土木工程拓展署
Civil Engineering and Development Department

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 – February 2021

Revision 0

March 2021

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Document Code: 0400720_Monthly February 2021_v0.doc

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Client:	Project No:
Civil Engineering and Development Department (CEDD)	0400720
Summary: This document presents the Monthly EM&A Report for *Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau*.	Date: 11 March 2021 Approved by:  Craig A. Reid *Partner*

Revision	Description	By	Checked	Approved	Date
v0	Monthly EM&A Report for ESC CMPs	GS	RC	CAR	11/03/21

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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 – February 2021
Date of Report:	11 March 2021
Date prepared by ET:	11 March 2021
Date received by IA:	11 March 2021

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: 11/03/2021

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: 11/03/2021

CONTENTS

ANNEXES

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 FEBRUARY 2021

1.1 BACKGROUND

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

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

1.1.3 A proposal on the change of number of sample replication of water quality & sediment monitoring and combination of routine water quality monitoring and water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes have been effective for the EM&A activities since December 2020. The latest sampling schedule is provided in *Annex A*.

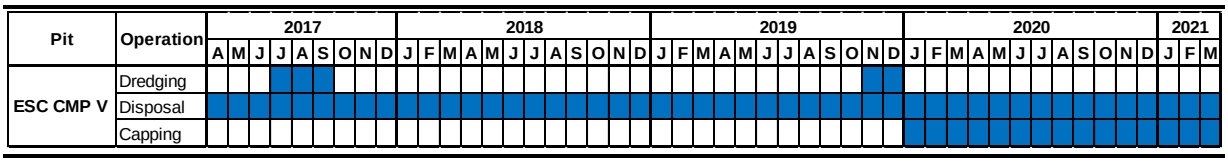
(1) ERM (2013) Final Report. Submitted under Agreement No. CE 4/2009 (EP) Environmental Monitoring and Audit for Contaminated Mud Pit at East Sha Chau. For CEDD.

(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.

1.1.4 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 February 2021, the following works were undertaken:

- Disposal of contaminated mud at ESC CMP Vb; and
- Capping operations at ESC CMP Vd.

Figure 1.1 Works Schedule for ESC CMP V



1.2 REPORTING PERIOD

1.2.1 This *Monthly EM&A Report for February 2021* covers the EM&A activities for the reporting month of February 2021.

1.3 DETAILS OF SAMPLING AND LABORATORY TESTING ACTIVITIES

1.3.1 The following monitoring activities were undertaken for ESC CMP V in February 2021:

- *Water Column Profiling of ESC CMP Vb*;
- *Routine Water Quality Monitoring of ESC CMPs;*
- *Pit Specific Sediment Chemistry of ESC CMP Vb;*
- *Cumulative Impact Sediment Chemistry of ESC CMPs*;
- *Sediment Toxicity Tests of ESC CMPs*; and
- *Demersal Trawling for ESC CMPs.*

1.4 DETAILS OF OUTSTANDING SAMPLING AND/OR ANALYSIS

1.4.1 No outstanding sampling remained for February 2021.

1.4.2 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 February 2021; and

- *Sediment Toxicity Tests of ESC CMPs* in February 2021.

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 February 2021*:

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

1.5.2 ***Water Column Profiling of ESC CMP Vb – February 2021***

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 11 February 2021. 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 dry season period (November to March) of 2010 - 2019 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 February 2021 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 February 2021 indicated that the SS levels at both Downstream and Upstream stations 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 Vb did not appear to cause any deterioration in water quality during this reporting period.

1.5.7 ***Routine Water Quality Monitoring of ESC CMPs – February 2021***

1.5.8 *Routine Water Quality Monitoring of ESC CMPs* was undertaken on 4 February 2021. 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 February 2021 as shown in *Figure 1.2*.

[1] http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en

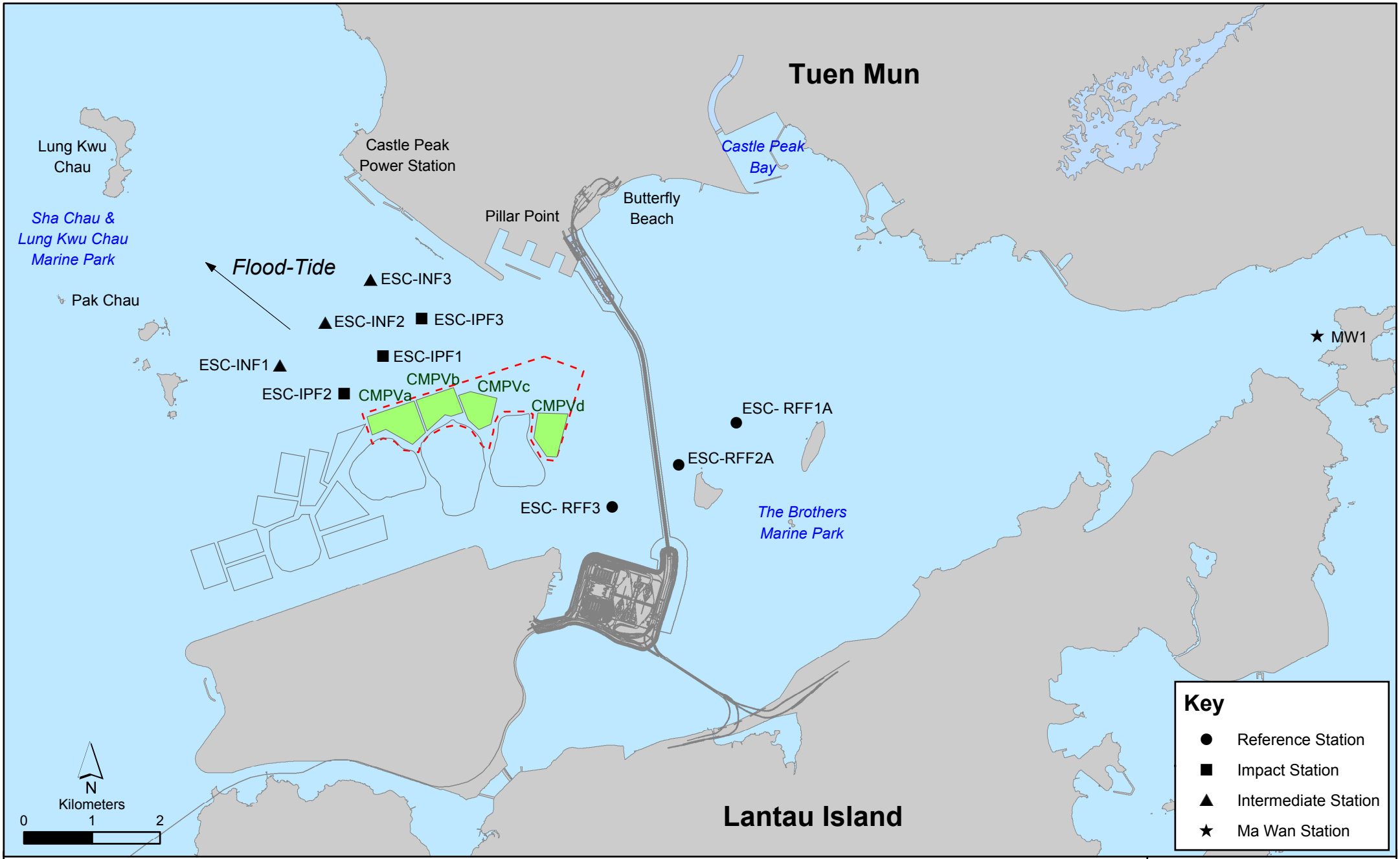


Figure 1.2

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

File: T:\GIS\CONTRACT\0175086\Mxd\updated_20170419\0175086_R_C_WQMS_flood.mxd
Date: 25/4/2017

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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 indicated that the levels of pH, Salinity and DO complied with the WQOs at all stations in February 2021.

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 and capping operation at ESC CMPs did not appear to cause any unacceptable impacts in water quality in February 2021.

Laboratory Measurements

1.5.12 Laboratory analysis of February 2021 results indicated that concentrations of Arsenic, Chromium, Copper, Lead, Nickel and Zinc were detected in February 2021 samples at all stations and their concentrations were generally similar across stations (*Table B4* of *Annex B*; *Figure 7* of *Annex C*).

1.5.13 For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at Ma Wan station complied with the WQO (0.5 mg/L) while those recorded at Reference, Intermediate and Impact stations were higher than the WQO (*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 CMPs. The concentrations of Ammonia Nitrogen (NH_3-N) were generally similar across stations in February 2021 (*Table B4* of *Annex B*; *Figure 8* of *Annex C*). The concentrations of Biochemical Oxygen Demand (BOD_5) were generally similar across stations (*Table B4* of *Annex B*; *Figure 9* of *Annex C*).

1.5.14 Analyses of results for February 2021 indicated that the SS levels at all stations complied with the WQO (12.8 mg/L) and 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 and capping operation at ESC CMPs did not appear to cause any unacceptable deterioration in water quality in February 2021. 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 Vb – February 2021***

1.5.17 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vb* are shown in *Figure 1.3.* A total of six (6) monitoring stations were sampled on 8 February 2021.

