	4 times per year	3	3			3				3															
Sensitive Receiver Stations	MW1	4 times per year	3	3			3				3															
	THB1	4 times per year	3	3			3				3															
	THB2	4 times per year	3	3			3				3															
	WSR45C	4 times per year	3	3			3				3															
	WSR46	4 times per year	3	3			3				3															
Benthic Recolonisation Studies																										
Capped Contaminated Mud Pits	SB-CPA	2 times per year																								
	SB-CPB	2 times per year					12				12								12				12			
Reference Stations	RBA	2 times per year																								
	RBB	2 times per year					12				12															
	RBC	2 times per year					12				12															

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 *Summary Table of DO, Turbidity and SS Levels Recorded in July 2017 for Impact Water Quality Monitoring during Dredging Operations of ESC CMP Vb*

Sampling Date	Tidal Period	Station	Average DO Levels (mg/L)		Average Turbidity Level (NTU)	Average SS Level (mg/L)
			Bottom	Surface and Mid Depth		
2017/07/31	Mid-Ebb	DS1	3.83	4.67	7.67	6.75
		DS2	3.73	4.71	6.23	6.10
		DS3	3.97	4.95	5.18	5.35
		DS4	3.34	4.38	5.92	7.28
		DS5	3.93	4.75	5.77	5.72
		US1	3.94	4.83	7.90	4.88
		US2	4.27	4.89	4.53	5.08
		MW1	3.31	5.14	3.16	4.32
		Mid-Flood	DS1	3.90	4.89	7.65
	DS2		4.24	5.11	7.23	9.42
	DS3		4.26	5.06	6.68	9.63
	DS4		4.30	5.38	6.36	8.47
	DS5		4.29	5.25	6.03	9.33
	US1		4.49	5.21	4.44	8.12
	US2		4.32	5.30	5.15	7.42
	MW1		3.08	4.77	3.47	4.32

Table B3 *Water Column Profiling Results for ESC CMP Vd in July 2017*

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L ⁻¹)	pH	Suspended Solids (mg L ⁻¹)
WCP 1 (Downstream)	27.41	19.73	3.91	82.63	5.85	7.91	4.63
WCP 2 (Upstream)	27.94	16.47	4.56	85.38	6.10	7.88	4.78
WQO (Wet season)	N/A	18.19 - 14.88#	N/A	N/A	>4	6.5-8.5	11.0

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 B4 *In-situ Monitoring Results for Routine Water Quality Monitoring of ESC CMPs in July 2017*

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L ⁻¹)	pH (mg L ⁻¹)
July 2017	RFE (Reference)	27.08	18.41	6.79	59.04	4.24	7.75
	IPE (Impact)	27.06	18.74	15.74	58.34	4.18	7.75
	INE (Intermediate)	27.06	19.29	6.75	64.39	4.60	7.81
	Ma Wan	27.45	18.94	2.80	89.45	6.36	7.97
	WQO	N/A	16.57 – 20.25#	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 B5 *Laboratory Results for Routine Water Quality Monitoring of ESC CMPs in July 2017*

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)
July 2017	RFE	2.47	<LOR	0.61	1.38	0.53	<LOR	1.96	<LOR	39.68	0.07	1.05	2.13	7.66
	IPE	2.83	<LOR	0.62	0.50	1.07	<LOR	2.11	<LOR	43.88	0.05	0.95	1.19	15.72
	INE	2.68	<LOR	0.67	0.50	0.50	<LOR	2.16	<LOR	38.92	0.06	0.94	1.43	8.59
	Ma Wan	2.35	<LOR	0.70	2.75	0.59	<LOR	2.13	<LOR	45.59	0.06	1.00	2.79	5.21

WQO of TIN: 0.5 mg/L

Wet Season WQO of SS : 11.0 mg/L

Notes:

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

Cell shaded grey indicate value exceeding the WQO.

Annex C

Dredging Record for ESC CMP Vb

Table C1 Dredging Record at ESC CMP Vb

Date	Daily Dredging Volume (m ³)	Weekly Dredging Volume (m ³) (From Sunday to Saturday)
01-Jul-2017	0	0
02-Jul-2017	0	0
03-Jul-2017	0	
04-Jul-2017	0	
05-Jul-2017	0	
06-Jul-2017	0	
07-Jul-2017	0	
08-Jul-2017	0	
09-Jul-2017	0	0
10-Jul-2017	0	
11-Jul-2017	0	
12-Jul-2017	0	
13-Jul-2017	0	
14-Jul-2017	0	
15-Jul-2017	0	
16-Jul-2017	0	0
17-Jul-2017	0	
18-Jul-2017	0	
19-Jul-2017	0	
20-Jul-2017	0	
21-Jul-2017	0	
22-Jul-2017	0	
23-Jul-2017	0	500
24-Jul-2017	0	
25-Jul-2017	0	
26-Jul-2017	0	
27-Jul-2017	0	
28-Jul-2017	0	
29-Jul-2017	500	
30-Jul-2017	2,000	4,500
31-Jul-2017	2,500	

