



**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 –  
September 2019**

Revision 0

October 2019

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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</i> .		Date: 14 October 2019			
		Approved by:    Craig A. Reid Partner			
v0	Monthly EM&A Report for ESC CMPs	GS	RC	CAR	14/10/19
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

### Environmental Certification Sheet EP-312/2008/A

#### Reference Document/Plan

Document/ <del>Plan</del> to be Certified/ Verified:	Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau - September 2019
Date of Report:	14 October 2019
Date prepared by ET:	14 October 2019
Date received by IA:	14 October 2019

#### Reference EP Condition

Environmental Permit Condition:

Condition 3.4 of EP-312/2008/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

Craig Reid,  
Environmental Team Leader:



Date: 14/10/2019

#### IA Verification

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

Dr Wang Wen Xiong,  
Independent Auditor:



Date: 14/10/2019

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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 SEPTEMBER 2019**

**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 <sup>(1)</sup> <sup>(2)</sup>. 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). The scheduled EM&A programme for SB CMPs was completed in December 2018. Detailed works schedule for ESC CMP V is shown in *Figure 1.1*. In September 2019, disposal of contaminated mud at ESC CMP Vd was undertaken.

(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**

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
ESC CMP V	Dredging																																			
	Disposal																																			
	Capping																																			

**1.2 REPORTING PERIOD**

1.2.1 This *Monthly EM&A Report for September 2019* covers the EM&A activities for the reporting month of September 2019.

**1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES**

1.3.1 The following monitoring activities were undertaken for ESC CMP V in September 2019:

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

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

1.4.1 No outstanding sampling remained for September 2019.

**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 September 2019*:

- *Water Column Profiling of ESC CMP Vd in September 2019;*
- *Pit Specific Sediment Chemistry of ESC CMP Vd in September 2019; and*
- *Cumulative Impact Sediment Chemistry of ESC CMPs in August 2019.*

1.5.2 ***Water Column Profiling of ESC CMP Vd – September 2019***

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 17 September 2019. 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 2008 - 2017 from stations in the Northwestern Water Control Zone (WCZ), where the ESC CMPs are located <sup>(1)</sup>. 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 September 2019 indicated that levels of Salinity, pH and DO complied with the WQOs at both Downstream and Upstream stations (*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 September 2019 indicated that the SS levels at both Downstream and Upstream stations were complied with the WQO and the Action and Limit Levels (*Tables B1 and B2 of Annex B*).

1.5.6 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>

- 1.5.7 *Pit Specific Sediment Chemistry of ESC CMP Vd – September 2019*
- 1.5.8 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vd* are shown in *Figure 1.2*. A total of six (6) monitoring stations were sampled on 16 September 2019.
- 1.5.9 The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at most stations, except for Arsenic, Copper and Silver at Active-Pit stations (*Figures 1 and 2 of Annex C*). The concentrations of Arsenic were higher than the LCEL at Active-Pit station ESC-NPAA. The concentrations of Copper were higher than the LCEL at Active-Pit stations ESC-NPAA and ESC-NPAB. The concentrations of Silver were higher than the LCEL at Active-Pit station ESC-NPAB.
- 1.5.10 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 <sup>(1)</sup>. It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments <sup>(2)</sup>, and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the LECL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vd but rather as a result of naturally occurring deposits.
- 1.5.11 Considering that the higher levels of Copper and Silver occurred within Active-Pit stations only but not at the Pit-Edge and Near-Pit stations, 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 2019.
- 1.5.12 For organic contaminants, the concentrations of Total Organic Carbon (TOC) varied between stations in September 2019 and were higher at Active-Pit stations ESC-NPAA and ESC-NPAB (*Figure 3 of Annex C*). The concentrations of Tributyltin (TBT) were also higher at Active-Pit stations ESC-NPAA and ESC-NPAB in September 2019 (*Figure 4 of Annex C*). Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs), High Molecular Weight 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.