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

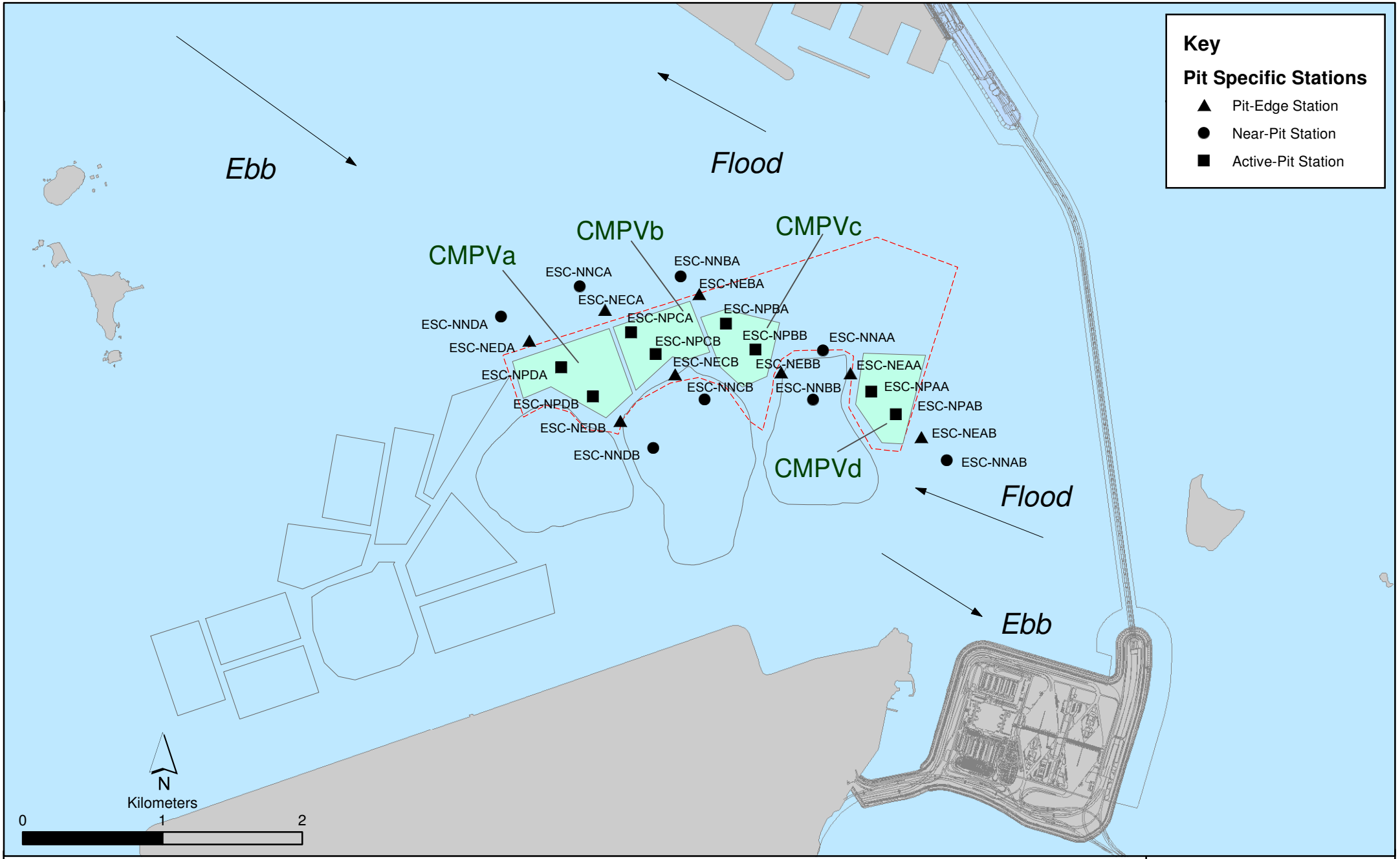

Figure 1.3

Pit Specific Sediment Quality Monitoring Stations for CMPV

File: T:\GIS\CONTRACT\0400720\Mxd\0400720_SQMS_pit specific.mxd
Date: 9/5/2017

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1.5.18 The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at most stations, except for Arsenic and Copper (*Figures 11 and 12* of *Annex C*). The concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge stations ESC-NECA and ESC-NECB; the concentrations of Copper was higher than LECL at Active-Pit station ESC-NPCB.

1.5.19 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 Vb but rather as a result of naturally occurring deposits.

1.5.20 Considering that the higher levels of Copper occurred within Active-Pit station 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 Vb in February 2021.

1.5.21 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Pit-Edge station ESC-NPCB in February 2021 (*Figure 13 of Annex C*). The concentrations of Low Molecular Weight and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were lower than the LECLs at all stations (*Figure 14 of Annex C)*. The concentrations of Tributyltin (TBT) were higher at Near-Pit station ESC-NNCA and Active-Pit station ESC-NPCA (*Figure 15 of Annex C)*. The concentrations of Total Polychlorinated Biphenyls (PCBs), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodiphenyldichloroethylene (DDE) were below the limit of reporting at all stations in February 2021.

1.5.22 Overall, there is no evidence indicating any unacceptable environmental impacts to sediment quality outside the pit area as a result of the contaminated mud disposal operations at ESC CMP Vb in February 2021.

1.5.23 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) 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

1.5.24 ***Cumulative Impact Sediment Chemistry of ESC CMPs – February 2021***

1.5.25 Monitoring locations for Cumulative Impact Sediment Chemistry for ESC CMPs are shown in *Figure 1.4*. A total of nine (9) monitoring stations were sampled on 9 and 10 February 2021.

1.5.26 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 February 2021, except concentrations of Arsenic were higher than the LCEL at Mid-field stations ESC-RMA, ESC-RMB, Near-field station ESC-RNB1, Capped Pit stations ESC-RCA1 and ESC-RCB1 (*Figures 16* and *17* of *Annex C*). As discussed in *Section 1.5.19*, the LECL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vb but rather as a result of naturally occurring deposits.

1.5.27 For organic contaminants, the concentrations of TOC were higher at Far-field station ESC-RFA (*Figure 18* of *Annex C*). The concentrations of TBT were higher at Ma Wan station (*Figure 19* of *Annex C*). The concentrations of High Molecular Weight PAHs were below LECL (*Figure 20* of *Annex C*). The concentrations of Total PCBs, Total DDT, 4,4'- DDE and Low Molecular Weight PAHs were below the limit of reporting at all stations in February 2021.

1.5.28 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 Vb in February 2021. 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 March 2021 for ESC CMP V (see *Annex A* for the sampling schedule):

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

1.7 STUDY PROGRAMME

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

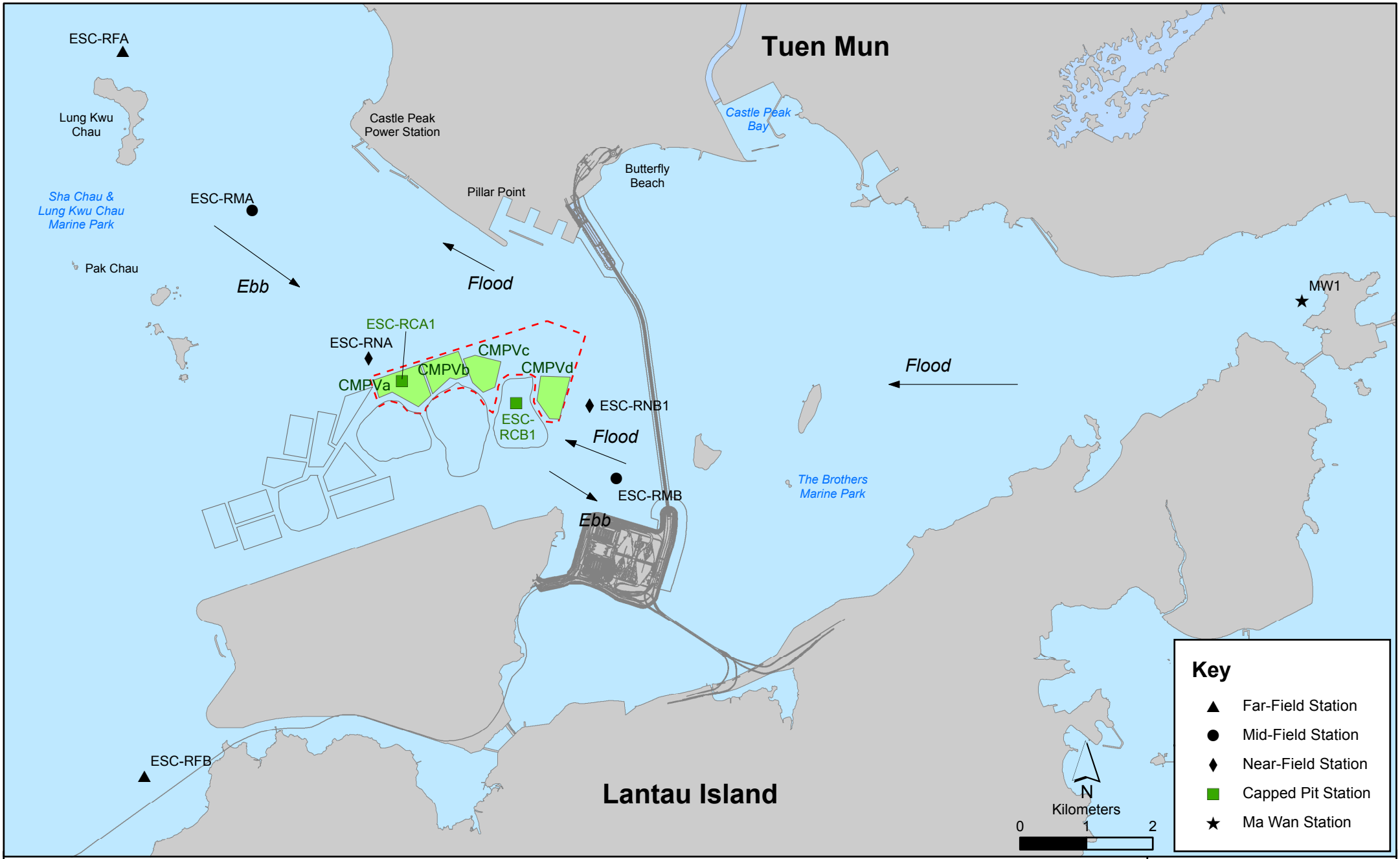

Figure 1.4

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

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Date: 19/4/2017

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Annex A

Sampling Schedule

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

			2017				2018												2019												2020												2021		
Pit Specific Sediment Chemistry *	**Code**	**Frequency**	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	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	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6
	ESC-NPAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6
Pit-Edge																																														
	ESC-NEAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6
	ESC-NEAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6
Near-Pit																																														
	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	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6
	ESC-NNAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	6	6	6	6

Cumulative Impact Sediment Chemistry *			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-field Stations																																														
	ESC-RNA	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
	ESC-RNB1	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
Mid-field Stations																																														
	ESC-RMA	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
	ESC-RMB	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
Capped Pit Stations																																														
	ESC-RCA1	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
	ESC-RCB1	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
Far-Field Stations																																														
	ESC-RFA	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
	ESC-RFB	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	
Ma Wan Station																																														
	MW1	4 times per year				12		12				12		12				12		12				12		12				12		12				12		12				6		6	

