



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 – August 2019

Revision 0

September 2019

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Dredging, Management and Capping of Contaminated Sediment Disposal Facility at Sha Chau

Environmental Certification Sheet EP-312/2008/A

Reference Document/Plan

Document/Plan to be Certified/ Verified:

Monthly EM&A Report for Contaminated Mud Pits to the

East of Sha Chau - August 2019

Date of Report:

12 September 2019

Date prepared by ET:

12 September 2019

Date received by IA:

12 September 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/ $\frac{1}{plan}$ complies with the above referenced condition of EP-312/2008/A

Craig Reid,

Environmental Team Leader:

Date:

12/9/2019

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

12/9/2019

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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 AUGUST 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 opensea 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). 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 August 2019, disposal of contaminated mud at ESC CMP Vd was undertaken.

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	Operation				2	201	7									20	18											20	19										20	020)					2	202	1
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ESC CMP V	Disposal																																	T														
	Capping																																															

1.2 REPORTING PERIOD

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

1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

- 1.3.1 The following monitoring activities were undertaken for ESC CMP V in August 2019:
 - Water Column Profiling of ESC CMP Vd;
 - Routine Water Quality Monitoring of ESC CMPs;
 - Pit Specific Sediment Chemistry of ESC CMP Vd;
 - Cumulative Impact Sediment Chemistry of ESC CMP V;
 - *Sediment Toxicity Tests of ESC CMP V;*
 - Demersal Trawling for ESC CMPs; and
 - Sediment Chemistry after a Major Storm of ESC CMP V.

1.4 DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS

- 1.4.1 No outstanding sampling remained for August 2019.
- 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 *Cumulative Impact Sediment Chemistry of ESC CMP V* in August 2019.
- 1.4.3 The following analyses are in progress and will be presented in the corresponding quarterly report:
 - Laboratory analyses for *Sediment Toxicity Test of ESC CMP V* in August 2019; and
 - Species identification of the biota samples collected from *Demersal Trawling for ESC CMPs* in August 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 August 2019*:
 - Water Column Profiling of ESC CMP Vd;
 - Routine Water Quality Monitoring of ESC CMPs;
 - Pit Specific Sediment Chemistry of ESC CMP Vd; and
 - Sediment Chemistry after a Major Storm of ESC CMP V.

1.5.2 Water Column Profiling of ESC CMP Vd - August 2019

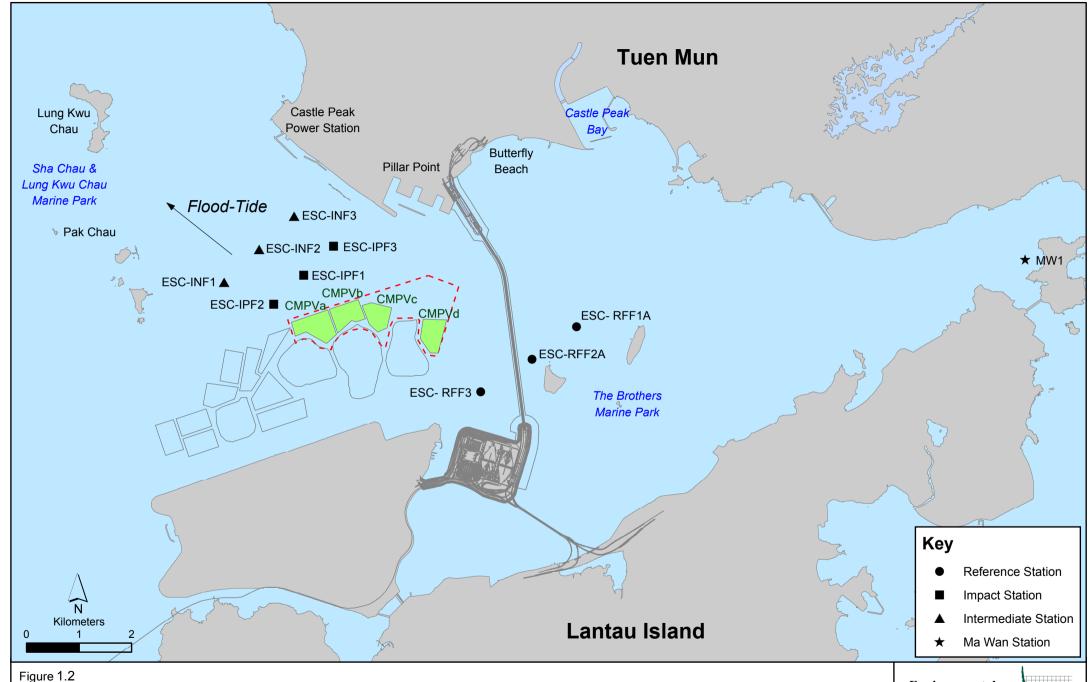
1.5.3 Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 13 August 2019. The monitoring results have been assessed for compliance with the Water Quality Objectives (WQOs) set by Environmental Protection Department (EPD). This consists of a 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 (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 August 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 August 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.
- 1.5.7 Routine Water Quality Monitoring of ESC CMP V August 2019
- 1.5.8 Routine Water Quality Monitoring of ESC CMP V was undertaken on 8 August 2019. 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 August 2019 as shown in Figure 1.2.