Annex D

Graphical Presentations

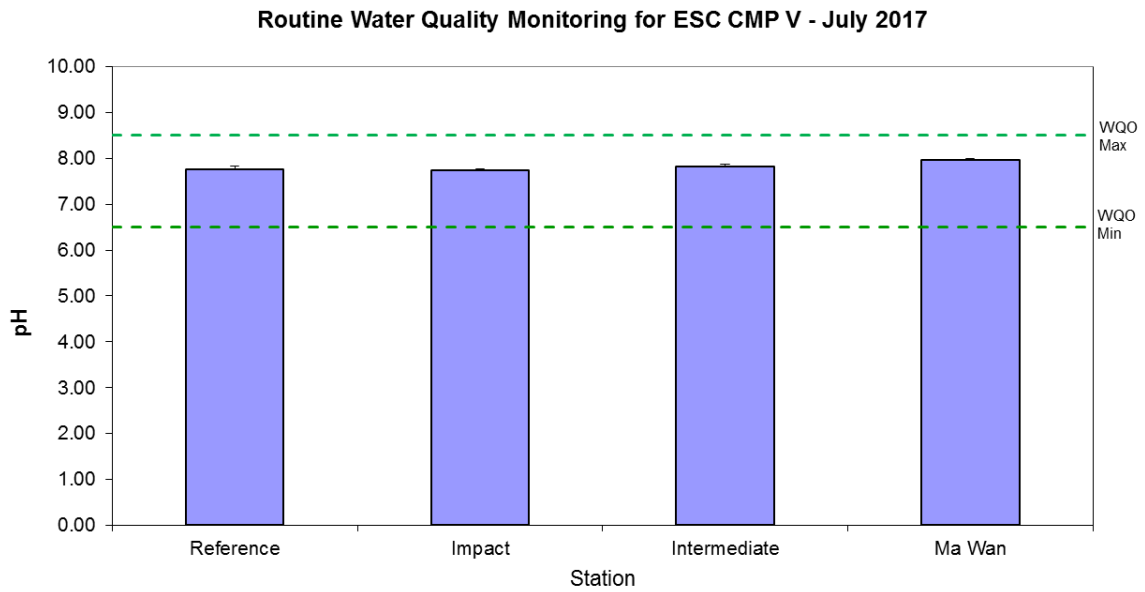


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

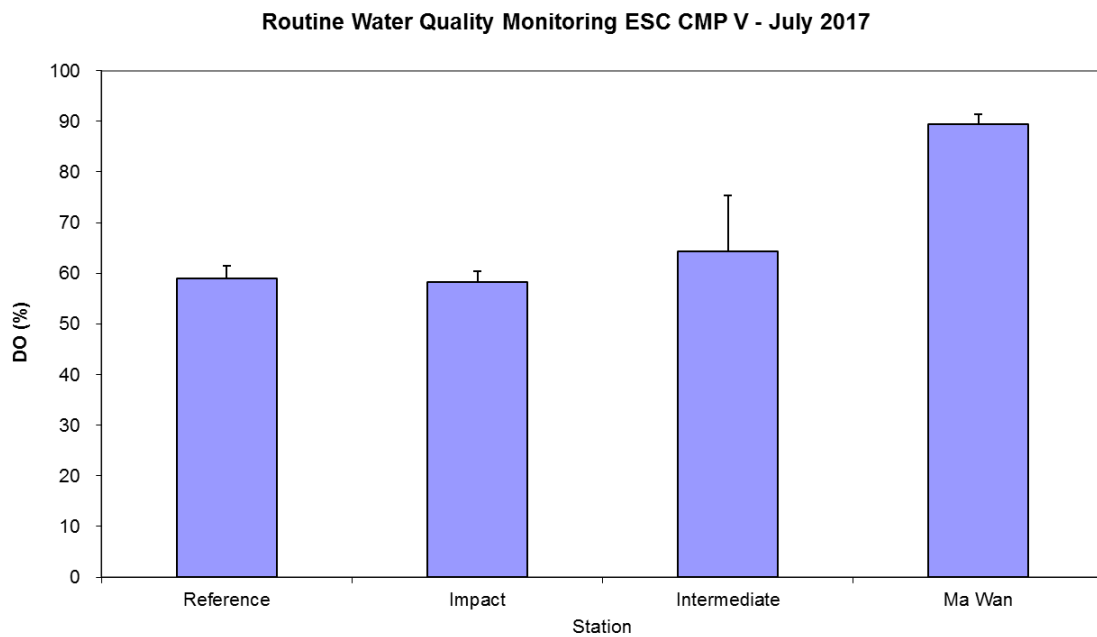


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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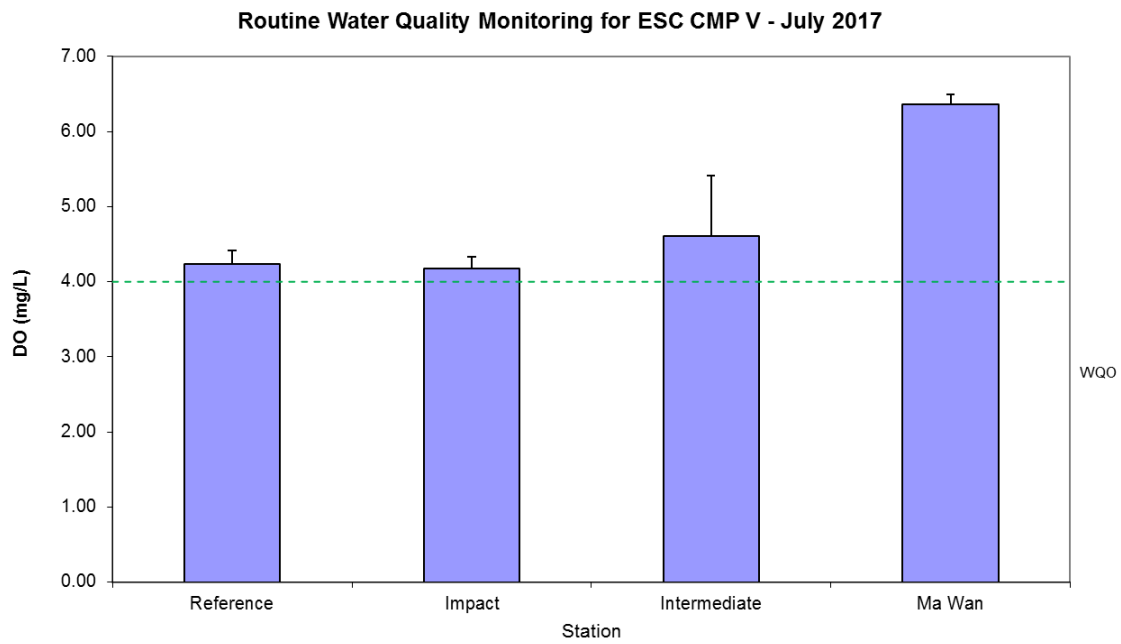


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

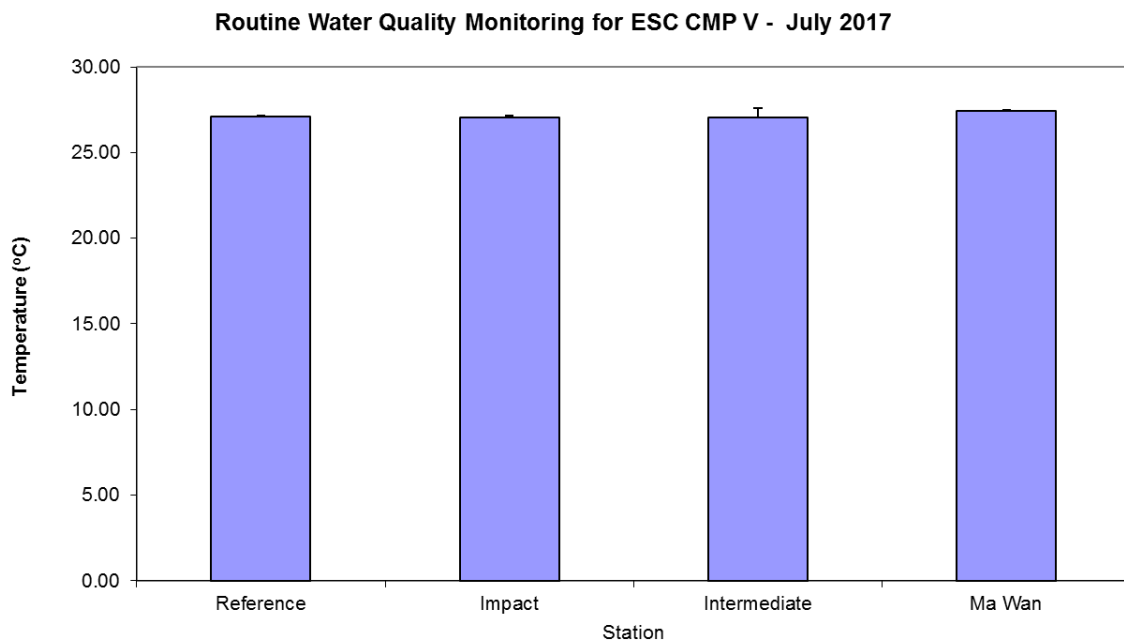


Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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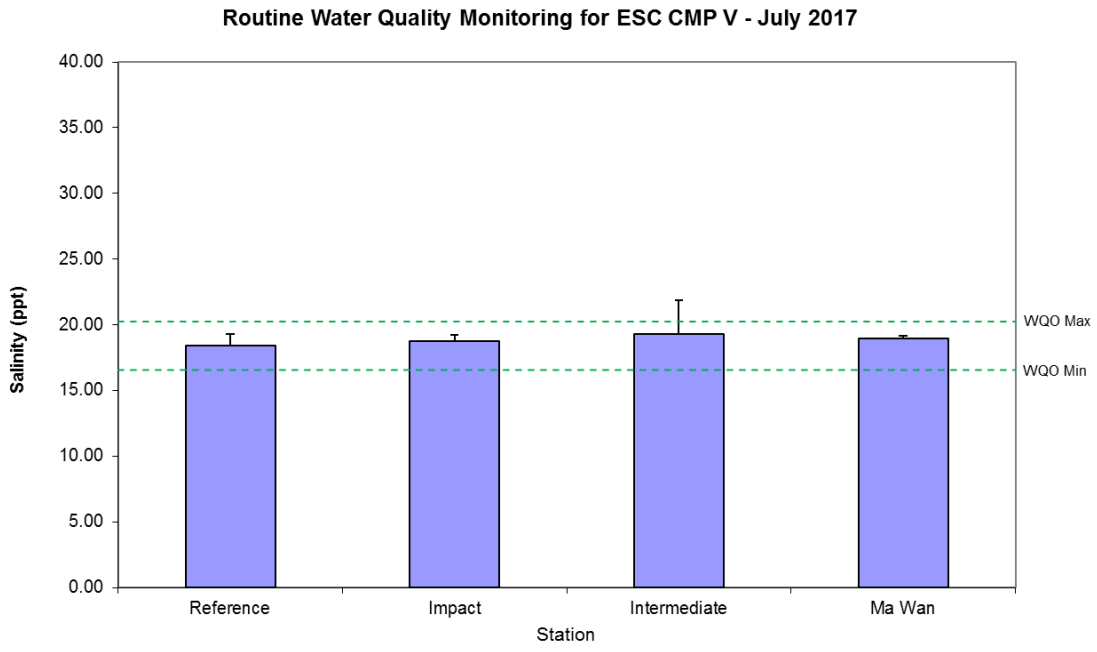