Sediment Toxicity Tests			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																																														
	ESC-TDA	2 times per year						5						5						5						5						5						5						5	
	ESC-TDB1	2 times per year						5						5						5						5						5						5						5	
Reference Stations																																														
	ESC-TRA	2 times per year						5						5						5						5						5						5						5	
	ESC-TRB	2 times per year						5						5						5						5						5						5						5	
Ma Wan Station																																														
	MW1	2 times per year						5						5						5						5						5						5						5	

Tissue/ Whole Body Sampling			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																																														
	ESC-INA	2 times per year						*						*						*						*						*						*						*	
	ESC-INB	2 times per year						*						*						*						*						*						*						*	
Reference North																																														
	TNA	2 times per year						*						*						*						*						*						*						*	
	TNB	2 times per year						*						*						*						*						*						*						*	
Reference South																																														
	TSA	2 times per year						*						*						*						*						*						*						*	
	TSB	2 times per year						*						*						*						*						*						*						*	

Demersal Trawling			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near Pit Stations																																														
	ESC-INA	4 times per year					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	ESC-INB	4 times per year					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Reference North																																														
	TNA	4 times per year					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	TNB	4 times per year					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Reference South																																														
	TSA	4 times per year					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	TSB	4 times per year					5	5					5	5					5	5					5	5					5	5					5	5					5	5	

Capping *			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																																														
Impact Station Downcurrent																																														
	ESC-IPE1A	4 times per year *																														3				3		3							
	ESC-IPE2A	4 times per year *																														3				3		3							
	ESC-IPE3	4 times per year *																														3				3		3							
	ESC-IPE4	4 times per year *																														3				3		3							
	ESC-IPE5	4 times per year *																														3				3		3							
Intermediate Station Downcurrent																																														
	ESC-INE1A	4 times per year *																														3				3		3							
	ESC-INE2A	4 times per year *																														3				3		3							
	ESC-INE3A	4 times per year *																														3				3		3							
	ESC-INE4A	4 times per year *																														3				3		3							
	ESC-INE5A	4 times per year *																														3				3		3							
Reference Station Upcurrent																																														
	ESC-RFE1	4 times per year *																														3				3		3							
	ESC-RFE2	4 times per year *																														3				3		3							
	ESC-RFE3	4 times per year *																														3				3		3							
	ESC-RFE4	4 times per year *																														3				3		3							
	ESC-RFE5	4 times per year *																														3				3		3							
Ma Wan Station																																														
	MW1	4 times per year *																														3				3		3							
Flood Tide																																														
Impact Station Downcurrent																																														
	ESC-IPF1	4 times per year *																														3				3		3							
	ESC-IPF2	4 times per year *																														3				3		3							
	ESC-IPF3	4 times per year *																														3				3		3							
Intermediate Station Downcurrent																																														
	ESC-INF1	4 times per year *																														3				3		3							
	ESC-INF2	4 times per year *																														3				3		3							
	ESC-INF3	4 times per year *																														3				3		3							
Reference Station Upcurrent																																														
	ESC-RFF1A	4 times per year *																														3				3		3							
	ESC-RFF2A	4 times per year *																														3				3		3							
	ESC-RFF3	4 times per year *																														3				3		3							
Ma Wan Station																																														
	MW1	4 times per year *																														3				3		3							

Routine Water Quality Monitoring *			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																																														
Impact Station Downcurrent																																														
	ESC-IPE1A	Monthly *		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	4	4	4	4
	ESC-IPE2A	Monthly *		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	4	4	4	4
	ESC-IPE3	Monthly *		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	4	4	4	4
	ESC-IPE4	Monthly *		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	4	4	4	4
	ESC-IPE5	Monthly *		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	4	4	4	4
Intermediate Station Downcurrent																																														
	ESC-INE1A	Monthly *		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	4	4	4	4
	ESC-INE2A	Monthly *		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	4	4	4	4
	ESC-INE3A	Monthly *		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	4	4	4	4
	ESC-INE4A	Monthly *		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	4	4	4	4
	ESC-INE5A	Monthly *		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	4	4	4	4
Reference Station Upcurrent																																														
	ESC-RFE1	Monthly *		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	4	4	4	4
	ESC-RFE2	Monthly *		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	4	4	4	4
	ESC-RFE3	Monthly *		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	4	4	4	4
	ESC-RFE4	Monthly *		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	4	4	4	4
	ESC-RFE5	Monthly *		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	4	4	4	4
Ma Wan Station																																														
	MW1	Monthly *		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	4	4	4	4
Flood Tide																																														
Impact Station Downcurrent																																														
	ESC-IPF1	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
	ESC-IPF2	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
	ESC-IPF3	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
Intermediate Station Downcurrent																																														
	ESC-INF1	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
	ESC-INF2	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
	ESC-INF3	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
Reference Station Upcurrent																																														
	ESC-RFF1A	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
	ESC-RFF2A	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
	ESC-RFF3	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4
Ma Wan Station																																														
	MW1	Monthly *		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	4	4	4	4

Water Column Profiling *			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Plume Stations	WCP1	Monthly	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2
	WCP2	Monthly	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2

Benthic Recolonisation Studies			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Capped Stations at CMPV																																														
	ESCV-CPA	2 times per year																																														
	ESCV-CPB	2 times per year																																														
	ESCV-CPC	2 times per year																																														
	ESCV-CPD	2 times per year																																														
Reference Stations																																														
	RBA	2 times per year																																														
	RBB	2 times per year																																														
	RBC1	2 times per year																																														

Impact Monitoring for Dredging			S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Upstream Stations																																														
	US1	3 times per week	2																										2	2															
	US2	3 times per week	2																										2	2															
Downstream Stations																																														
	DS1	3 times per week	2																										2	2															
	DS2	3 times per week	2																										2	2															
	DS3	3 times per week	2																										2	2															
	DS4	3 times per week	2																										2	2															
	DS5	3 times per week	2																										2	2															
Ma Wan Station																																														
	MW1	3 times per week	2																										2	2															

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.

* A proposal on the change of number of sample replication of water quality & sediment monitoring and combination of routine water quality monitoring and water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes will be effective for the EM&A activities since December 2020. Water Quality Monitoring during Capping Operation and Routine Water Quality Monitoring are combined such that Routine Water Quality Monitoring will be conducted monthly starting in December 2020.

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) 5%-ile of baseline data for surface and middle layer = **3.76 mg L^{-1}** and Significantly less than the reference stations mean DO (at the same tide of the same day)	Surface and Mid-depth (2) 1%-ile of baseline data for surface and middle layer = **3.11 mg L^{-1}** (3) and Significantly less than the reference stations mean DO (at the same tide of the same day)
	Bottom 5%-ile of baseline data for bottom layers = **2.96 mg L^{-1}** and Significantly less than the reference stations mean DO (at the same tide of the same day)	Bottom The average of the impact station readings are **<2 mg/L^{-1}** and 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}** and 120% of control station's SS at the same tide of the same day	99%-ile of baseline data for depth average = **61.92 mg L^{-1}** and 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** and 120% of control station's Tby at the same tide of the same day	99%-ile of baseline data = **38.32 NTU** and 130% of control station's Tby at the same tide of the same day

Notes:

(1) For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.

(2) The Action and Limit Levels for DO for Surface & Middle layers were calculated from the combined pool of baseline surface layer data and baseline middle layer data.

(3) 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 Vb in February 2021

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L^{-1})	pH	Suspended Solids (mg L^{-1})
WCP 1 (Downstream)	18.81	28.85	1.12	105.82	8.30	8.34	6.0
WCP 2 (Upstream)	18.75	29.18	1.46	104.51	8.19	8.31	4.3
WQO (Dry Season)	N/A	26.26-32.09#	N/A	N/A	>4	6.5-8.5	12.8

Note:
#Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.
Cell shaded yellow / red indicate value exceeding the Action/Limit levels.
Cell shaded grey indicate value exceeding the WQO.

Table B3 In-situ Monitoring Results for Routine Water Quality Monitoring of ESC CMPs in February 2021

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	Dissolved Oxygen (mg L^{-1})	pH (mg L^{-1})
February 2021	RFF (Reference)	18.58	28.92	1.33	108.06	8.51	8.31
	IPF (Impact)	18.72	28.81	2.18	110.85	8.71	8.29
	INF (Intermediate)	18.75	28.70	2.39	111.65	8.77	8.30
	Ma Wan	18.40	29.43	0.59	106.23	8.37	8.25
	WQO	N/A	26.03- 31.81#	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 higher than the WQO.

Table B4 Laboratory Results for Routine Water Quality Monitoring of ESC CMPs in February 2021

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)
February 2021	RFF	1.57	<LOR	0.89	8.50	1.10	<LOR	1.20	<LOR	46.14	0.28	0.58	1.67	4.41
	IPF	1.69	<LOR	1.31	6.36	0.93	<LOR	1.39	<LOR	62.03	0.29	0.58	1.56	6.61
	INF	1.63	<LOR	0.91	7.82	0.58	<LOR	1.30	<LOR	41.78	0.30	0.56	1.33	6.72
	Ma Wan	1.50	<LOR	0.90	6.83	1.28	<LOR	1.28	<LOR	48.08	0.22	0.46	1.33	3.73

WQO of TIN: 0.5 mg/L
Dry Season WQO of SS : 12.8 mg/L

Notes:
<LOR indicates the concentrations of metals and metalloids are below the limit of reporting
Cell shaded yellow / red indicate value exceeding the Action/Limit levels.
Cell shaded grey indicate value higher than the WQO.