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

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



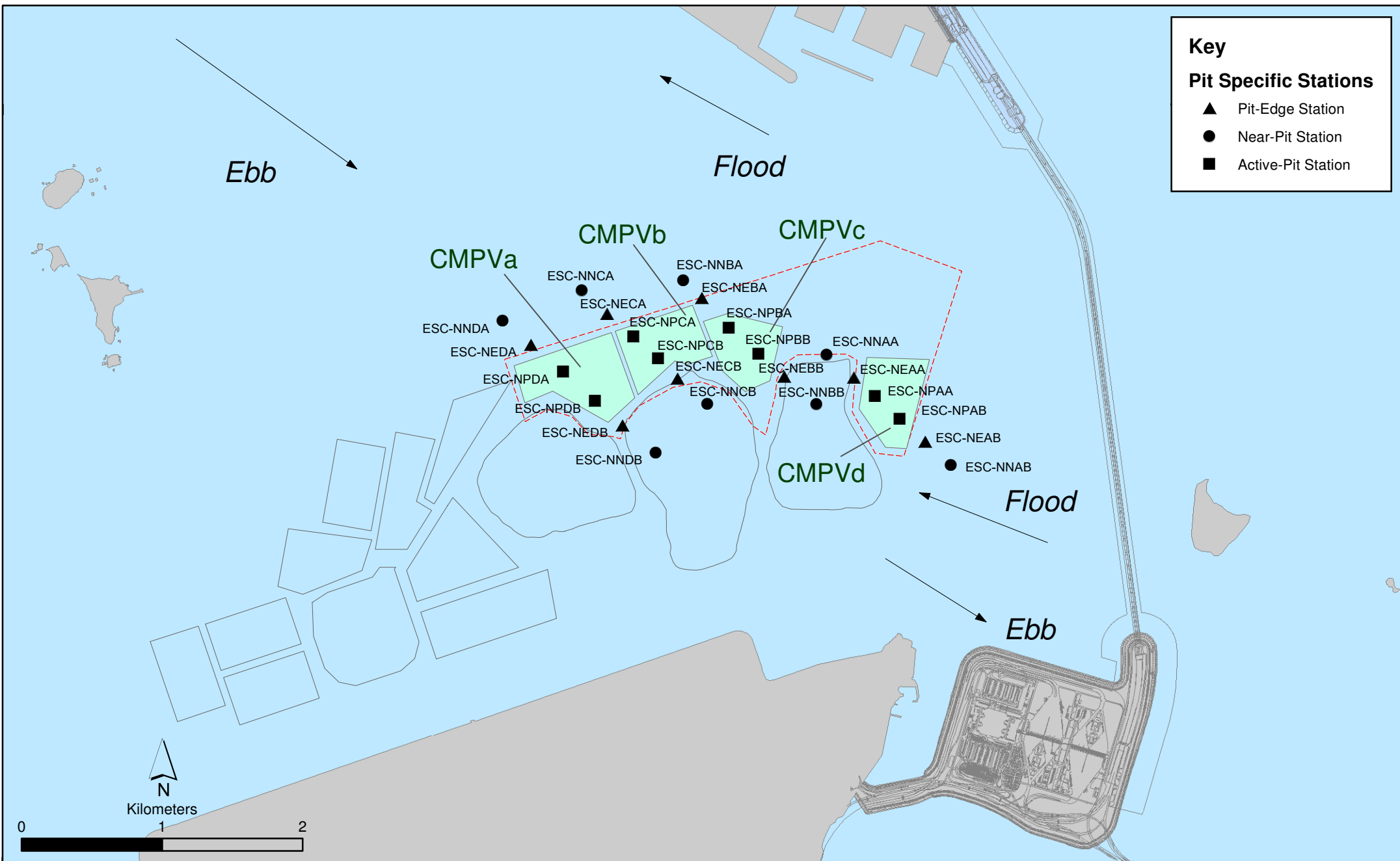


Figure 1.2

Pit Specific Sediment Quality Monitoring Stations for CMPV

1.5.13 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 2019. 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.

1.5.14 *Cumulative Impact Sediment Chemistry of ESC CMPs – August 2019*

1.5.15 Monitoring locations for Cumulative Impact Sediment Chemistry for ESC CMPs are shown in *Figure 1.3*. A total of nine (9) monitoring stations were sampled on 20 and 21 August 2019.

1.5.16 Analyses of results for the *Cumulative Impact Sediment Chemistry Monitoring* indicated that the concentrations of most inorganic contaminants were below the LCEL at most stations in August 2019, except concentrations of Arsenic were higher than the LCEL at Near-field station ESC-RNB, Mid-field stations ESC-RMA and ESC-RMB, Capped Pit station ESC-RCB and Ma Wan station and concentrations of Zinc were higher than the LCEL at Ma Wan station (*Figures 5 and 6 of Annex C*). As discussed in *Section 1.5.10*, the LCEL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vd but rather as a result of naturally occurring deposits. The LCEL exceedance of Zinc was only recorded in Ma Wan station but not in other stations located closer to ESC CMP Vd. Therefore, the LCEL exceedance of Zinc is unlikely to be caused by disposal operations at ESC CMP Vd.