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



In-situ Measurements

- 1.5.9 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 August 2019 indicated that the levels of pH, Salinity and DO generally complied with the WQOs at most stations (Impact, Intermediate, Reference and Ma Wan stations) in August 2019, except higher levels of Salinity were recorded at Ma Wan station.
- 1.5.10 The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (*Table B3* of *Annex B*; *Figures 3* and 6 of *Annex C*).
- 1.5.11 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 August 2019.

Laboratory Measurements

- 1.5.12 Laboratory analysis of August 2019 results indicated that concentrations of Cadmium, Mercury and Silver were below their limit of reporting at all stations. Arsenic, Chromium, Copper, Lead, Nickel and Zinc were detected in August 2019 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*).
- 1.5.13 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at all stations in August 2019 were higher than the WQO (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 August 2019 (*Table B4* of *Annex B*; *Figure 8 and 9* of *Annex C*).
- 1.5.14 Analyses of results for August 2019 indicated that the SS levels at all stations were lower than the WQO (10.8 mg/L for wet season) and complied with the Action and Limit Levels (*Tables B1 and B4* of *Annex B*; *Figure 10* of *Annex C*).
- 1.5.15 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 August 2019. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

1.5.16 Pit Specific Sediment Chemistry of ESC CMP Vd - August 2019

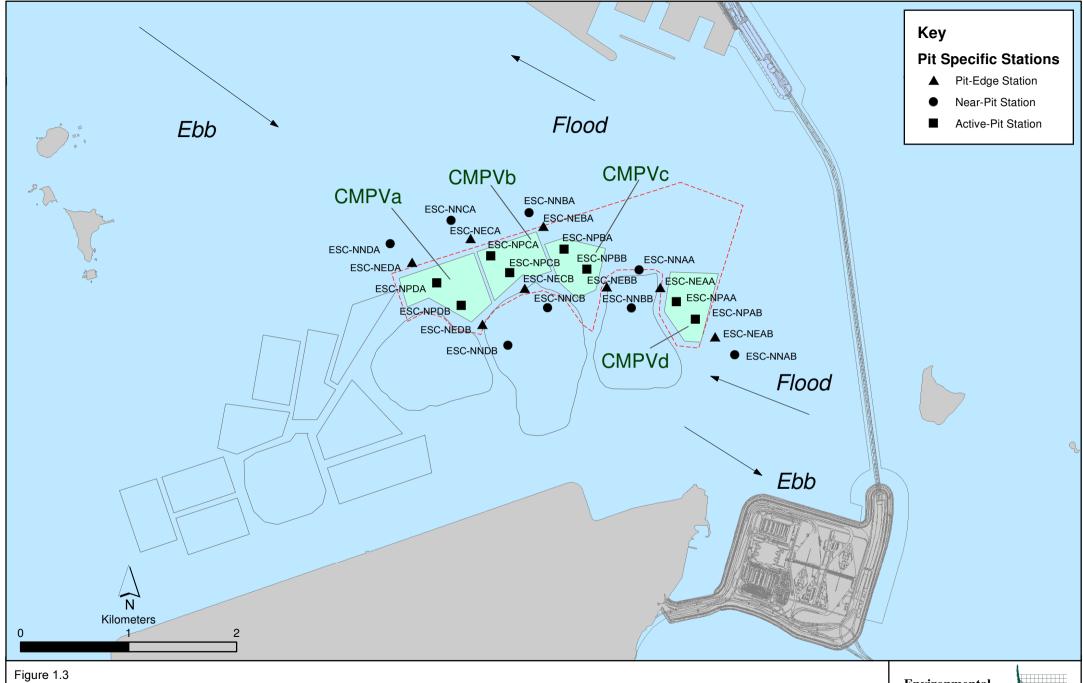
- 1.5.17 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vd* are shown in *Figure 1.3.* A total of six (6) monitoring stations were sampled on 5 August 2019.
- 1.5.18 The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at most stations, except concentrations of Arsenic and Copper were slightly higher than the LCEL at Active Pit stations ESC-NPAB and ESC-NPAA, respectively (Figures 11 and 12 of Annex C). 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 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. In addition, slight exceedance of Copper was recorded within one Active-Pit station ESC-NPAA only but not at the Pit-Edge and Near-Pit stations.
- 1.5.19 For organic contaminants, the concentrations of Total Organic Carbon (TOC) varied between stations in August 2019 and were generally higher at Active-Pit stations ESC-NPAA and ESC-NPAB (*Figure 13* of *Annex C*). The concentrations of Tributyltin (TBT) were higher at Active-Pit station ESC-NPAA in August 2019 (*Figure 14* of *Annex C*). Low 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. High Molecular Weight PAHs were detected at Near-Pit station ESC-NNAB and Pit-Edge ESC-NEAA in the reporting month (*Figure 15* of *Annex C*).
- 1.5.20 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.