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

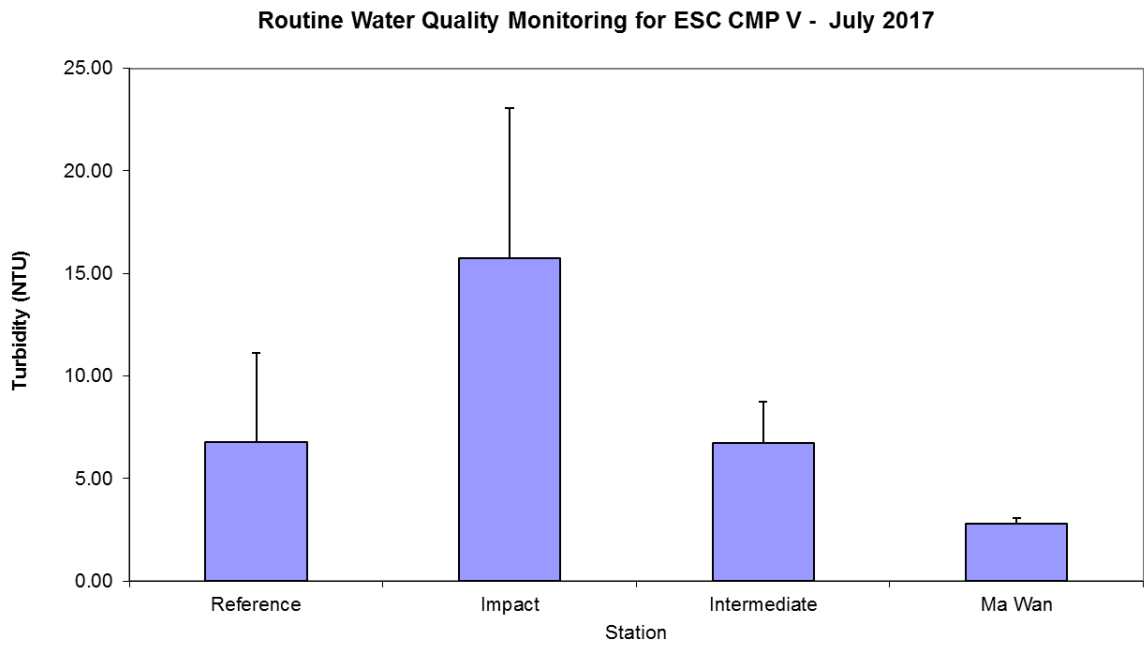


Figure 6: Levels of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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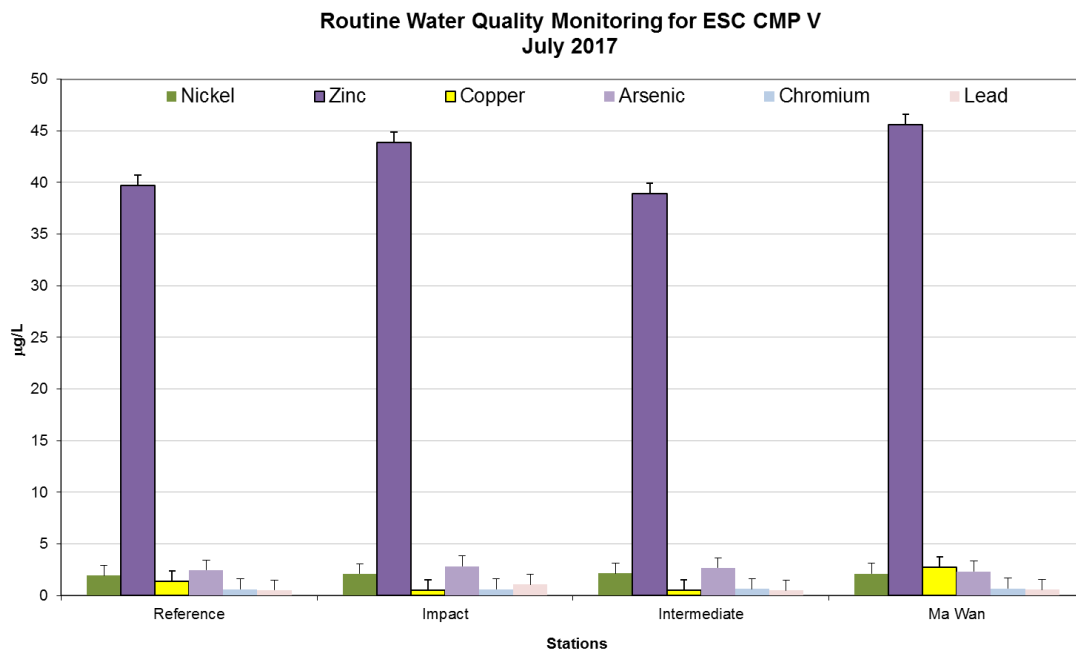


Figure 7: Concentration of Arsenic, Chromium, Nickel, Lead, Copper and Zinc ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

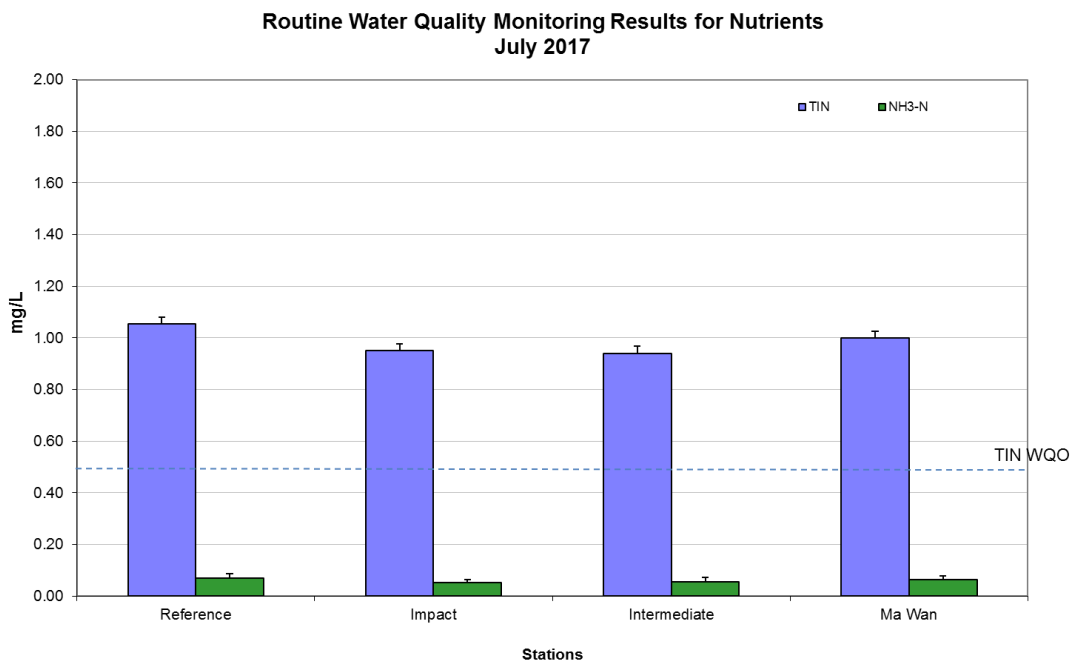


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen ($\text{NH}_3\text{-N}$) ($\mu\text{g/L}$; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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**Routine Water Quality Monitoring Results for Biochemical Oxygen Demand (BOD₅)
July 2017**