Annex C

Graphical Presentations

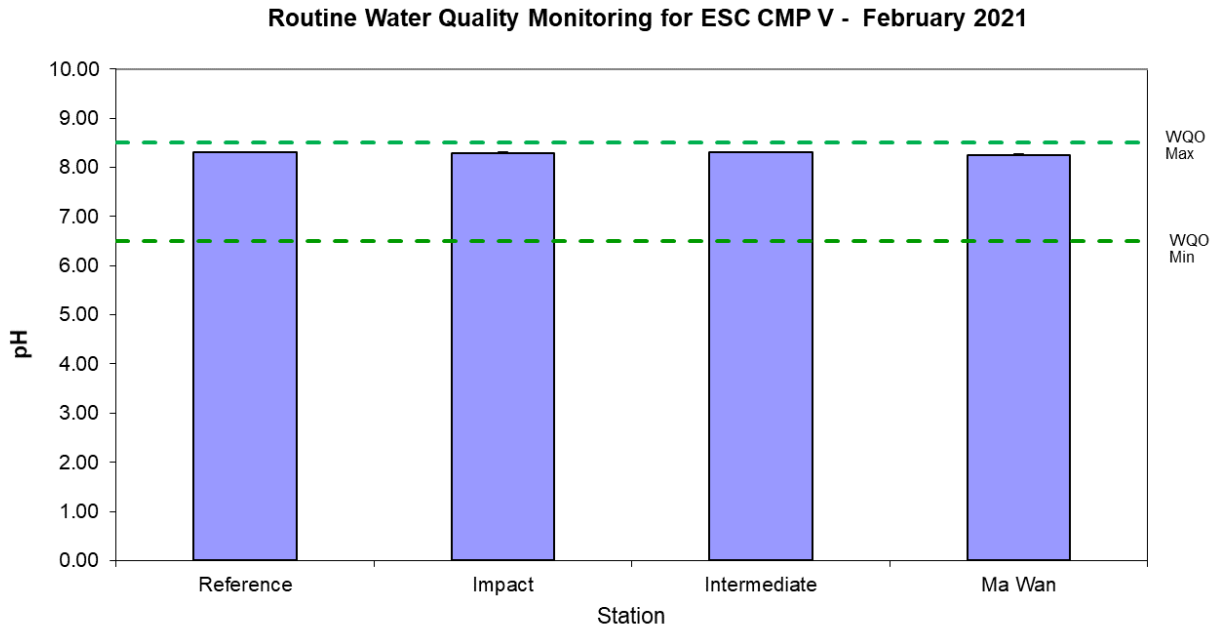

Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

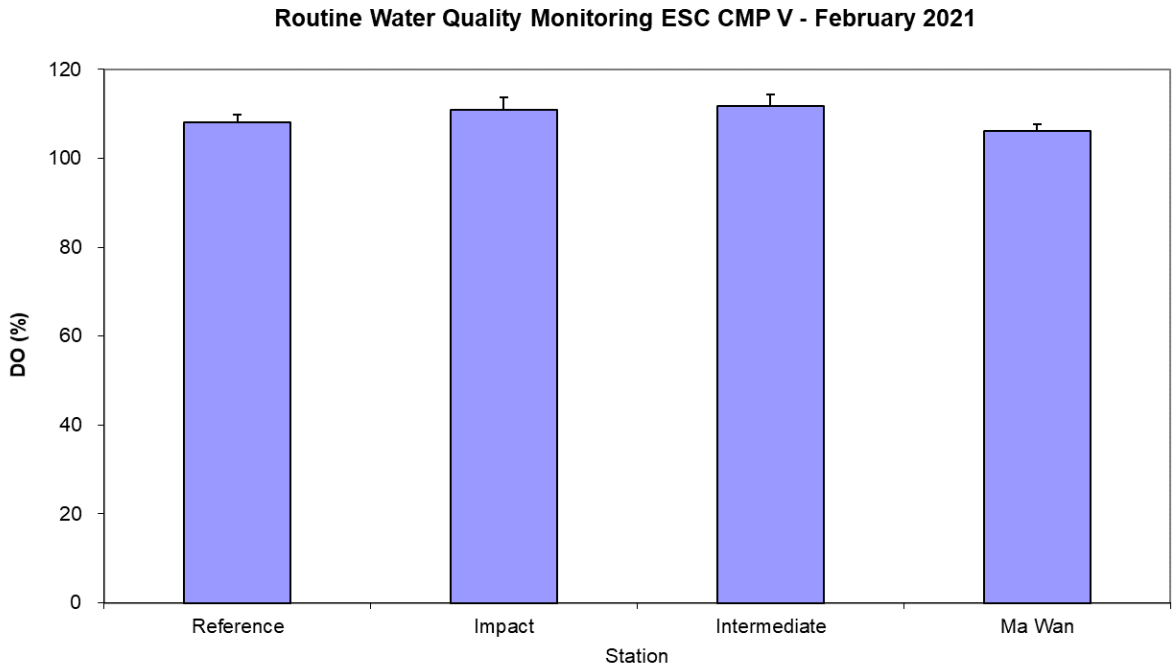

Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

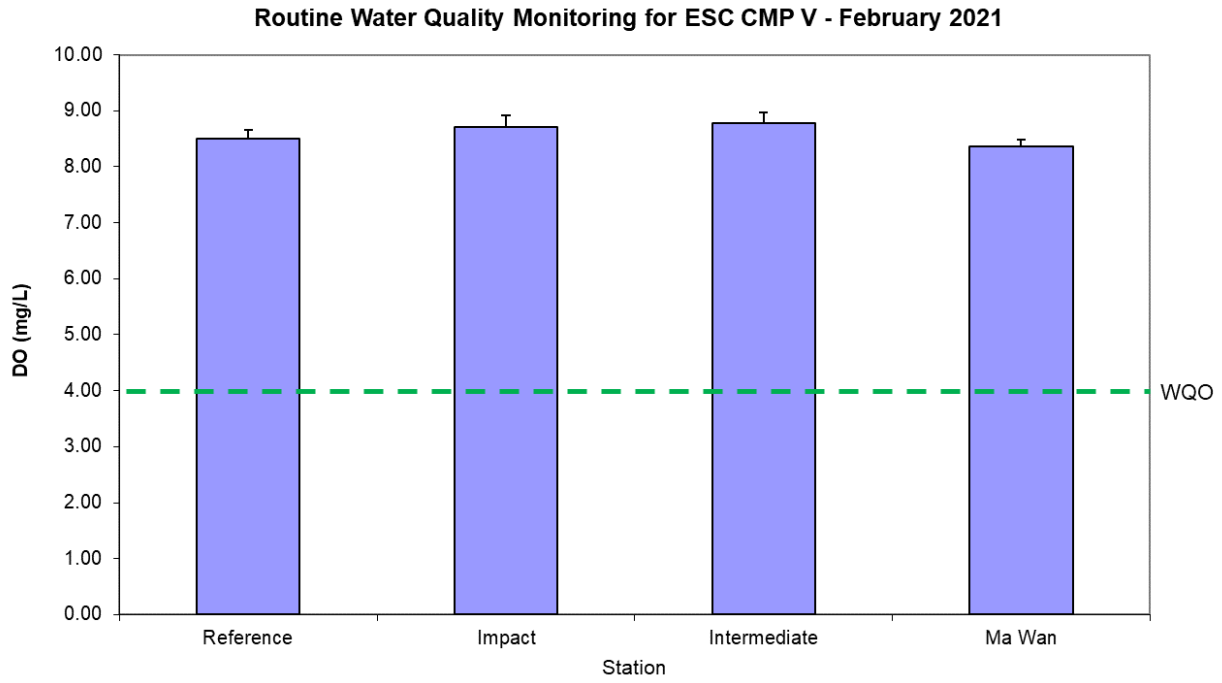

Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

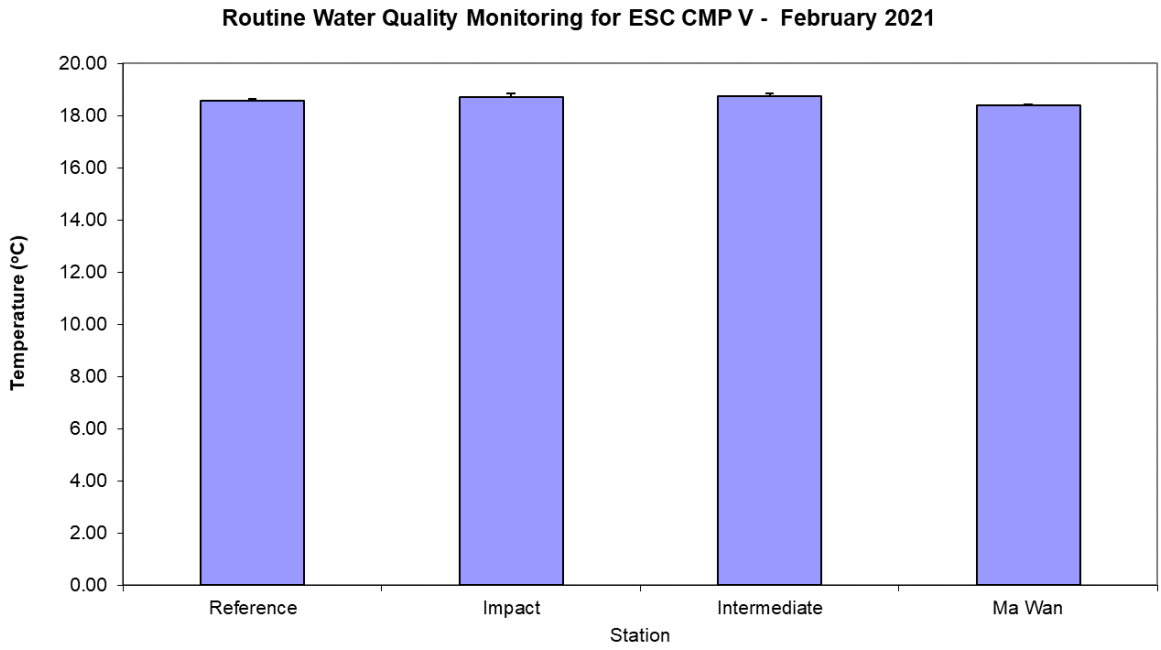

Figure 4: Level of Temperature (˚C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