1.5.21 Sediment Chemistry after a Major Storm of ESC CMP V - August 2019

Sampling for Sediment Chemistry after a Major Storm Event was conducted at nine (9) monitoring stations (see Figure 1.4 for the locations of the monitoring stations) on 7 August 2019 after the visit of tropical cyclone Wipha, which led

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

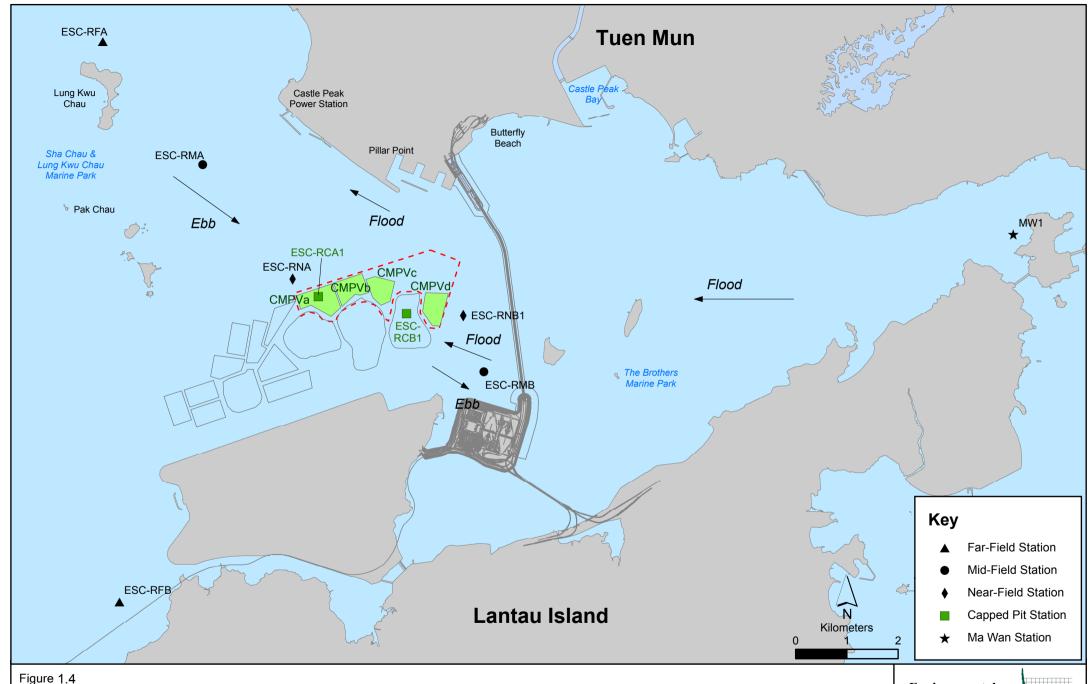
⁽²⁾ Whiteside PGD (2000) Natural geochemistry and contamination of marine sediments in Hong Kong. In: The Urban Geology of Hong Kong (ed Page A & Reels SJ). Geological Society of Hong Kong Bulletin No. 6, p109-121



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Pit Specific Sediment Quality Monitoring Stations for CMPV





Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

Environmental Resources Management



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to the issue of No. 8 Gale Signal on 31 July 2019. The track of Wipha are shown in Figure 1.5.

Figure 1.5 Track of Tropical Cyclone Wipha (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 stations ESC-RCA and ESC-RCB, Mid-field stations ESC-RMA and ESC-RMB and Near-field station ESC-RNB as well as Copper at Ma Wan Station in August 2019 (*Figures 16* and 17 of *Annex C*).
- 1.5.23 As mentioned in *Section 1.5.18*, it is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments, 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. For the exceedance of Copper, it was only recorded at Ma Wan Station but not the other monitoring stations.
- 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 August 2019.

1.6 ACTIVITIES SCHEDULED FOR THE NEXT MONTH

- 1.6.1 The following monitoring activities will be conducted in the next monthly period of September 2019 for ESC CMP V (see *Annex A* for the sampling schedule (1)):
 - Water Column Profiling of ESC CMP Vd; and
 - *Pit Specific Sediment Chemistry of ESC CMP V.*

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

1.7	STUDY PROGRAMME
1.7.1	A summary of the Study Programme is presented in <i>Annex D</i> .

Annex A

Sampling Schedule

Annex A1 - East of Sha Chau Environmental Monitoring and Audit Sampling Schedule for CMP (April 2017 - March 2021)