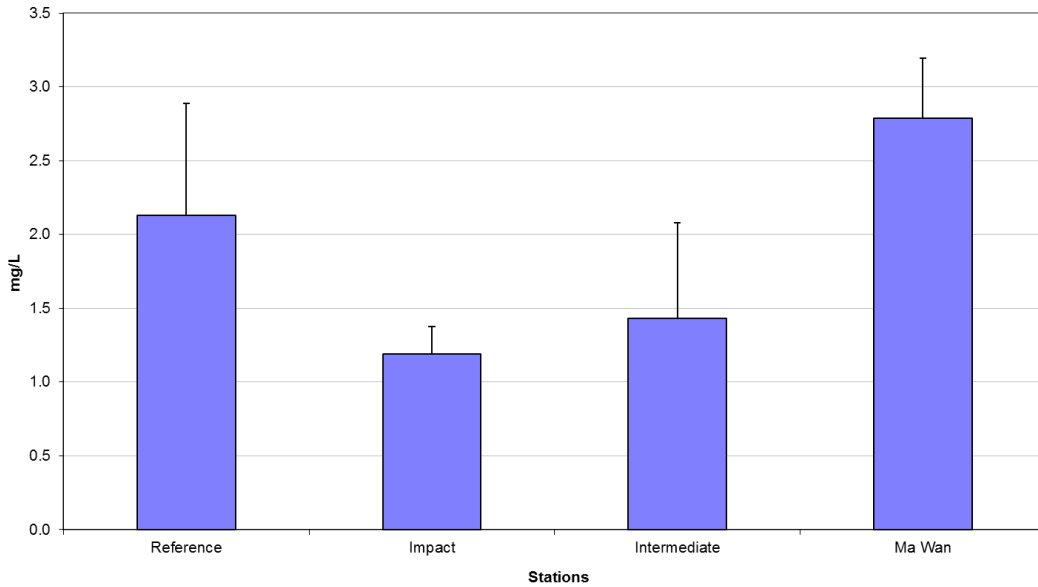


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

**Routine Water Quality Monitoring for Suspended Solids
July 2017**

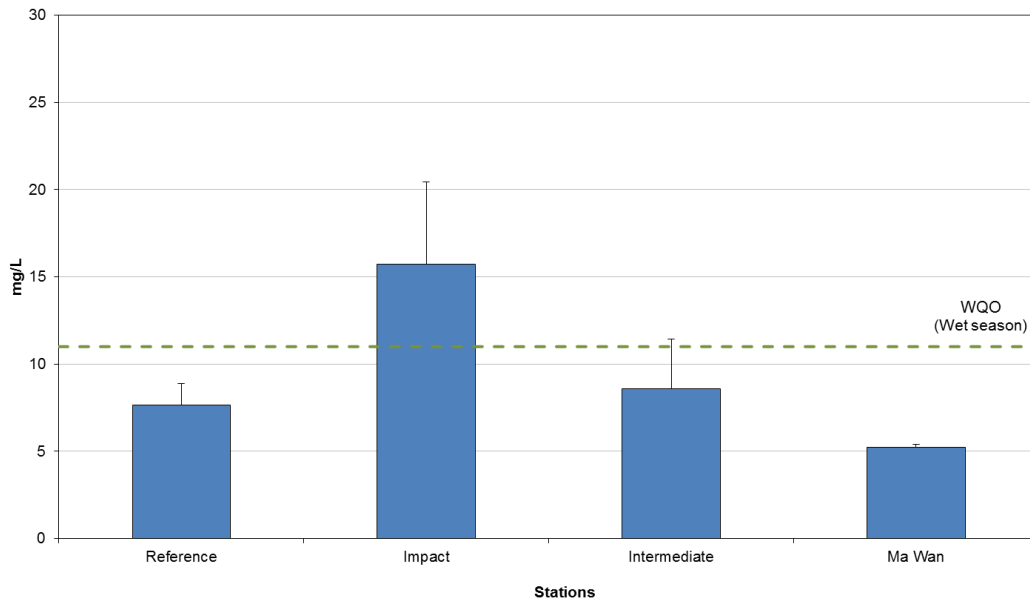


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in July 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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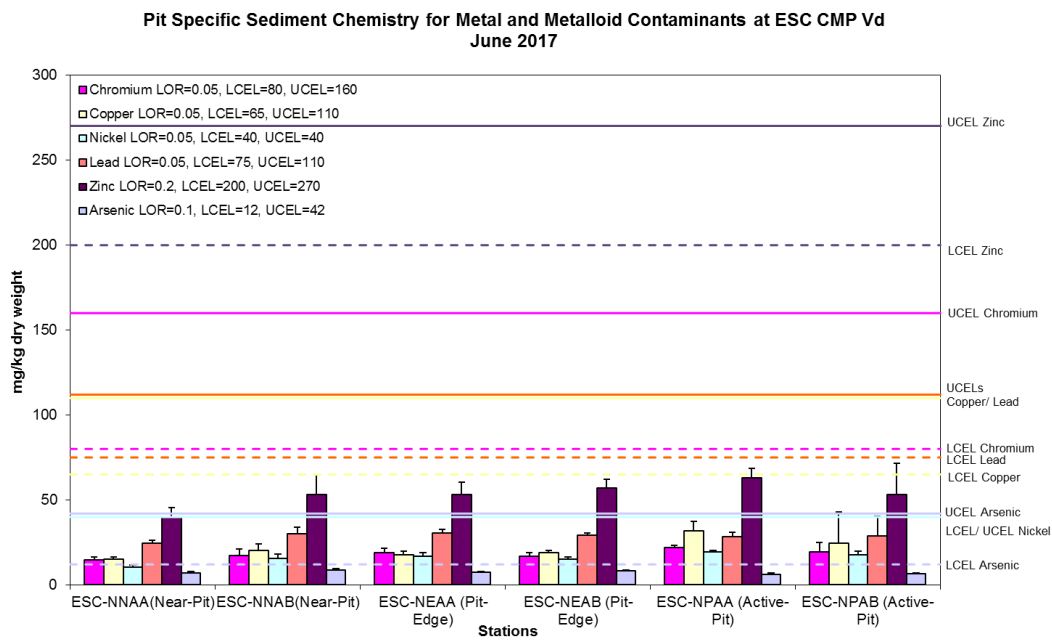


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in June 2017.