1.5.17 For organic contaminants, the concentrations of TOC varied between stations in August 2019, with the generally higher concentrations of TOC recorded at Far-field station ESC-RFA (*Figure 7 of Annex C*). The concentrations of TBT were generally similar against stations, except at Man Wan Station where higher concentrations were recorded (*Figure 8 of Annex C*). Low Molecular Weight PAHs, High Molecular Weight 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.

1.5.18 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 August 2019. 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.

**1.6** *ACTIVITIES SCHEDULED FOR THE NEXT MONTH*

1.6.1 The following monitoring activities will be conducted in the next monthly period of October 2019 for ESC CMP V (see *Annex A* for the sampling schedule <sup>(1)</sup>):

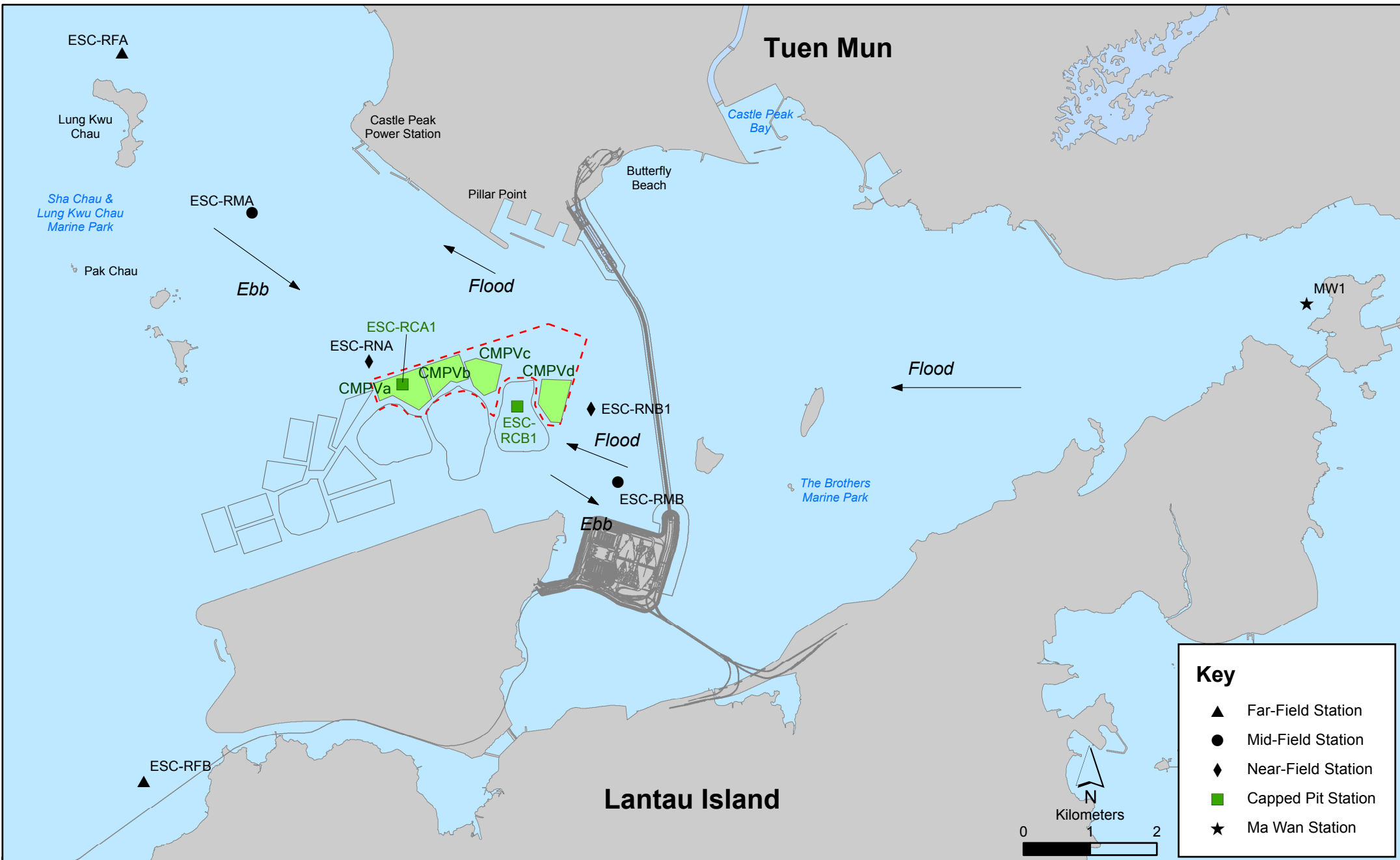


Figure 1.3

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

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

## **1.7**            **STUDY PROGRAMME**

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

(1)    The scheduled EM&A Programme for SB CMPs was completed in December 2018.