Annex A1 - East of Sha Chau Envi	ironmental Mon	itoring and Audit Sampling	g Schei	dule foi	r CM	,	2017 - 1	March	2021)				2.1.2																		
Pit Specific Sediment Chemistry Active-Pit	Code	Frequency	A	M	J	2017 J A	S O	N	D	J F M	I A	2 M J	018 J A	SO	N	D J	F M	A M	2019 J J	A S	0	N D	J	F M	A	202 M J		S	O N	D J	2021 J F N
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Pit-Edge	ESC-NEAA ESC-NEAB	Monthly Monthly	12	12 1	12 1	2 12	12 12	2 12	12	12 12 12 12 12 12	2 12	12 12	12 12	12 12	12 1	12 12 12 12	12 12	12 12	12 12	12 12	12	12 12 12 12	12	12 12 12 12	12 1	12 12	12 12	12	12 12 12 12 12 12 12 12 12 12 12 12 12 1	12 1 [']	12 12 1 12 12 1
Near-Pit	ESC-NNAA	Monthly			12 1	2 12	12 12	2 12	12	12 12 1	2 12	12 12	12 12	12 12	12 1	12 12	12 12	12 12	12 12	12 12	12	12 12	12	12 12	12 1	12 12	12 12	12	12 12	12 12	12 12 1
Cumulative Impact Sediment Cho	ESC-NNAB	Monthly		12 1	12 1				I				12 12				12 12	12 12	12 12	12 12		12 12	12	12 12	A B	12 12 M T	12 12		12 12 1		12 12 1 I F N
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Mid-field Stations	ESC-RNB1	4 times per year			12	12			12	12		12				12	12		12	12		12		12	\blacksquare	12	12			12	12
Capped Pit Stations	ESC-RMA ESC-RMB	4 times per year 4 times per year			12 12	12			12 12	12 12		12				12 12	12 12		12	12		12 12		12	\coprod	12	12			12 12	12
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Far-Field Stations	ESC-RFA ESC-RFB	4 times per year 4 times per year			12 12	12			12 12	12 12		12				12 12	12 12		12 12	12 12		12 12		12 12	\coprod	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	ightharpoons	12				12	12
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Near-Pit Stations	ESC-INA	2 times per year				*				*			*				*			*				*	\coprod		*			\pm	*
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Reference South	TNB	2 times per year			1	*				*			*				*			*				*	Ħ	\blacksquare	*	日		#	*
	TSA TSB	2 times per year 2 times per year				*				*			*				*			*				*	世		*			土	*
Demersal Trawling Near Pit Stations			A	M	J	JA	SO	N			1 A	M J		SO	N		F M	A M		A S	0	N D		F M	AI		JA	S	ON		J F N
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Reference South	TSA TSB	4 times per year 4 times per year				5 5			-	5 5 5 5			5 5 5 5			5				5			5	5	+	\blacksquare	5 5 5 5	H		5	5 5 5 5
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Capping Ebb Tide Impact Station Downcurrent			A	141	,	JA	3 0			J I IV	IA	IVI J	JA	3 0		<i>D</i> ,	T IVI	A W	, , ,	A 3		N D	,	1 141	A	VI J	JA				
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	ESC-IPE3 ESC-IPE4 ESC-IPE5	4 times per year 4 times per year 4 times per year																				3 3		3 3	igoplus	3 3	3 3	\Box		3 3	3 3
Intermediate Station Downcurrent	t ESC-INE1A	4 times per year																				3		3		3	3			3	3
	ESC-INE3A	4 times per year 4 times per year 4 times per year																				3 3		3 3	$\parallel \parallel$	3 3 3	3 3	\Box		3 3	3 3
Reference Station Upcurrent	ESC-INE5A	4 times per year																				3		3	$oxed{\pm}$	3	3			3	3
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Ma Wan Station	MW1	4 times per year																				3		3		3	3			3	3
Flood Tide Impact Station Downcurrent	ESC-IPF1	4 times per year		<u> </u>		1 1		1 1			<u> </u>		 		1 1						1 1	3		3		3	3	$\overline{}$		3	3
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Reference Station Upcurrent	ESC-INF3	4 times per year																				3		3		3	3			3	3
	ESC-RFF2A	4 times per year 4 times per year																				3 3 3		3		3 3	3			3	3 3
Ma Wan Station	ESC-RFF3 MW1	4 times per year 4 times per year														+						3		3	Ħ	3 3		\exists		3	3
Routine Water Quality Monitorin		T	A	M	J	J A	s o	N	D	J F N	1 A	МЈ	JA	S O	N	D J	F M	A M	JJ	A S	0	N D		F M	A 1			S	O N	D j	J F N
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Intermediate Station Downcurrent	ESC-IPE4 ESC-IPE5	8 times per year 8 times per year	8		_	8 8 8		8 8		8 8 8	8 8	8	8 8		8 8	8		8 8 8 8		8	8 8	8	8	8	8 8	8	8 8		8 8		8 8 8
intermediate Station Downcurrent	ESC-INE1A ESC-INE2A	8 times per year 8 times per year	8	8 8		8 8 8 8		8 8		8 8 8	8	8 8	8 8		8 8	8		8 8 8 8	8 8		8 8	8 8	8	8 8		8 8	8 8 8 8	\Box	8 8		8 8 8
	ESC-INE3A ESC-INE4A	8 times per year 8 times per year	8	8		8 8 8 8 8 8	8	8 8 8		8 8 8 8 8 8	8 8 8	8 8	8 8 8 8 8 8	8	8 8 8	8 8 8	8 8	8 8 8 8 8 8	8		8 8	8 8	8	8 8 8	8 8	8 8	8 8 8 8 8 8	H	8 8 8 8 8 8	8	8 8 8 8 8 8
Reference Station Upcurrent	ESC-INE5A ESC-RFE1	8 times per year 8 times per year	8	8		8 8	8	8	-	8 8	8	8	8 8	8	8	8	8	8 8	8	8	8	8	8	8	8 8	8	8 8		8 8	8	8 8
	ESC-RFE2 ESC-RFE3 ESC-RFE4	8 times per year 8 times per year	8 8 8	8	_	8 8 8 8 8 8	8	8 8		8 8 8 8	8 8	8	8 8 8 8 8 8		8 8	8 8 8	8	8 8 8 8 8 8	8 8 8	8	_	8 8	8 8 8	8 8 8	8 8		8 8 8 8 8 8	H	8 8 8 8	8	8 8 8 8 8 8
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Flood Tide Impact Station Downcurrent	MW1	8 times per year	8	8		8 8	8	8	\dashv	8 8	8	8	8 8	8	8	8	8	8 8	8	8	8	8	8	8	8	8	8 8	二	8 8	8	8 8
Impact Station Downcurrent	ESC-IPF1 ESC-IPF2	8 times per year 8 times per year	8			8 8 8	8	8 8	\dashv		8	8 8	8 8 8 8	8		8		8 8 8 8	8	8 8	8 8	8 8	8	8 8		8 8	8 8 8 8	П	8 8		8 8 8
Intermediate Station Downcurrent	ESC-IPF3	8 times per year	8	8		8 8	8	8	\pm		8	8	8 8	8	8	8	8	8 8	8	8	8	8	8	8	8	8	8 8		8 8	8	8 8
	ESC-INF1 ESC-INF2 ESC-INF3	8 times per year 8 times per year 8 times per year	8	8 8		8 8 8 8 8 8	8	8 8 8	+		8 8 8	8 8 8	8 8 8 8 8 8	8	8 8 8	8 8 8	8	8 8 8 8 8 8		8 8 8	8 8 8	8 8	8 8 8	8 8 8		8	8 8 8 8 8 8		8 8 8 8 8 8	8	8 8 8 8 8 8
Reference Station Upcurrent	ESC-RFF1A	8 times per year	8	8		8 8	8	8			8	8	8 8	8	8	8	8	8 8	8	8	8	8	8	8	8 8	8	8 8		8 8	8	8 8
Ma Wan Station	ESC-RFF2A ESC-RFF3	8 times per year 8 times per year	8		—	8 8 8		8 8	\exists		8	8	8 8	8	8 8	8		8 8 8 8		8 8	8 8	8	8	8		8 8	8 8 8		8 8 8		8 8 8
	MW1	8 times per year	8	8		8 8	8	8			8	8	8 8	<u> </u>	8	8	8	8 8	8	8	8	8	8	8	8 8	8	8 8		8 8	8	8 8
Water Column Profiling Plume Stations	WCP1	Monthly Monthly	4 4		J 4	,	S 0 4 4	4	D 4		4	4 4	J A 4 4	4 4	4	4 4	4 4		4 4		4						J A 4				J F N
Benthic Recolonisation Studies	WCP2	Monthly	4 A	4 -	4 ·	J A I	4 4 S O		4 D		1 A		4 4	4 4 S O			4 4 F M	4 4 A M		4 4 A S		4 4 N D		4 4 F M		4 4 M J	4 4 J A		0 N	4 4 D J	4 4 4 4 J F N
Capped Stations at CMPV	ESCV-CPA	2 times per year																												#	
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Reference Stations	RBA	2 times per year																												丰	#
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			A	M	J	JA	SO	N	D	J F N	1 A	M J	J A	SO	N	D J	F M	A M	J J	A S	0	N D	J	F M	AI	M J	JA	S	O N	D J	J F N
Impact Monitoring for Dredging Upstream Stations			1		,															1			_	-			•			=	
Upstream Stations	US1 US2	3 times per week 3 times per week	E			2 2 2 2	2 2																		\blacksquare			\boxminus		王	
	US1 US2 DS1	3 times per week 3 times per week				2 2 2 2 2 2 2 2 2 2																								#	#
Upstream Stations	US1 US2 DS1 DS2 DS3 DS4	3 times per week				2 2 2 2 2 2 2 2 2 2 2 2 2 2	2																								
Upstream Stations	US1 US2 DS1 DS2 DS3	3 times per week 3 times per week 3 times per week 3 times per week				2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2																								