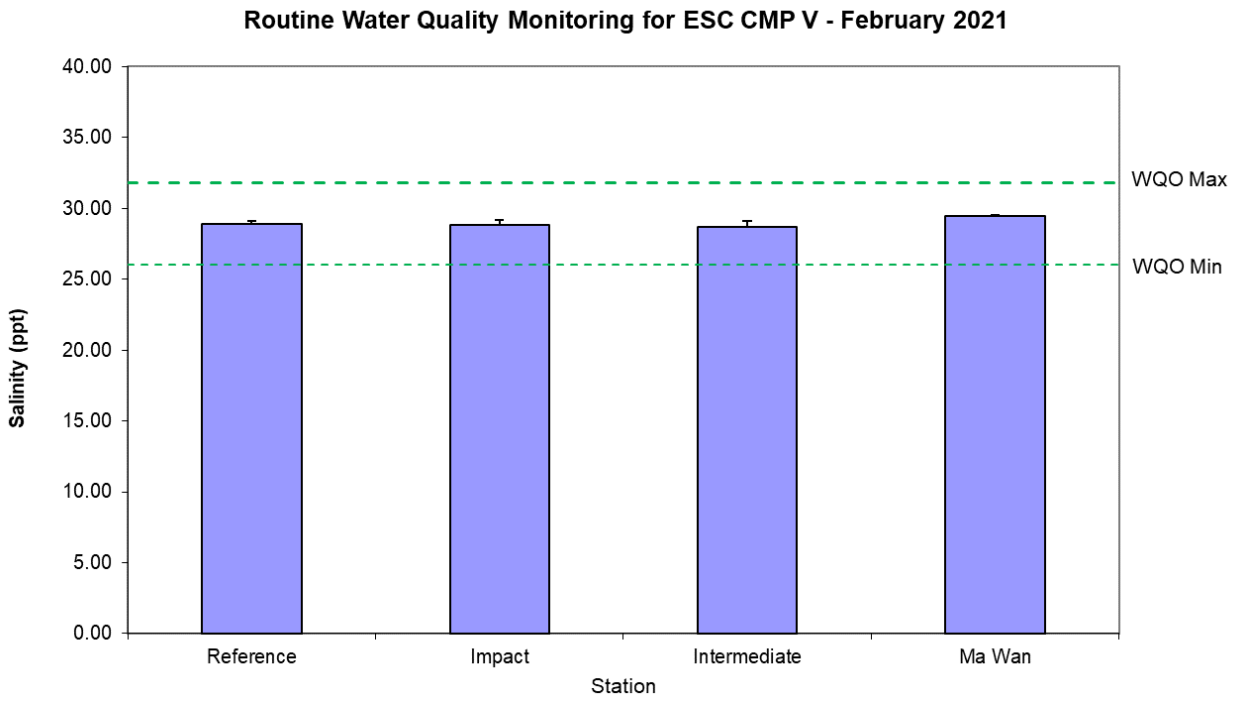

Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

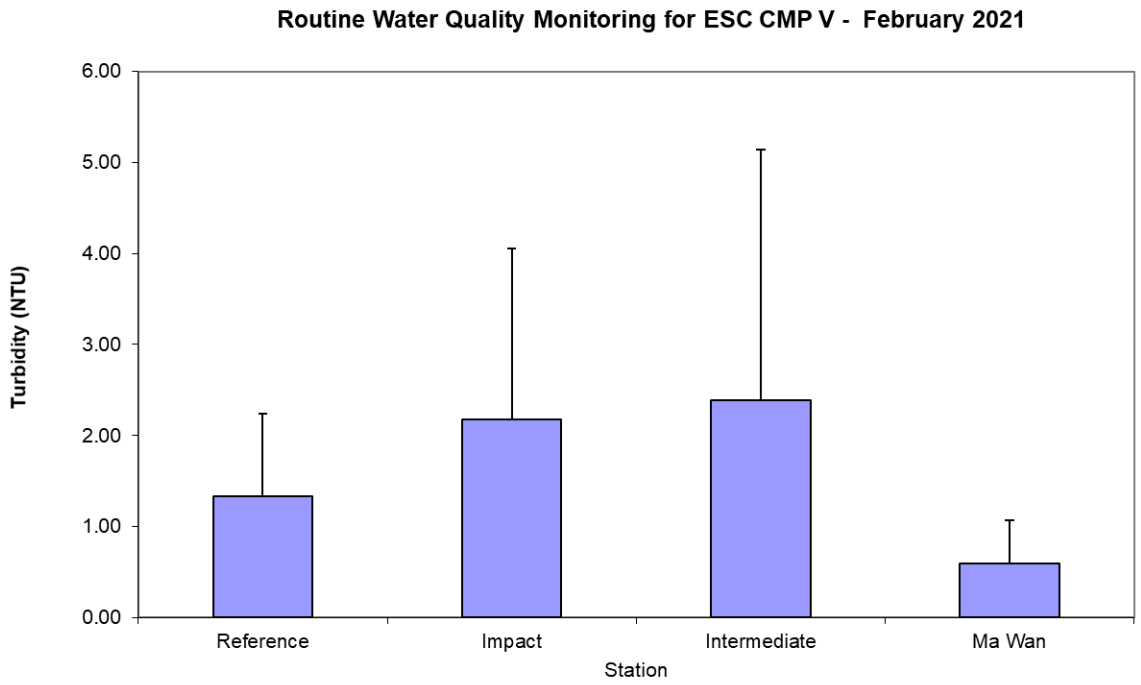

Figure 6: Levels of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

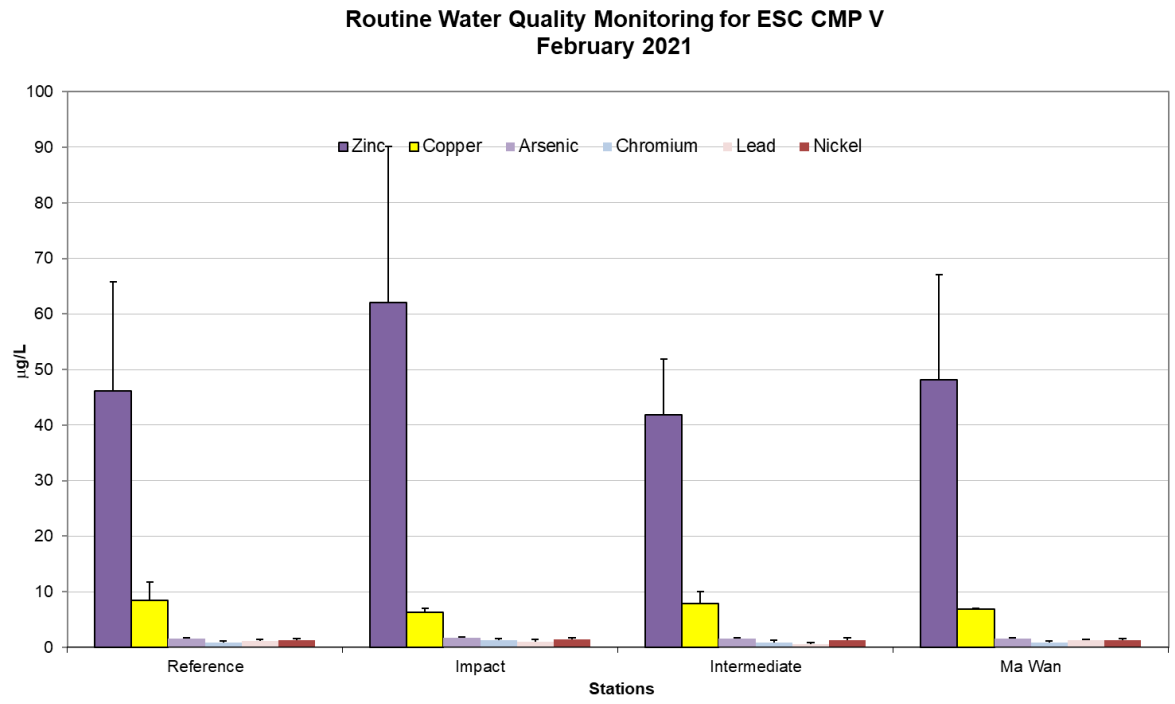

Figure 7: Concentration of Arsenic, Chromium, Copper, Lead, Nickel and Zinc (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