Annex A

## Sampling Schedule





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*

<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> 5%-ile of baseline data for surface and middle layer = <b>3.76 mg L<sup>-1</sup></b>	<u>Surface and Mid-depth</u> <sup>(2)</sup> 1%-ile of baseline data for surface and middle layer = <b>3.11 mg L<sup>-1</sup></b> <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)
	<u>Bottom</u> 5%-ile of baseline data for bottom layers = <b>2.96 mg L<sup>-1</sup></b>	<u>Bottom</u> The average of the impact station readings are <b>&lt;2 mg/L<sup>-1</sup></b>
	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 = <b>37.88 mg L<sup>-1</sup></b>	99%-ile of baseline data for depth average = <b>61.92 mg L<sup>-1</sup></b>
	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 = <b>28.14 NTU</b>	99%-ile of baseline data = <b>38.32 NTU</b>
	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<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 B2**      *Water Column Profiling Results for ESC CMP Vd in September 2019*

<b>Stations</b>	<b>Temp (°C)</b>	<b>Salinity (ppt)</b>	<b>Turbidity (NTU)</b>	<b>Dissolved Oxygen</b>		<b>pH</b>	<b>Suspended Solids (mg L<sup>-1</sup>)</b>
				<b>(%)</b>	<b>(mg L<sup>-1</sup>)</b>		
WCP 1 (Downstream)	29.55	25.32	4.59	70.53	4.67	7.94	4.8
WCP 2 (Upstream)	29.73	24.38	6.64	71.81	4.77	7.91	8.3
WQO (Wet Season)	N/A	21.95-26.82#	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.

Annex C

## Graphical Presentations

**Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMP Vd  
September 2019**

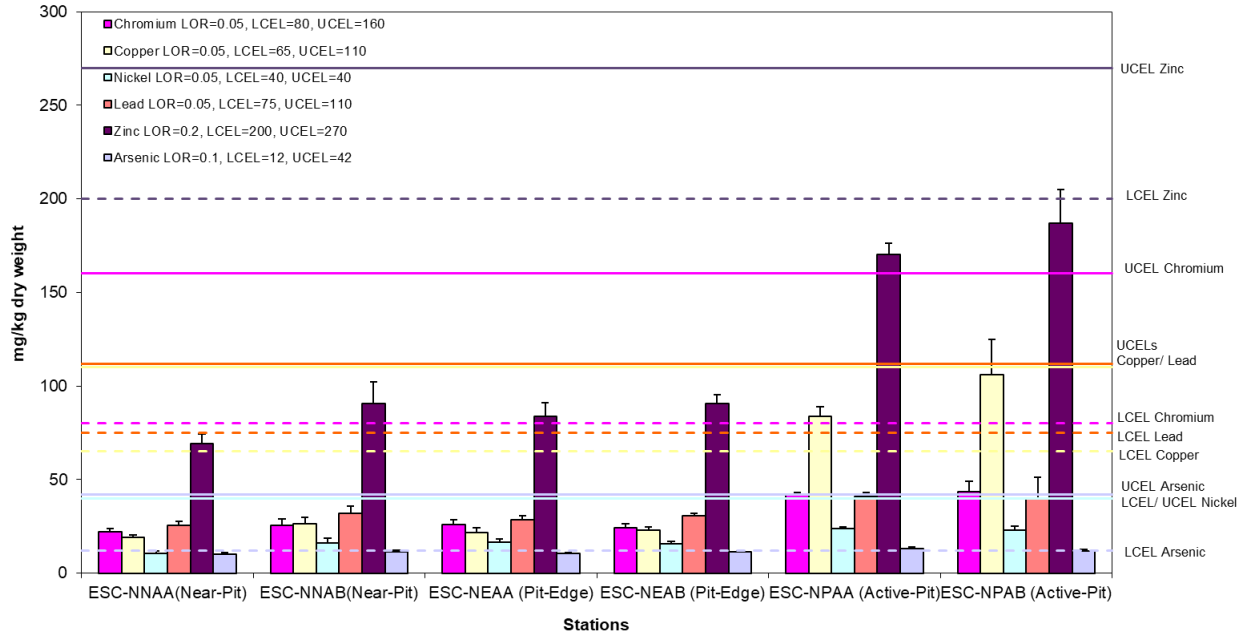


Figure 1: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in August 2019.