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)	Surface and Mid-depth (2)	Surface and Mid-depth (2)
	5%-ile of baseline data for surface and	1%-ile of baseline data for surface and
	middle layer = 3.76 mg L ⁻¹	middle layer = 3.11 mg L- 1 (3)
	and	and
	Significantly less than the reference	Significantly less than the reference
	stations mean DO (at the same tide of	stations mean DO (at the same tide of
	the same day)	the same day)
	Bottom	Bottom
	5%-ile of baseline data for bottom	The average of the impact station
	layers = 2.96 mg L-1	readings are <2 mg/L ⁻¹
	and	and
	Significantly less than the reference	Significantly less than the reference
	stations mean DO (at the same tide of the same day)	stations mean DO (at the same tide of the same day)
Depth-averaged Suspended	95%-ile of baseline data for depth	99%-ile of baseline data for depth
Solids (SS) (4) (5)	average = 37.88 mg L-1	average = 61.92 mg L -1
	and	
		and
	120% of control station's SS at the same	130% of control station's SS at the same
	tide of the same day	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 August 2019

Stations	Temp	Salinity	Turbidity	Dissolved	l Oxygen	pН	Suspended Solids
	(°C)	(ppt)	(NTU)	(%)	(mg L-1)		(mg L-1)
WCP 1 (Downstream)	29.59	19.85	6.36	79.55	5.43	7.88	4.48
WCP 2 (Upstream)	29.91	19.67	8.99	78.47	5.34	7.88	8.13
WQO (Wet Season)	N/A	17.70- 21.63#	N/A	N/A	>4	6.5-8.5	10.8

Note:

Cell shaded grey indicate value exceeding the WQO.