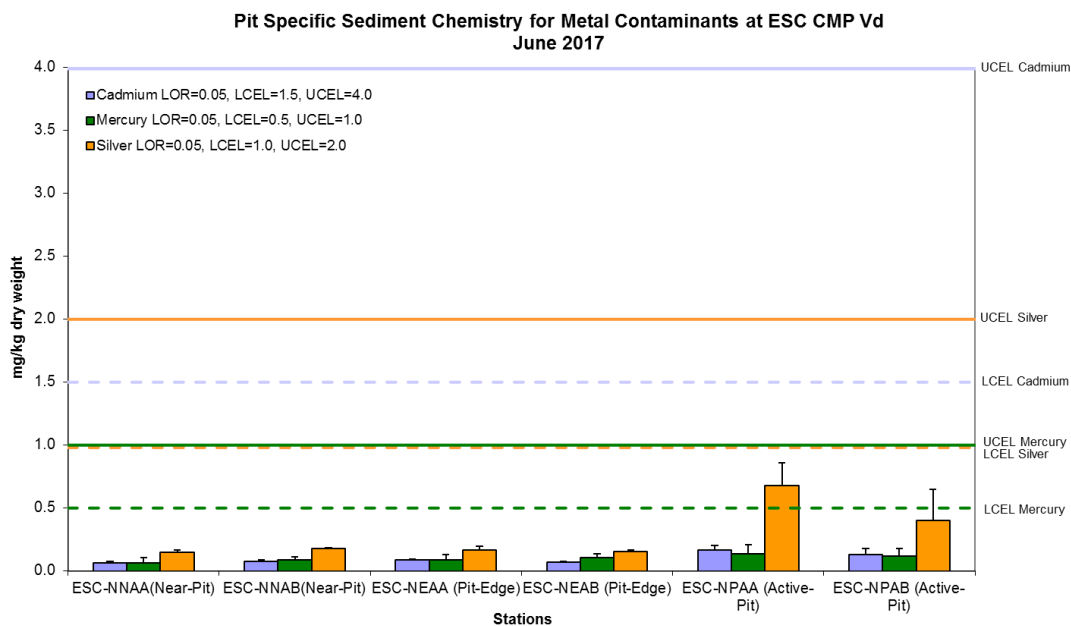


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in June 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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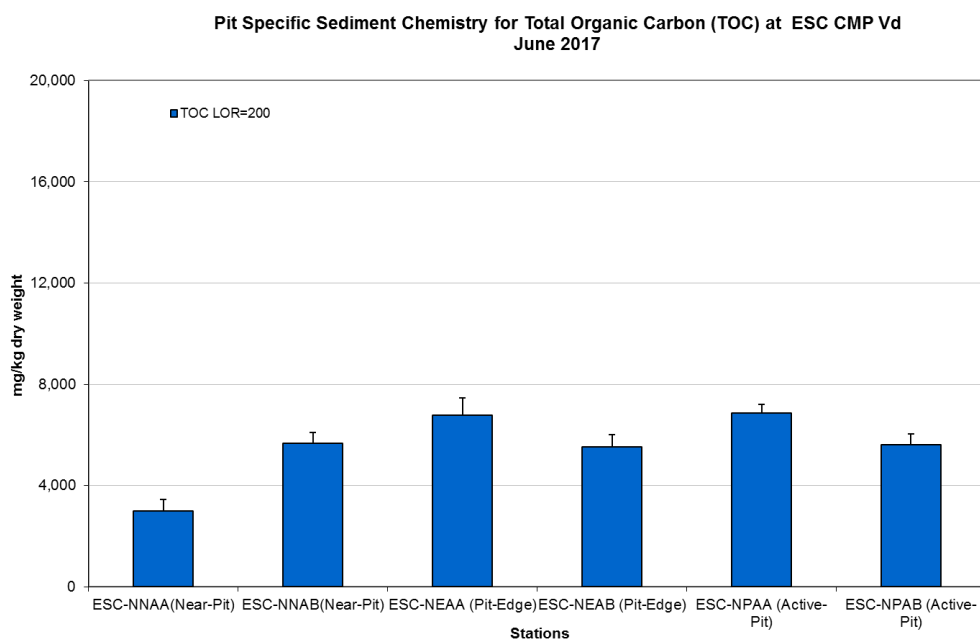


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in June 2017.

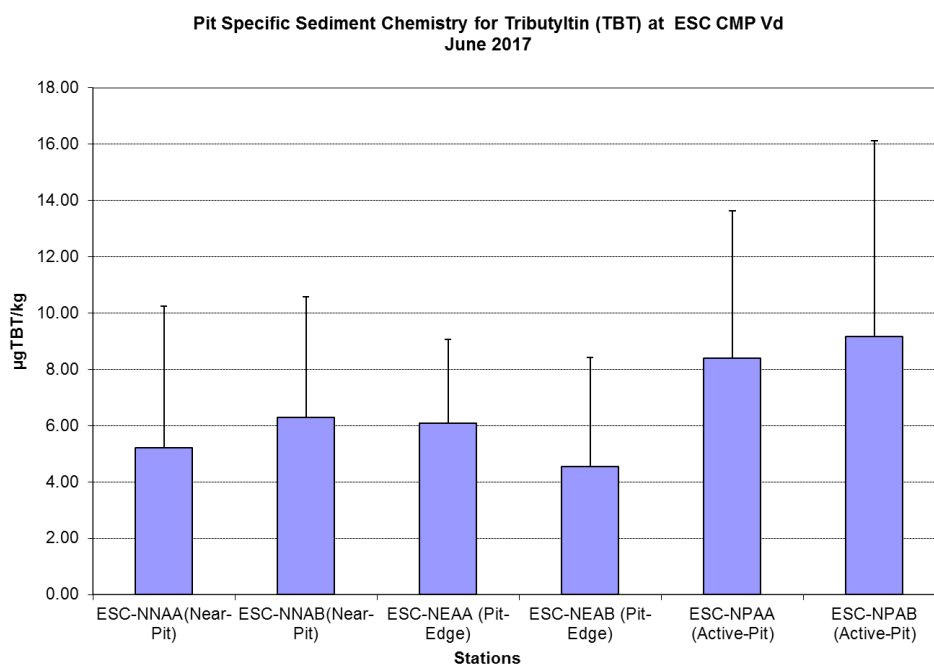


Figure 14: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in June 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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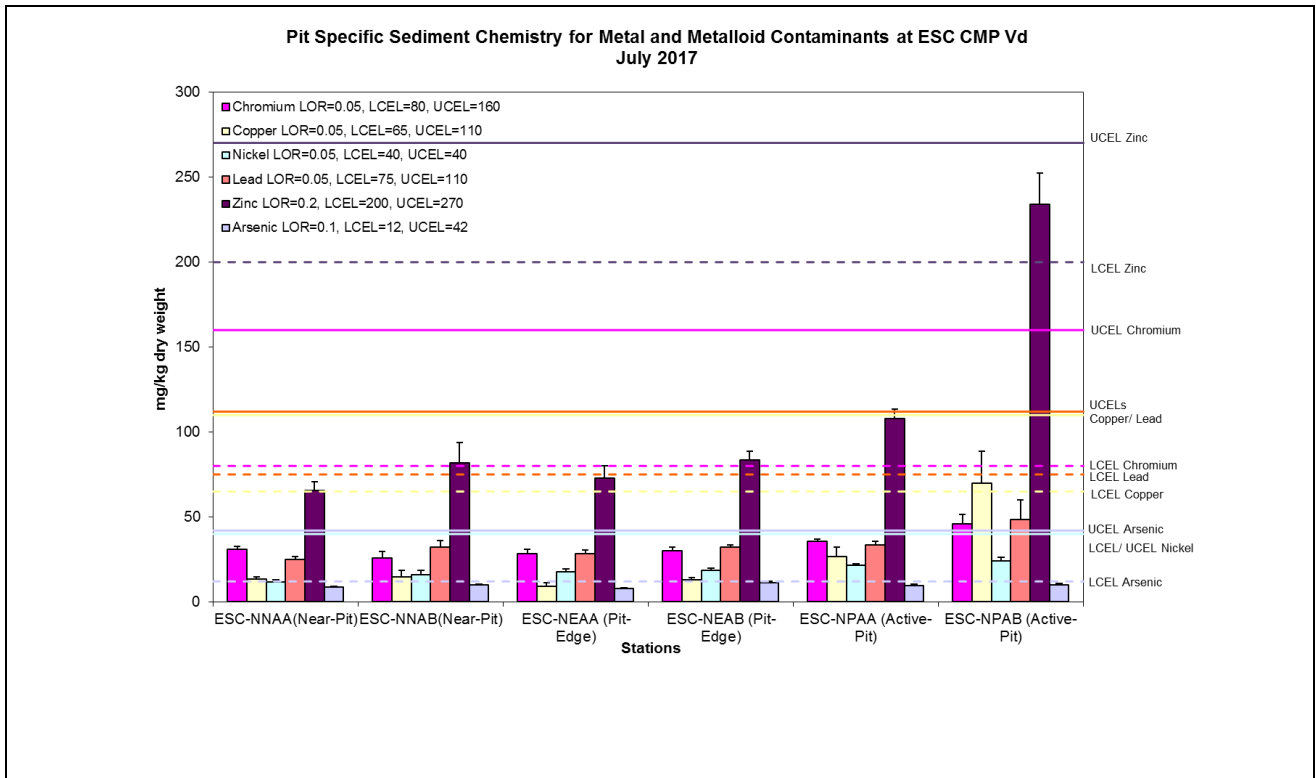


Figure 15: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in July 2017.