**Pit Specific Sediment Chemistry for Metal Contaminants at ESC CMP Vd  
September 2019**

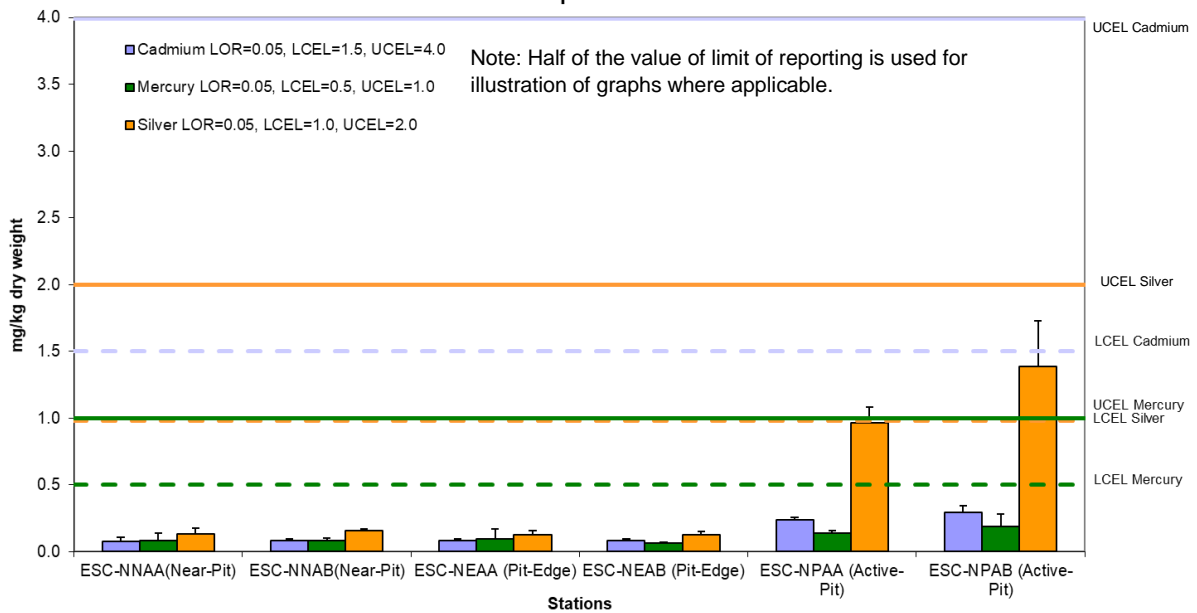


Figure 2: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2019.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\30 Monthly September 2019

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Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vd  
September 2019

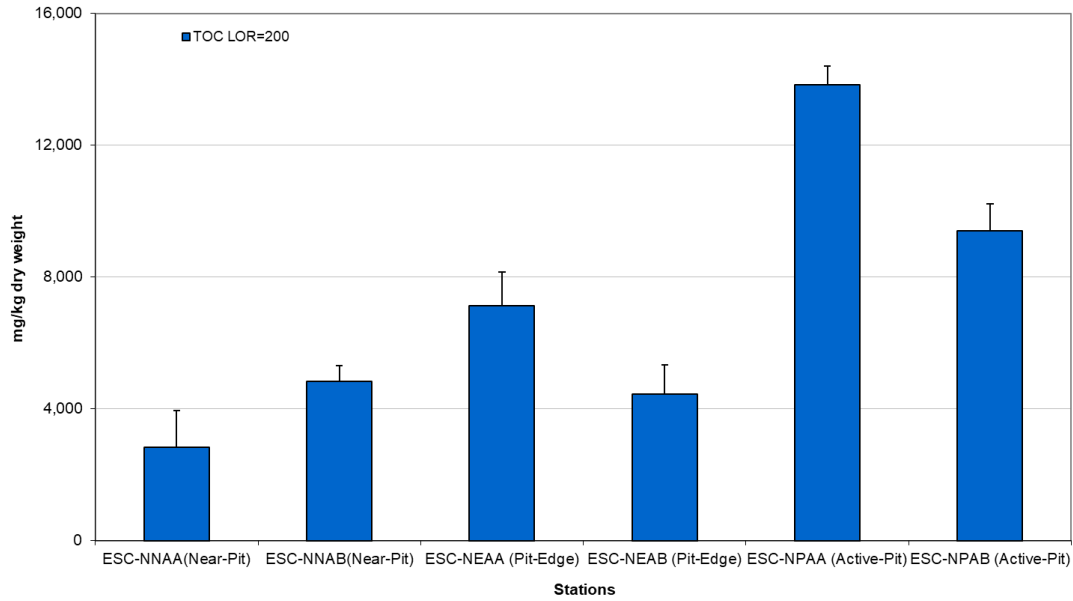


Figure 3: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2019.

Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vd  
September 2019

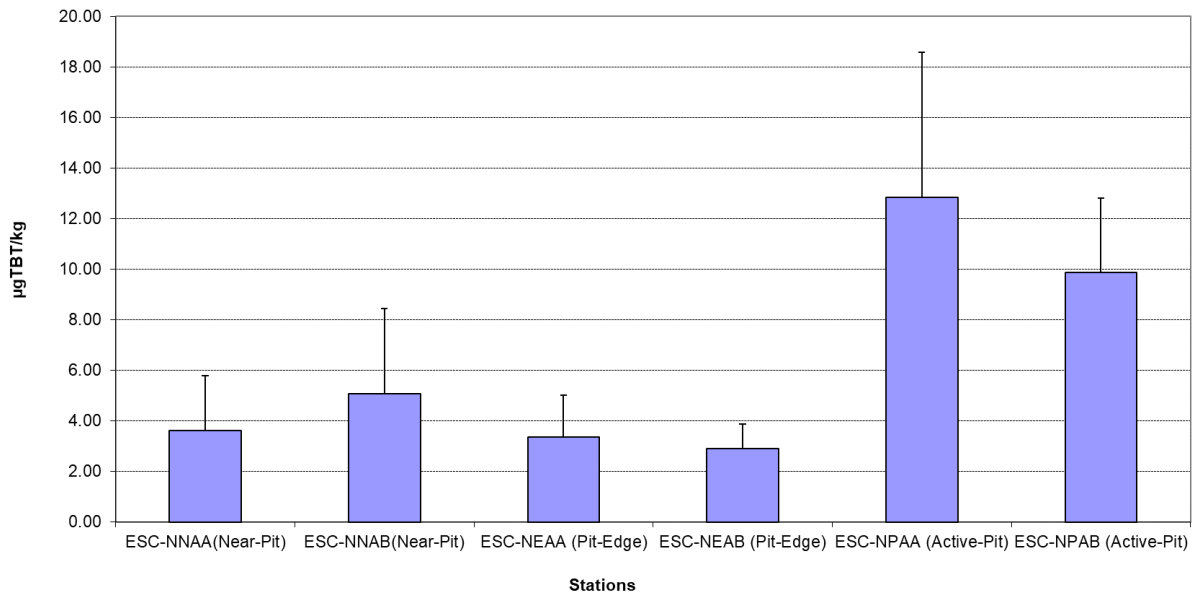


Figure 4: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in September 2019.