Table B3 In-situ Monitoring Results for Routine Water Quality Monitoring of ESC CMPs in August 2019

Sampling	Stations	Temp	Salinity	Turbidity	Dissolve	d Oxygen	pН
Period	Stations	(°C)	(ppt)	(NTU)	(%)	(mg L-1)	(mg L-1)
August	RFF (Reference)	28.34	23.13	7.88	72.75	4.98	7.66
2019	IPF (Impact)	28.29	22.45	8.56	70.92	4.88	7.65
	INF (Intermediate)	28.36	22.23	5.20	70.03	4.81	7.52
	Ma Wan	27.58	28.72	5.60	66.90	4.49	7.65
	WQO	N/A	20.82-25.44#	N/A	N/A	>4	6.5-8.5

Notes

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 August 2019

Sampling	Stations	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	NH_3	TIN	BOD_5	SS
Period	Stations	(μg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)								
August	RFF	2.05	0.25	0.52	27.28	2.09	0.25	1.32	0.50	26.05	0.09	2.08	2.33	9.30
2019	IPF	2.19	0.25	0.53	7.99	1.15	0.25	1.55	0.50	25.22	0.08	1.05	1.88	10.01
	INF	2.08	0.25	0.50	17.35	1.68	0.25	1.49	0.50	35.20	0.07	1.05	2.38	6.73
	Ma													
	Wan	1.79	0.25	0.50	6.26	0.50	0.25	0.50	0.50	14.43	0.09	1.10	1.74	7.18
												MOO	CTINIO	- /T

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 $\mbox{\it Action/Limit}$ levels.

Cell shaded grey indicate value exceeding the WQO.

^{*}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.

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

Annex C

Graphical Presentations

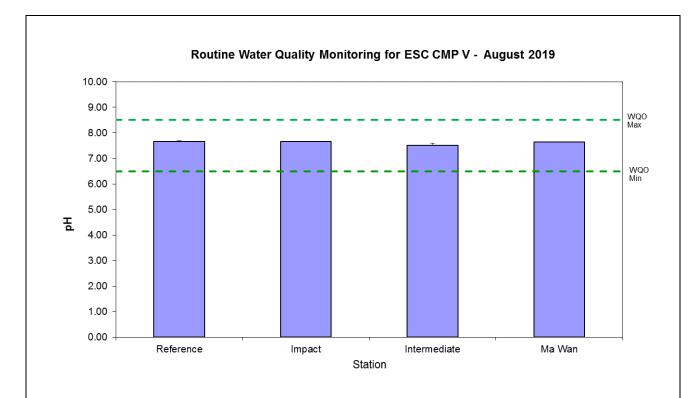


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

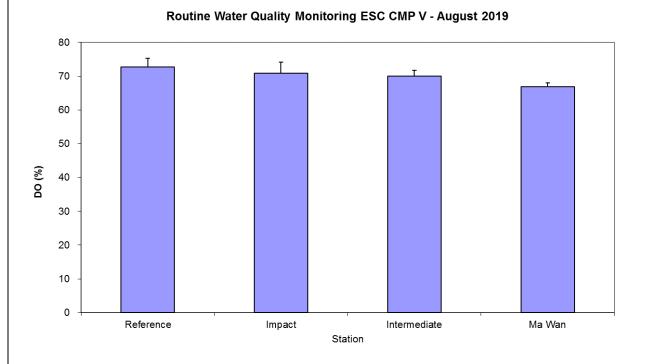


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

Date: September 2019



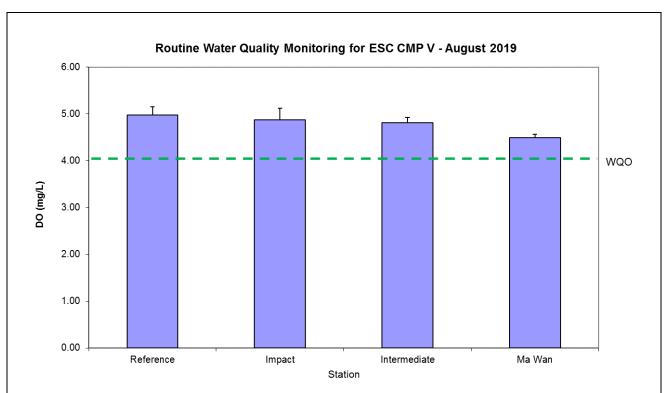


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

35.00 30.00 25.00 10.00 10.00 Reference Impact Station Research Ma Wan

Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\August 2019)

Date: September 2019



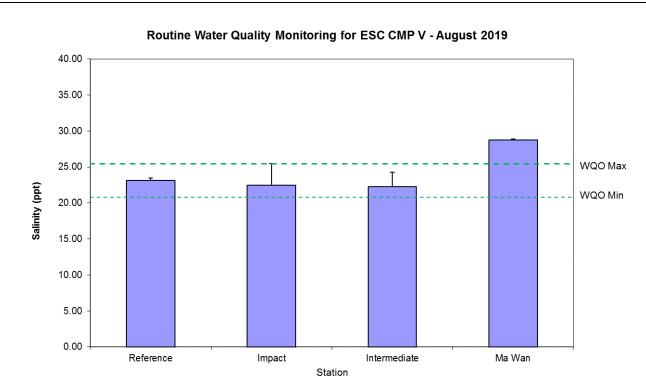


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

Routine Water Quality Monitoring for ESC CMP V - August 2019

12.00 10.00 -8.00 -4.00 -2.00 -

Station

Figure 6: Levels of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

Impact

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\August 2019)