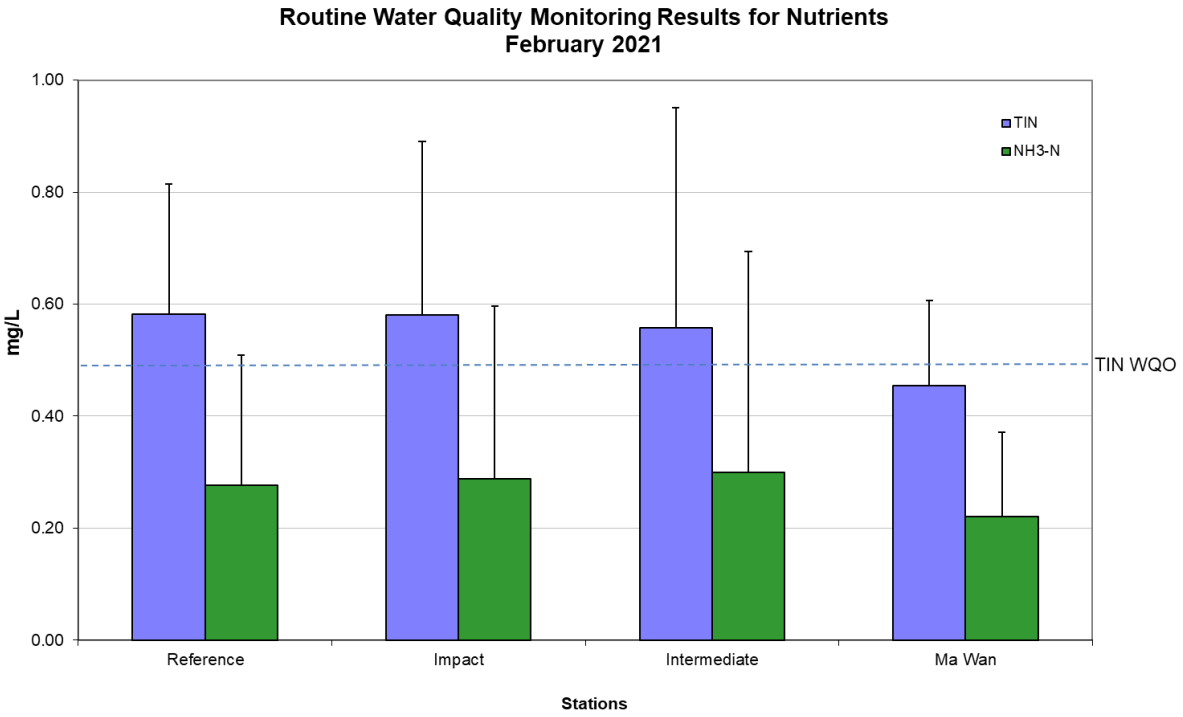

Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

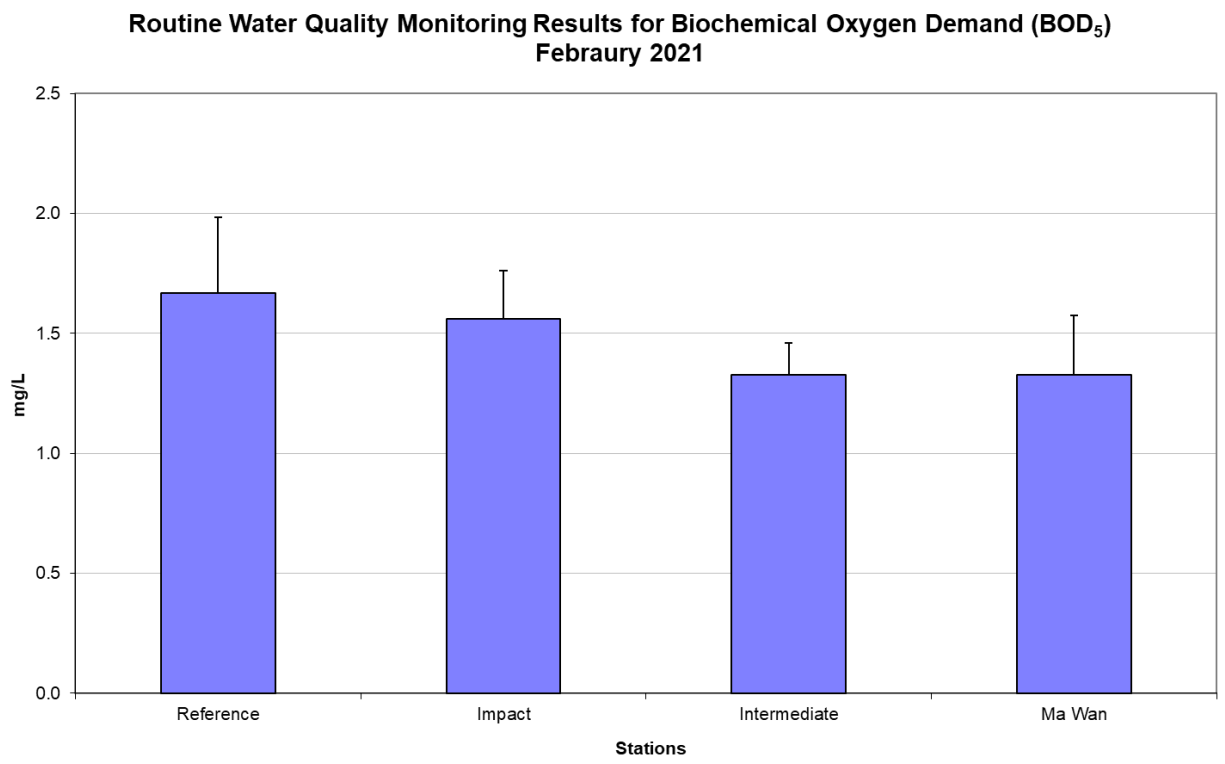

Figure 9: Level of Biochemical Oxygen Demand (BOD_5) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

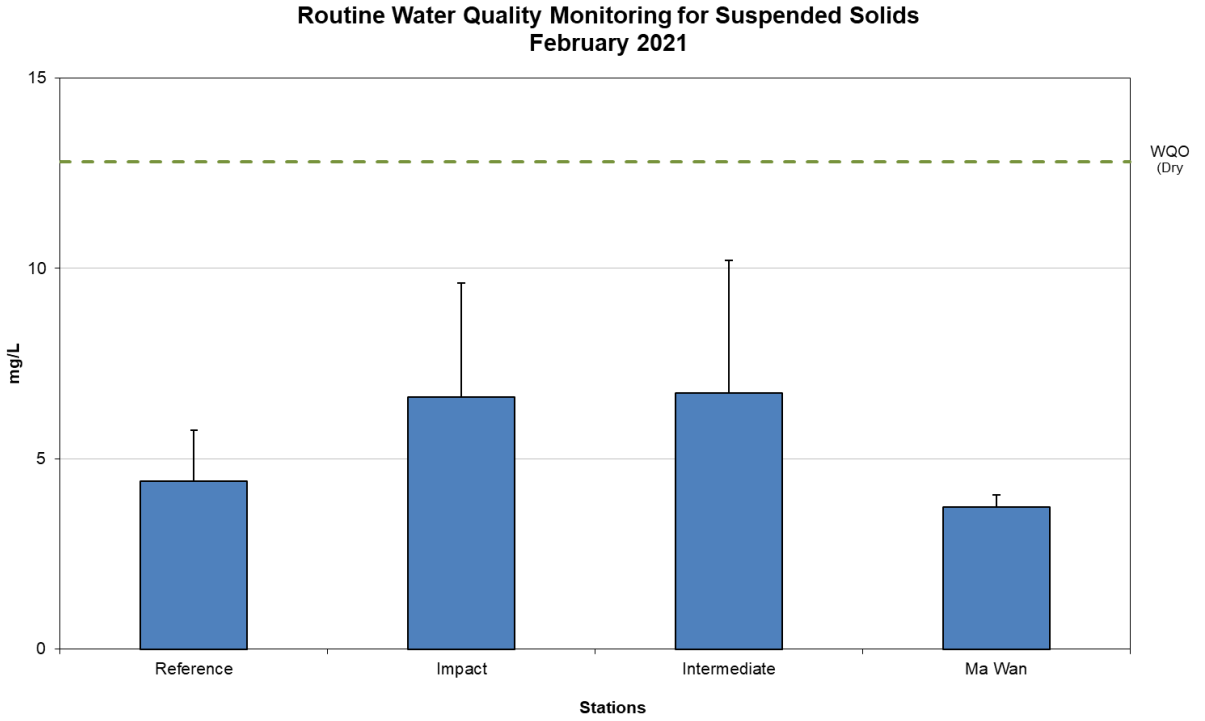

Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in February 2021.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\47 Monthly February 2021

Date: March 2021

Environmental Resources Management

ERM

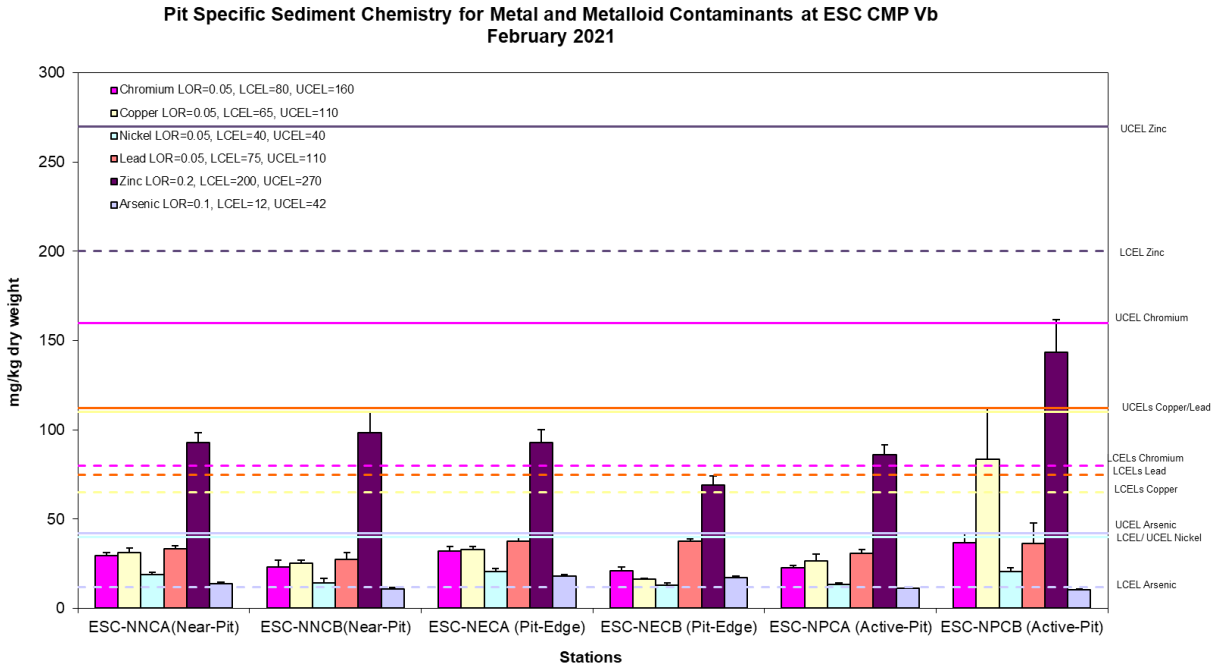

Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in February 2021.