**Cumulative Impact Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMPs  
August 2019**

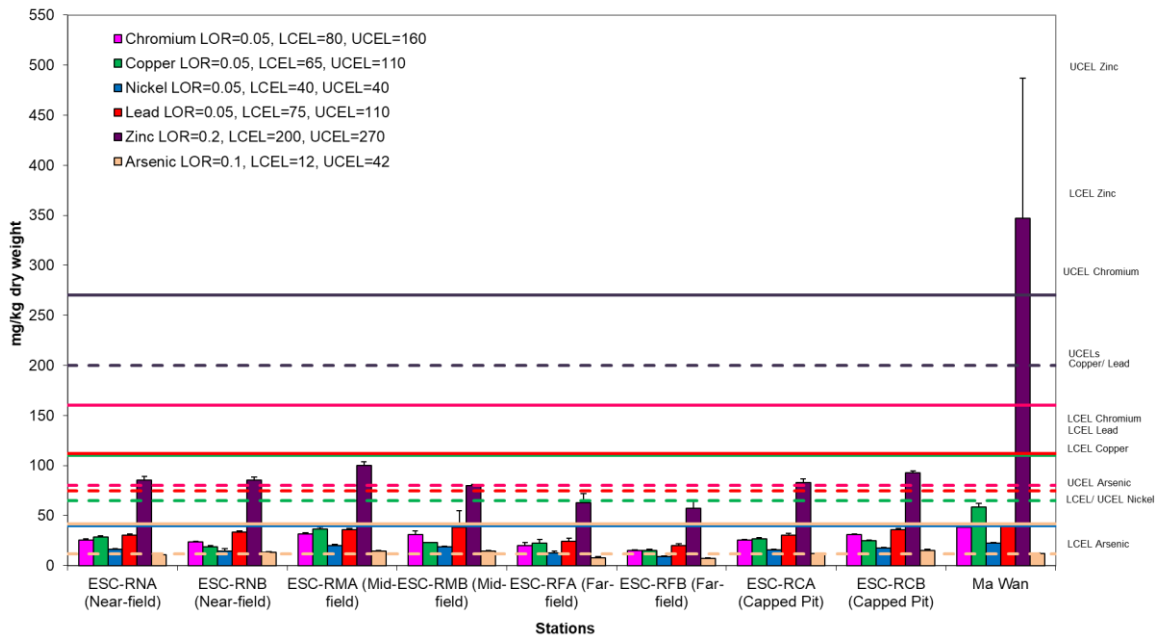


Figure 5: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in August 2019.

**Cumulative Impact Sediment Chemistry for Metal Contaminants at ESC CMPs  
August 2019**

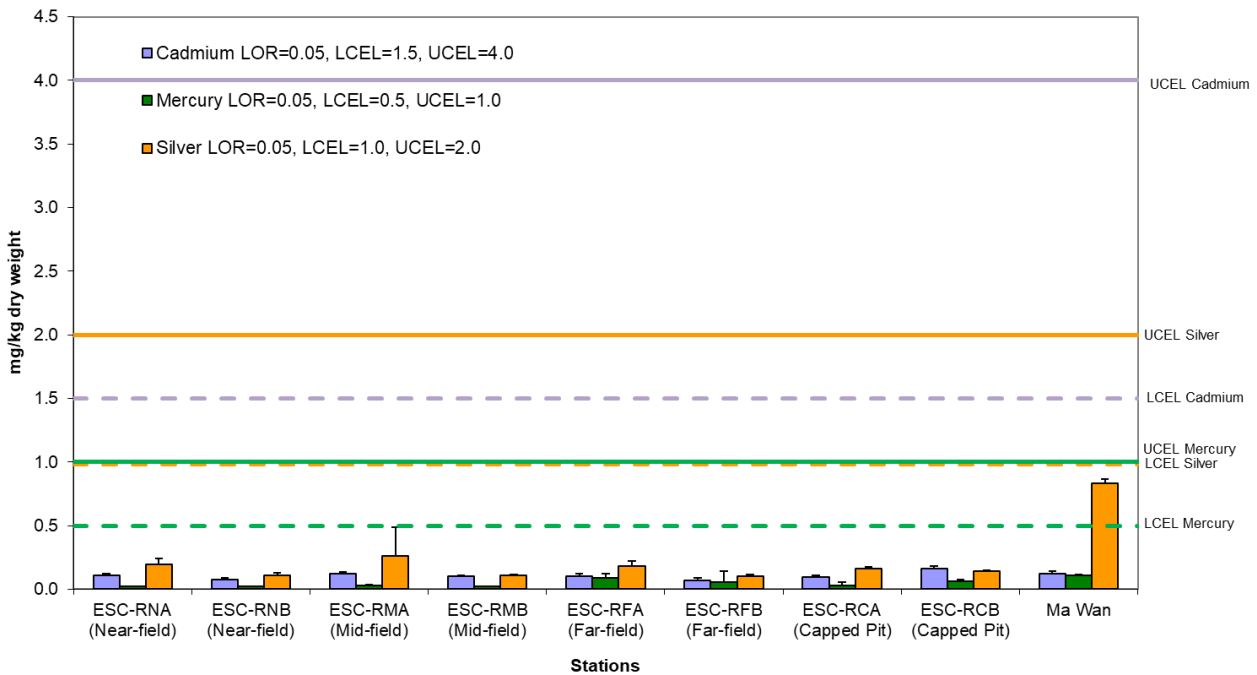


Figure 6: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in August 2019.