Reference

Date: September 2019

0.00

Environmental Resources Management

Ma Wan

Intermediate



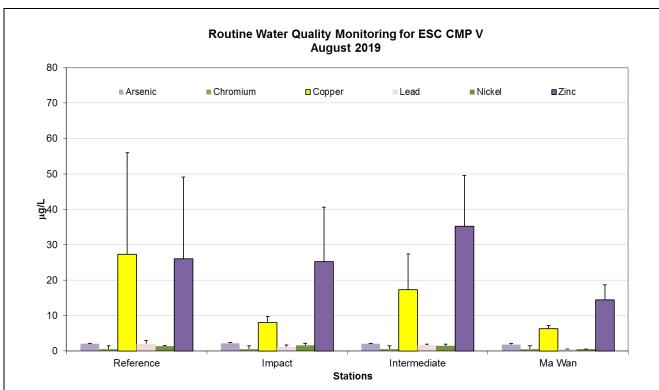


Figure 7: Concentration of Arsenic, Chromium, Nickel, Lead, Copper and Zinc (μg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

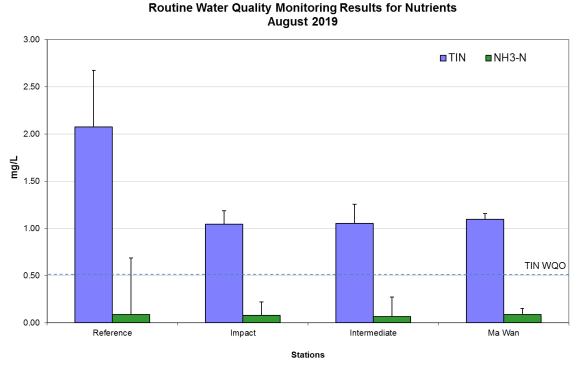


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) $(\mu g/L; mean + SD)$ in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

Source: H:\Team\EM\GMS Projects\0400720 CEDD CMP EM&A 2017-2020\02
Deliverable\05 CMP Monthly Report\August 2019)

Date: September 2019

Environmental
Resources
Management

ERM

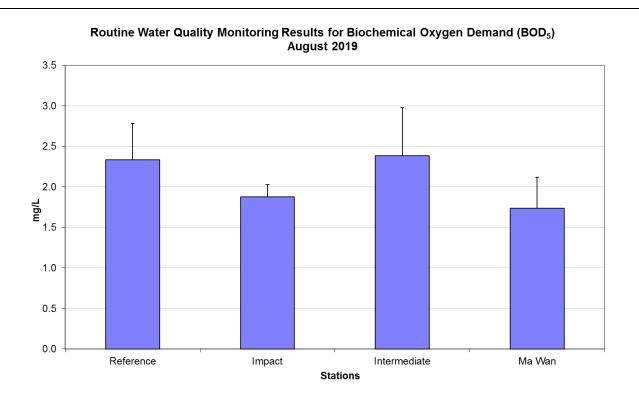


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

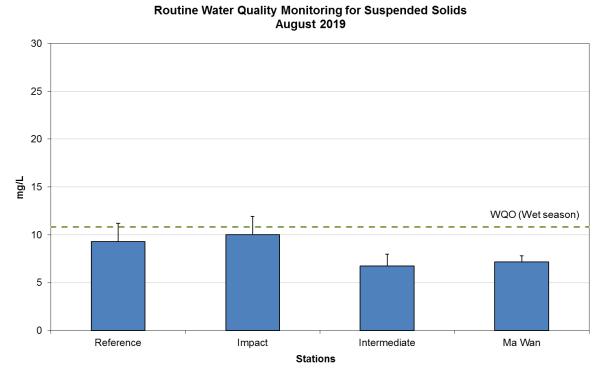


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in August 2019.

Date: September 2019



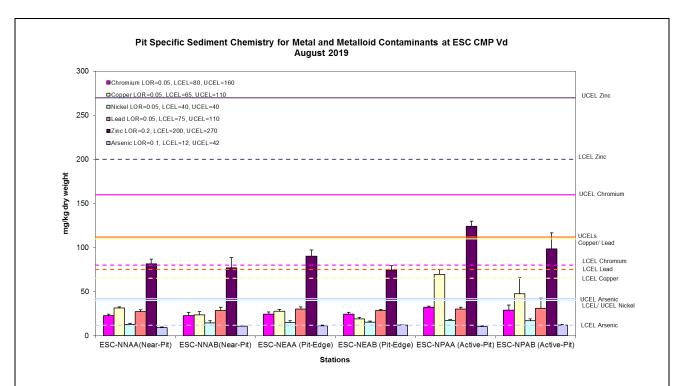


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in August 2019.