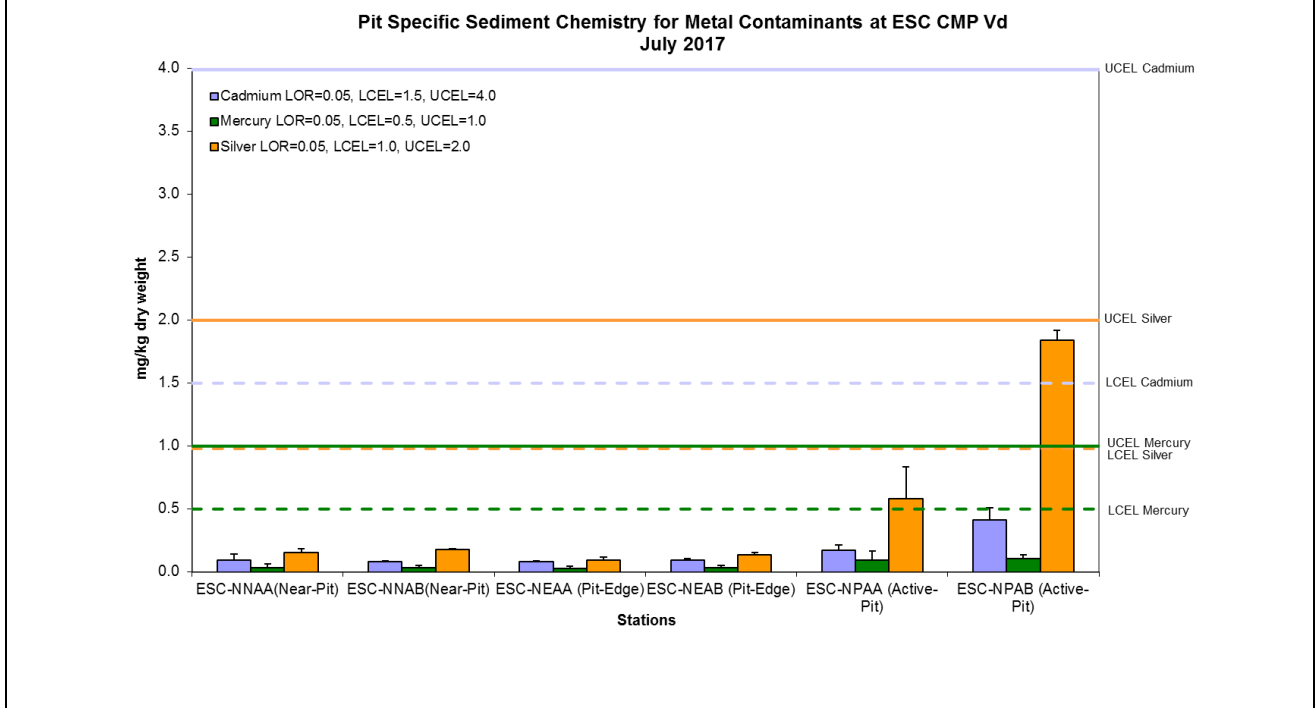


Figure 16: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in July 2017.

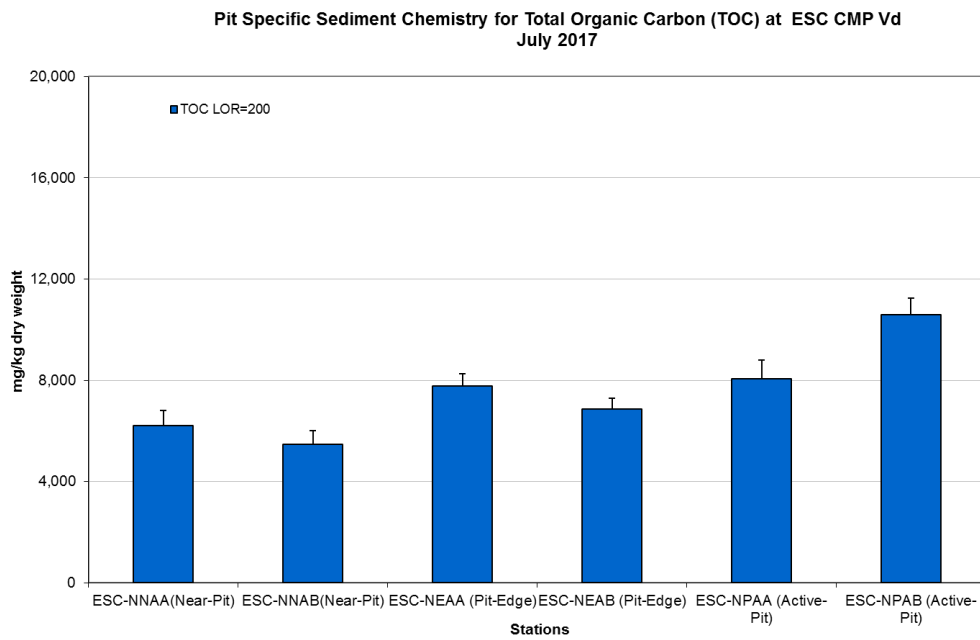


Figure 17: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in July 2017.

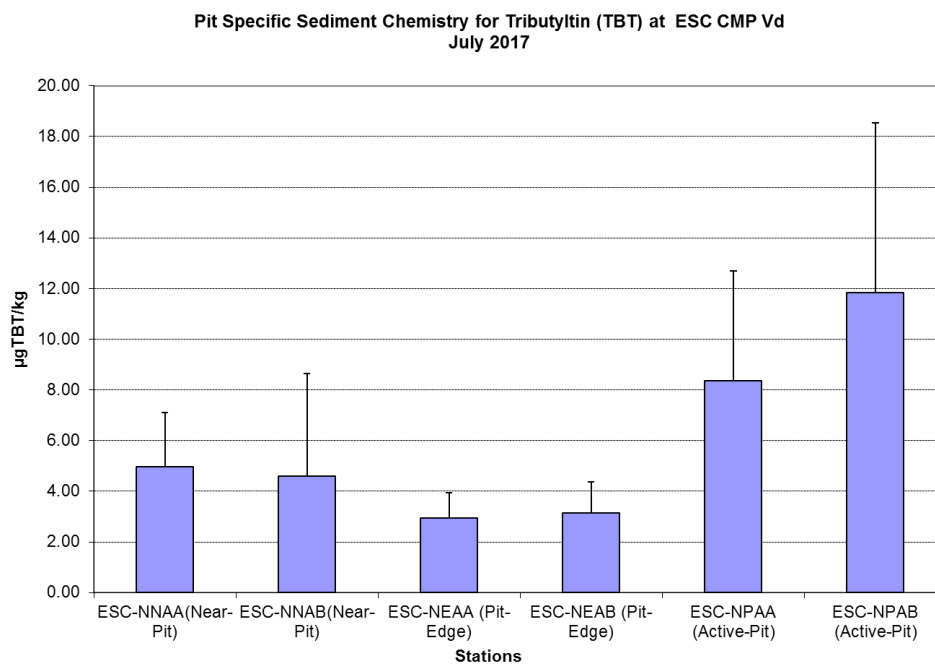


Figure 18: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in July 2017.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\4th (July 2017)

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**Cumulative Impact Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMPs
June 2017**