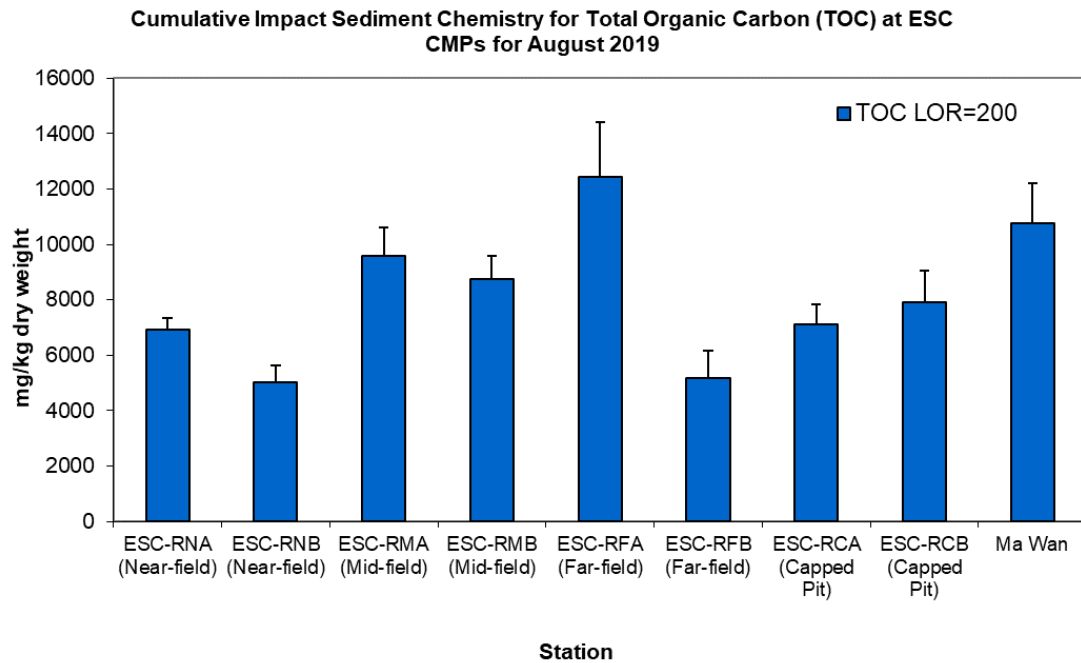


Figure 7: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in August 2019.

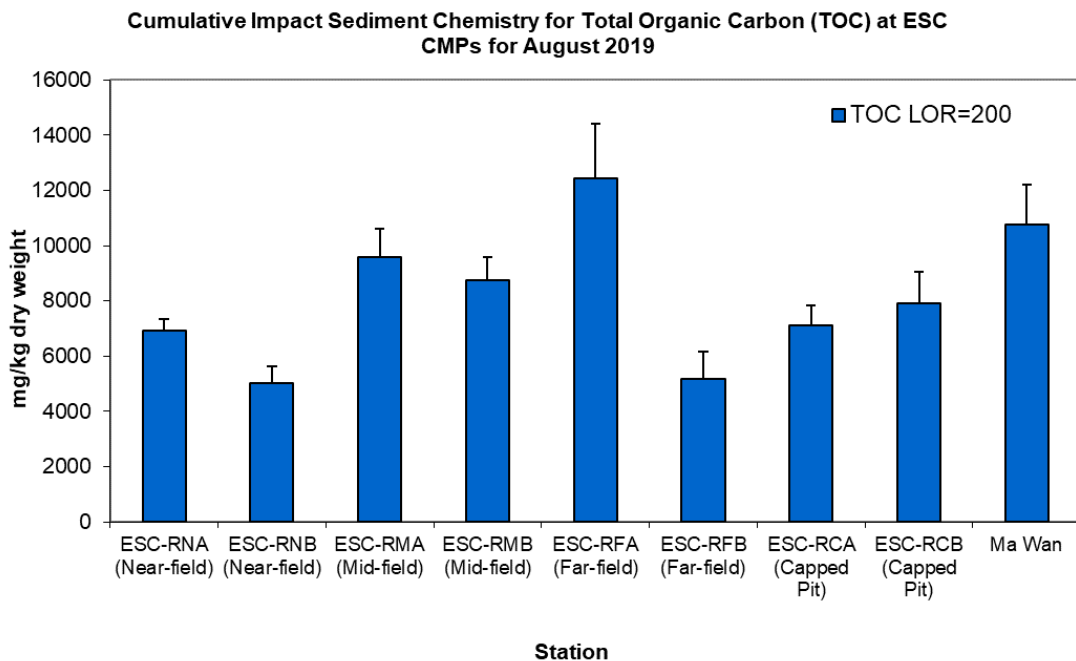


Figure 8: Concentration of Tributyltin ( $\mu\text{g TBT/kg}$ ; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in August 2019.

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Annex D

## Study Programme