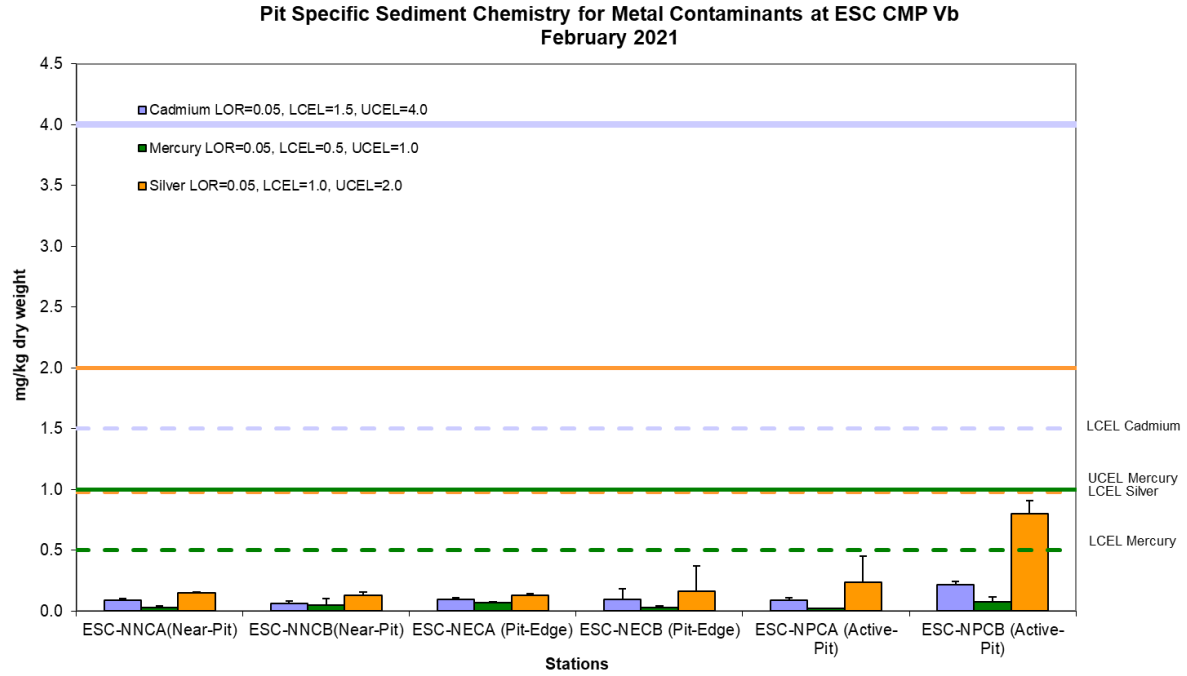

Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in February 2021.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\47 Monthly February 2021

Date: March 2021

Environmental Resources Management

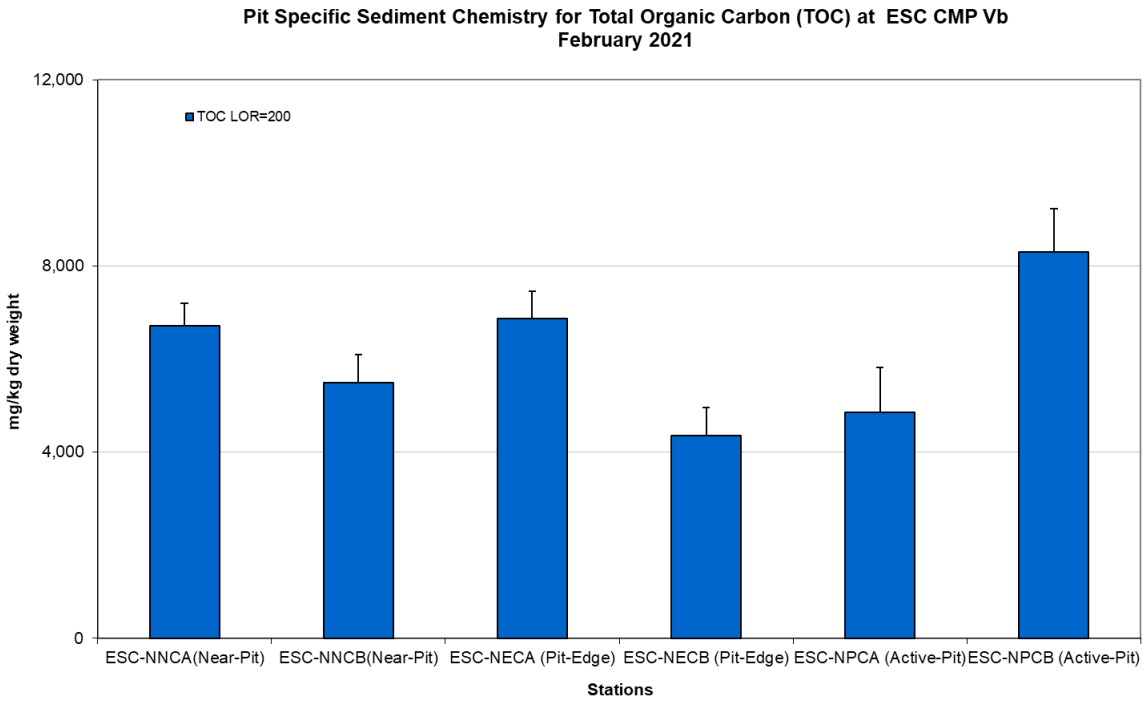

Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in February 2021.

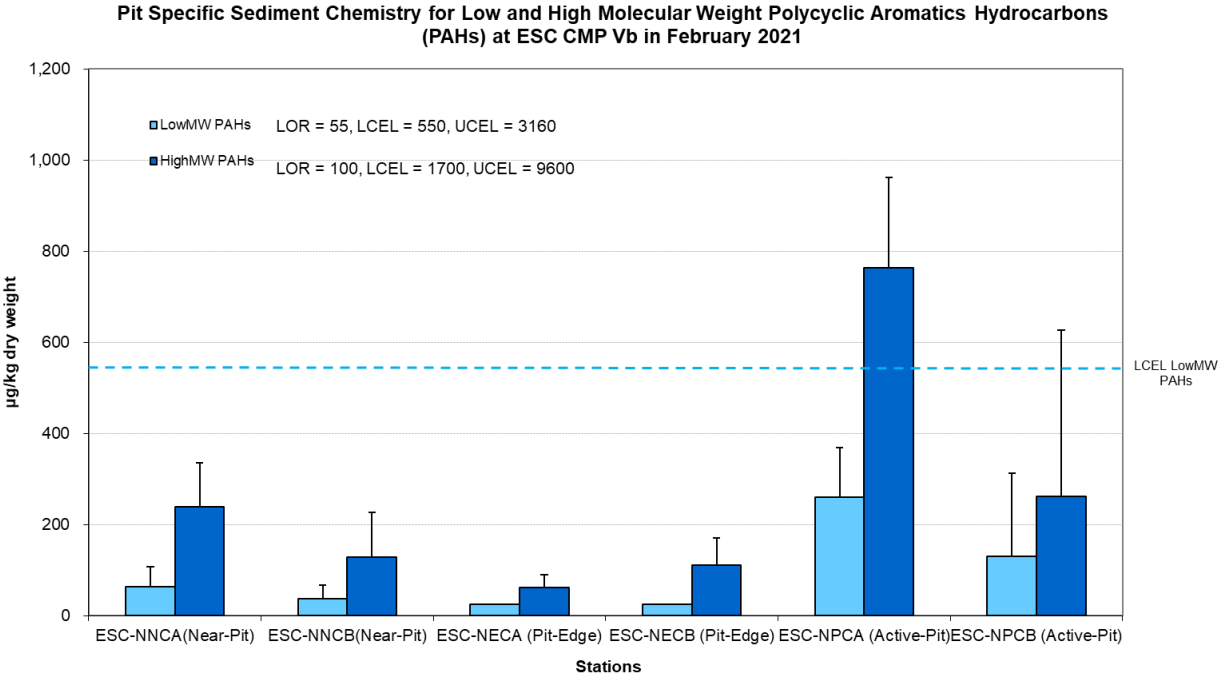

Figure 14: Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in February 2021.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\47 Monthly February 2021

Date: March 2021

Environmental Resources Management

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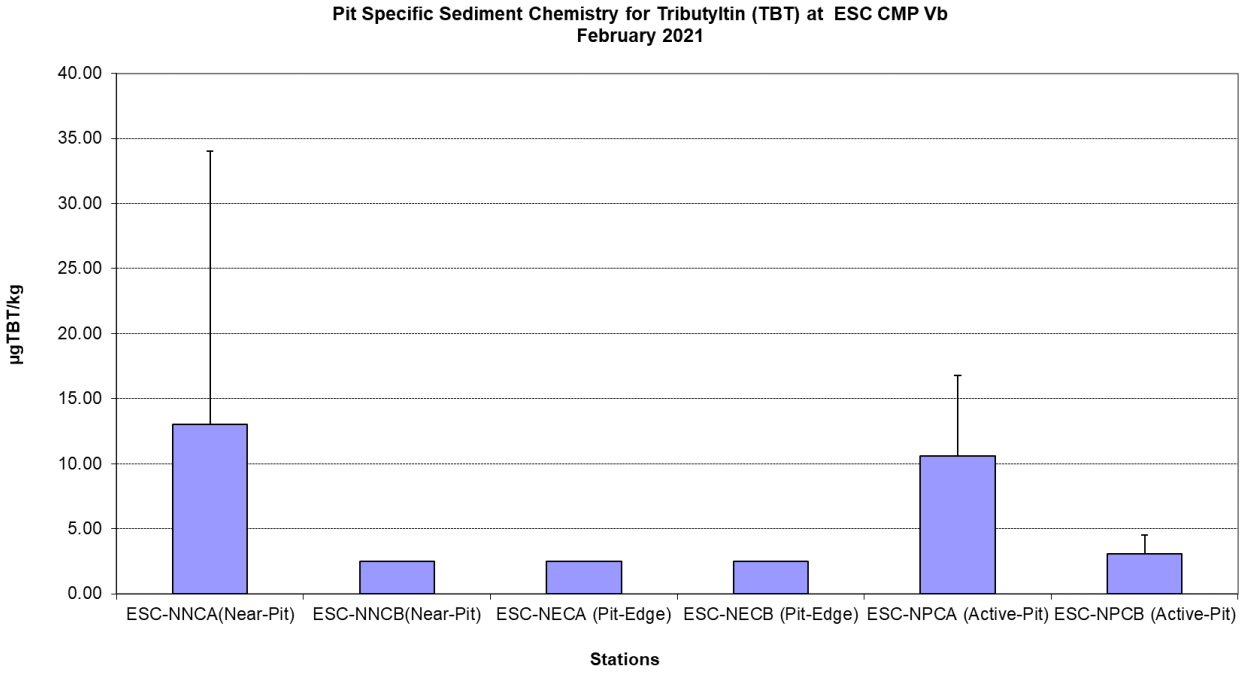


Figure 15: Concentration of Tributyltin (TBT) (µg TBT/kg; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in February 2021.