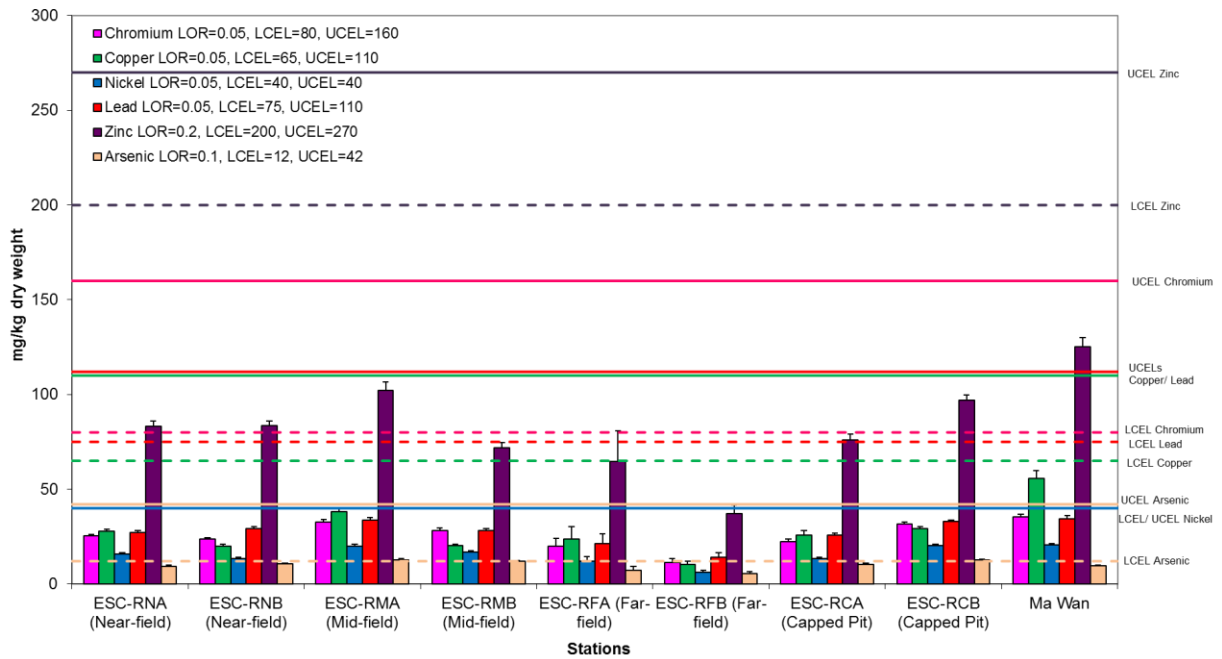


Figure 19: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2017.

**Cumulative Impact Sediment Chemistry for Metal Contaminants at ESC CMPs
June 2017**

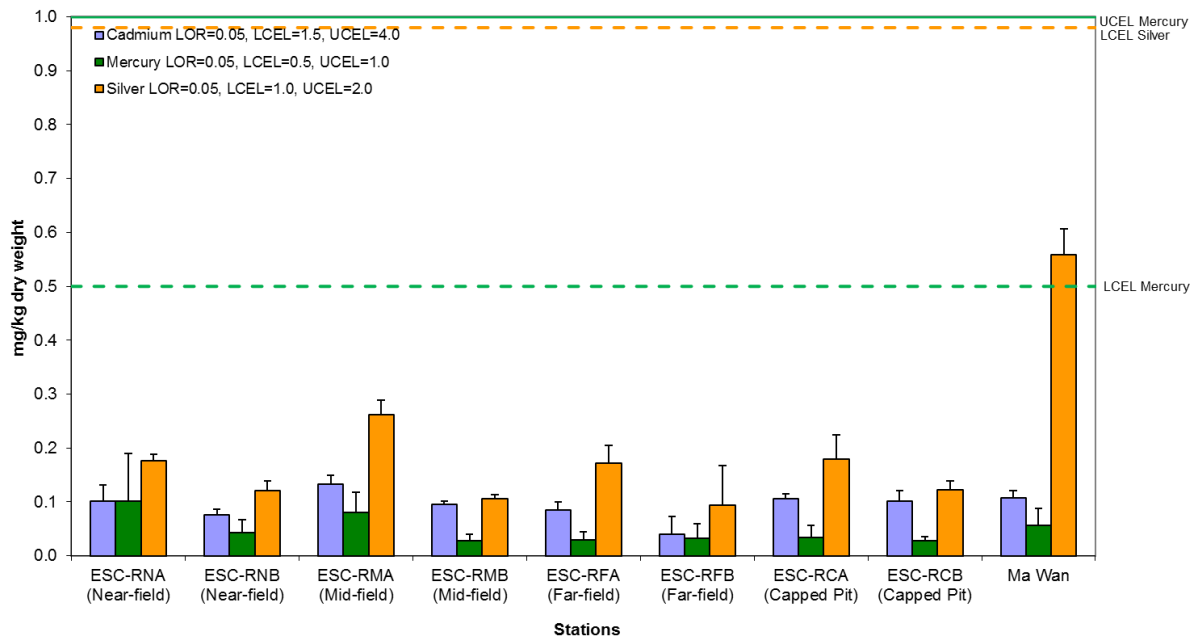


Figure 20: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2017.

Source: H:\Team\EM\GMS Projects\0175086 CEDD EM&A for South Brothers\02 Deliverable\07 CMP Monthly Report\4th (July 2017)

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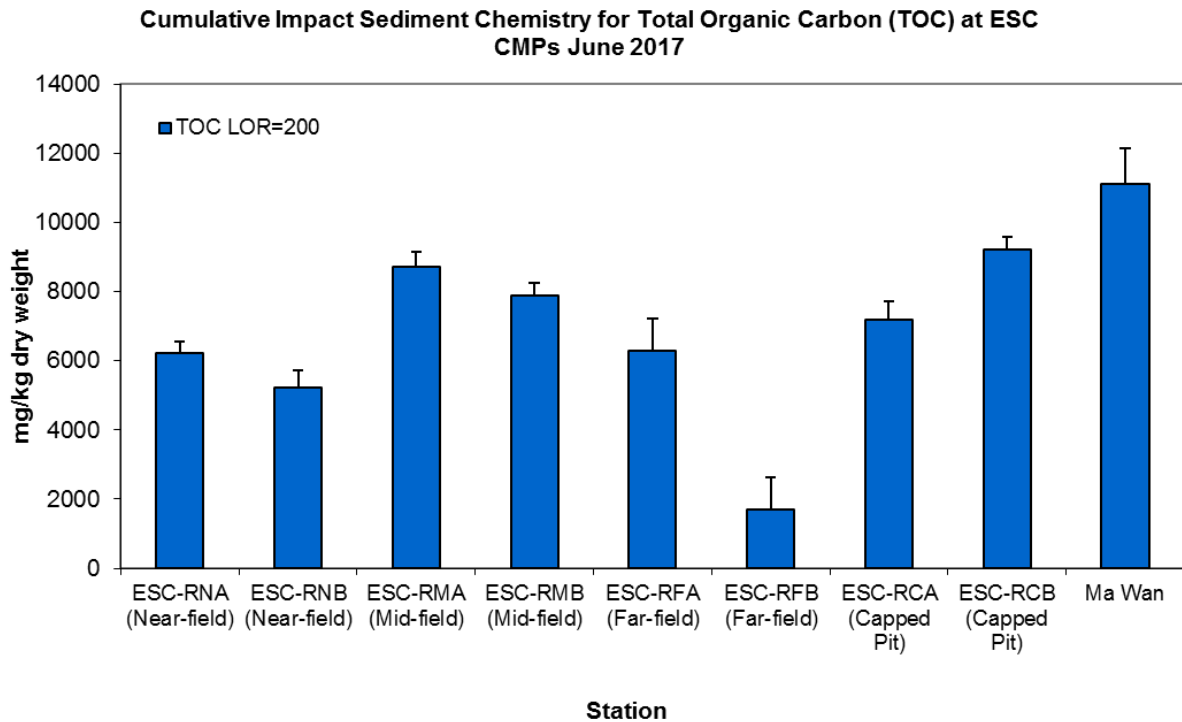


Figure 21: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2017.