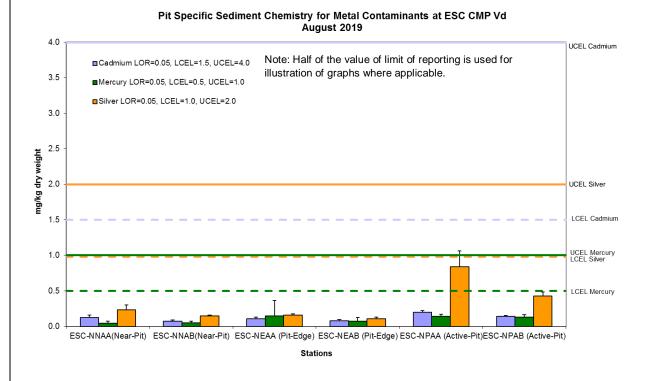


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in August 2019.

Date: September 2019



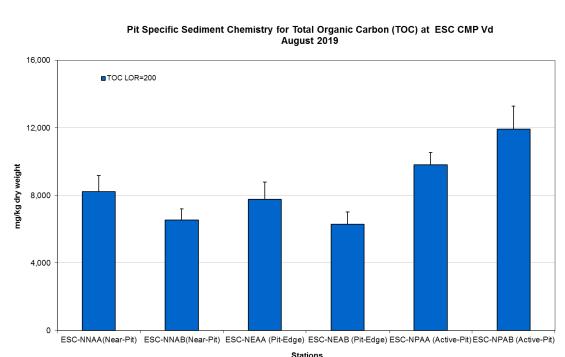


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in August 2019.

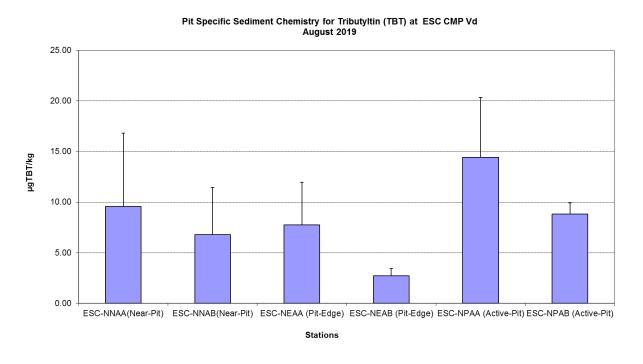


Figure 14: Concentration of Tributyltin (TBT) (μg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in August 2019.

Date: September 2019



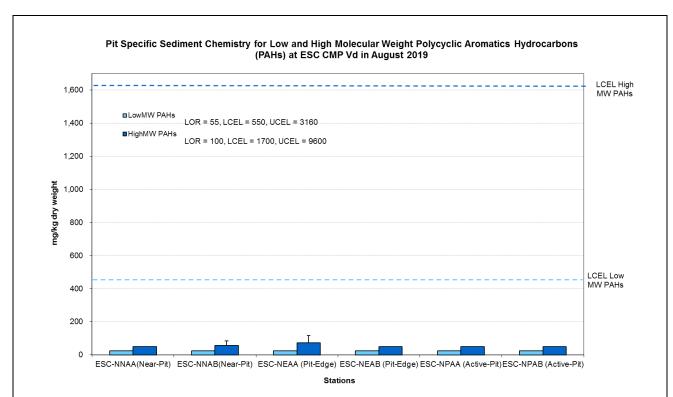


Figure 15: Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vd in August 2019.

Date: September 2019



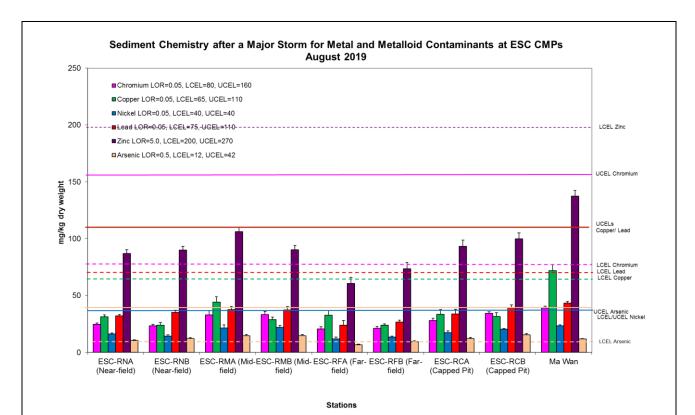


Figure 16: Concentration of Metals (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in August 2019.

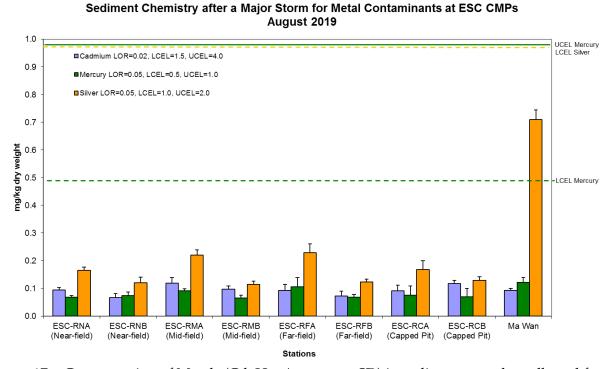


Figure 17: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Sediment Chemistry after a Major Storm for ESC CMPs in August 2019.

Date: September 2019



Annex D

Study Programme