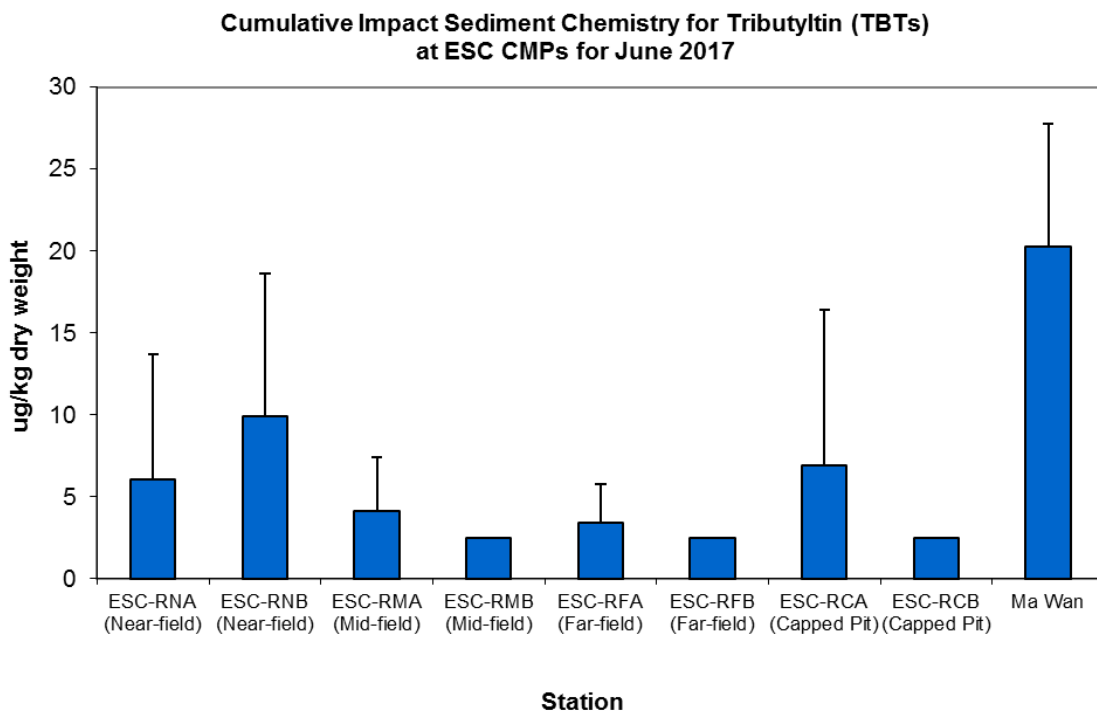


Figure 22: Concentration of Tributyltin ($\mu\text{g TBT/kg}$; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2017.

Source: H:\Team\EM\GMS Projects\0175086 CEDD EM&A for South Brothers\02 Deliverable\07 CMP Monthly Report\4th (July 2017)

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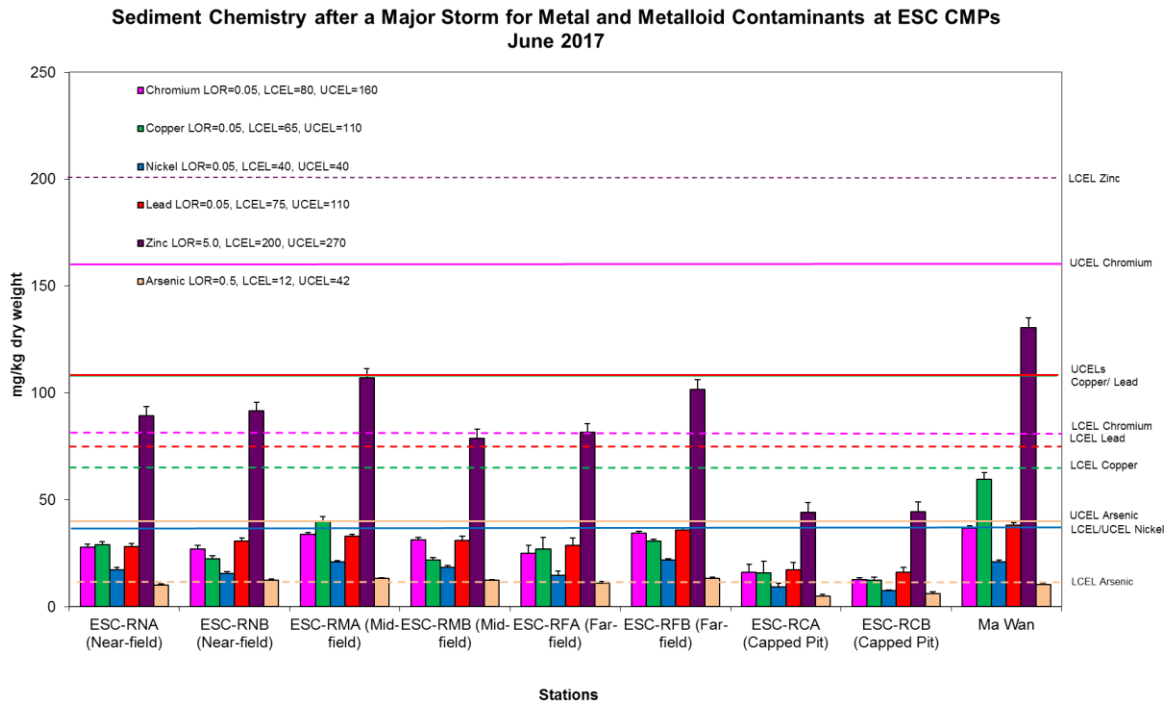


Figure 23: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in June 2017.

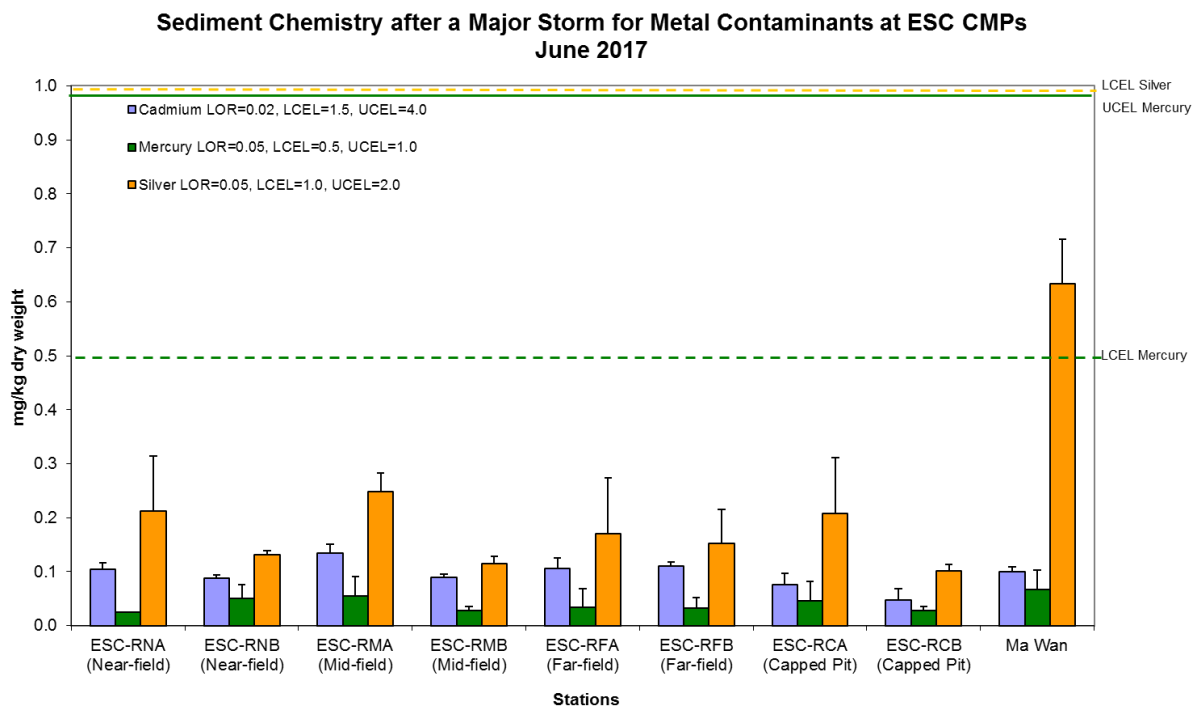


Figure 24: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in June 2017.

Source: H:\Team\EM\GMS Projects\0175086 CEDD EM&A for South Brothers\02 Deliverable\07 CMP Monthly Report\4th (July 2017)

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Annex E

Study Programme