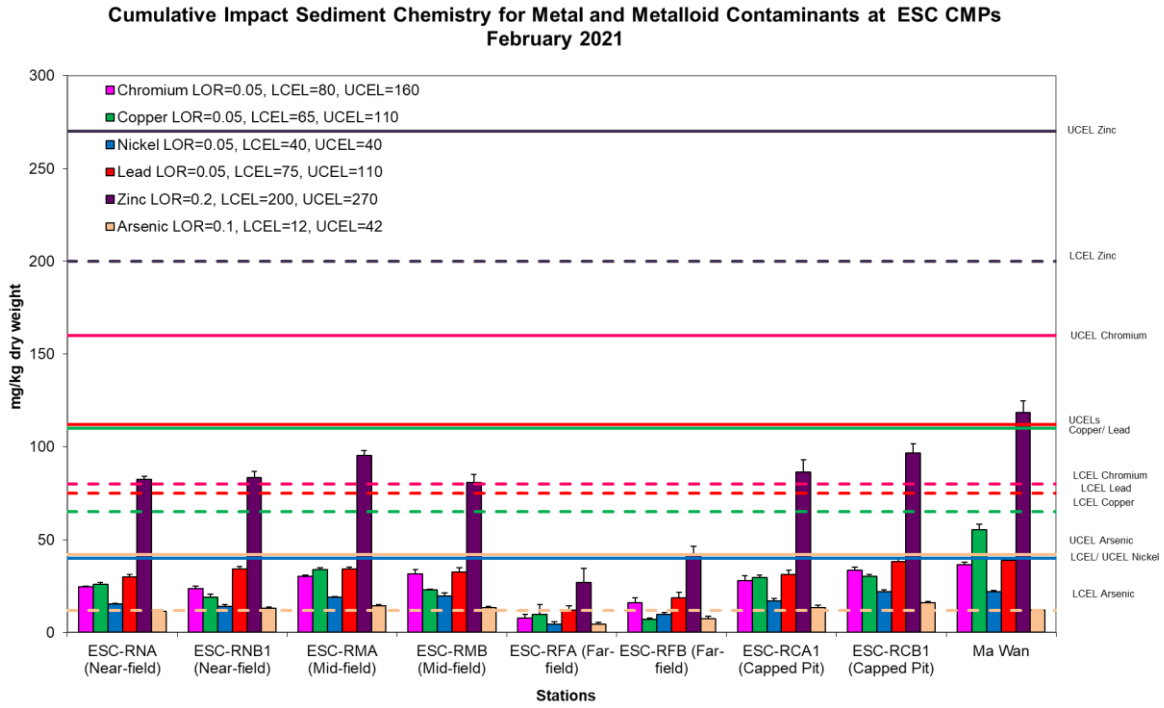


Figure 16: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2021.

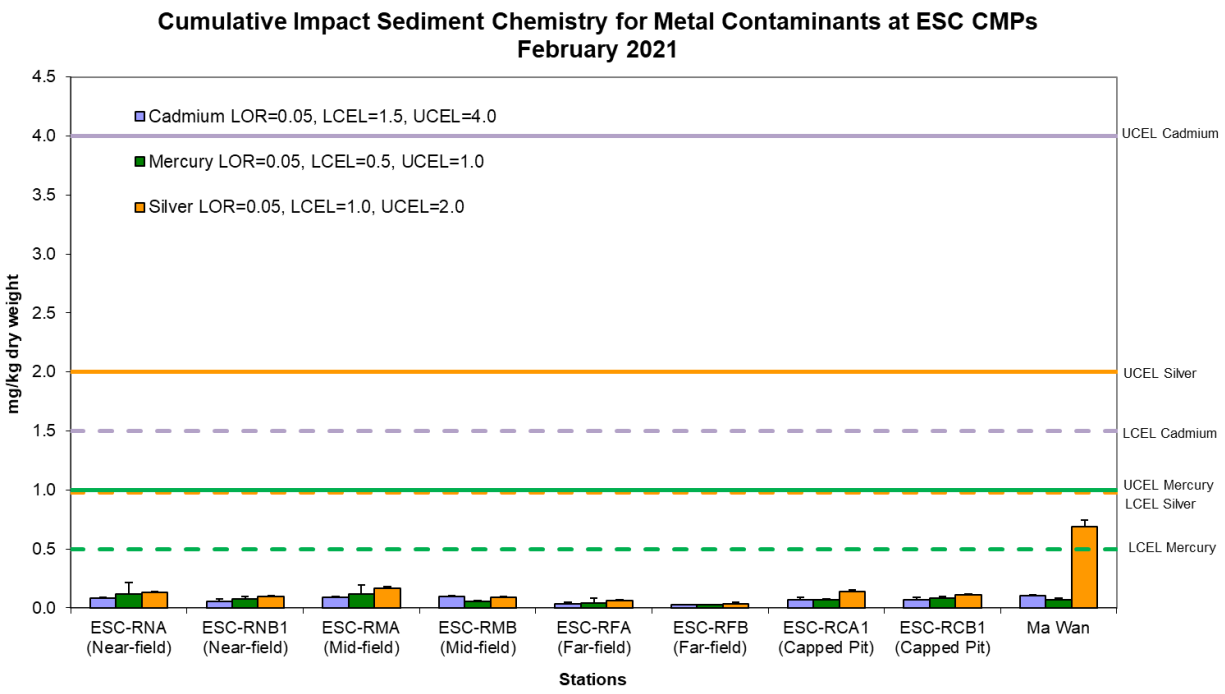


Figure 17: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2021.

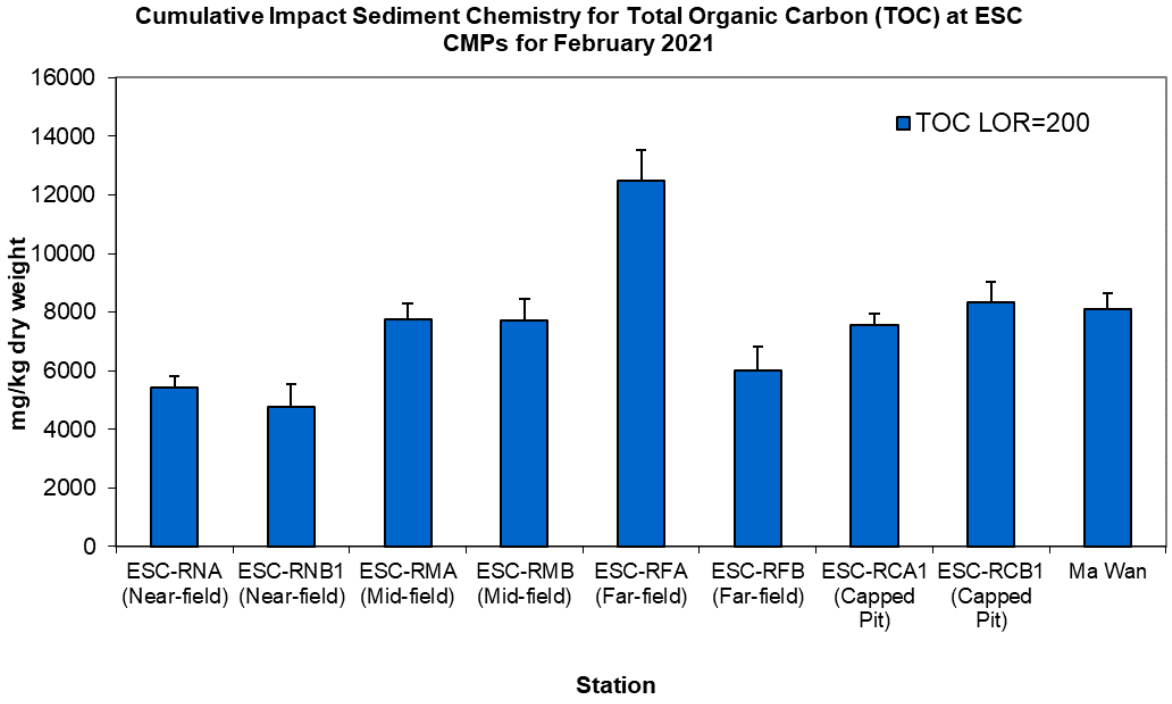


Figure 18: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2021.

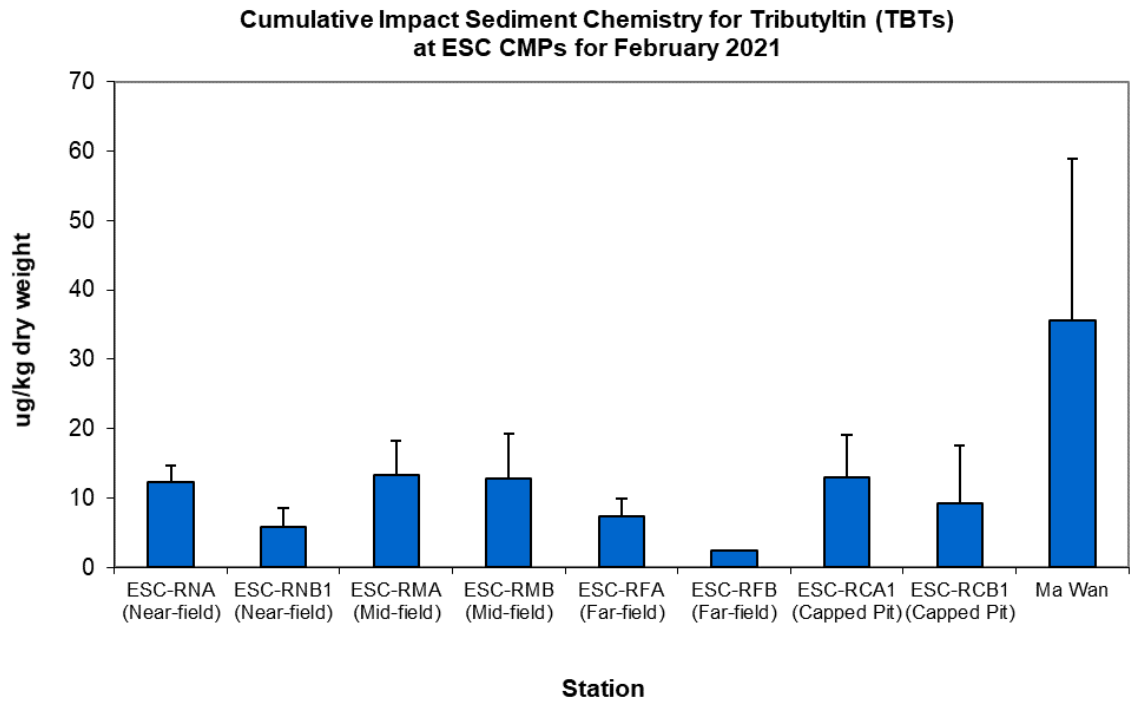


Figure 19: Concentration of Tributyltin (TBT) (µg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2021.

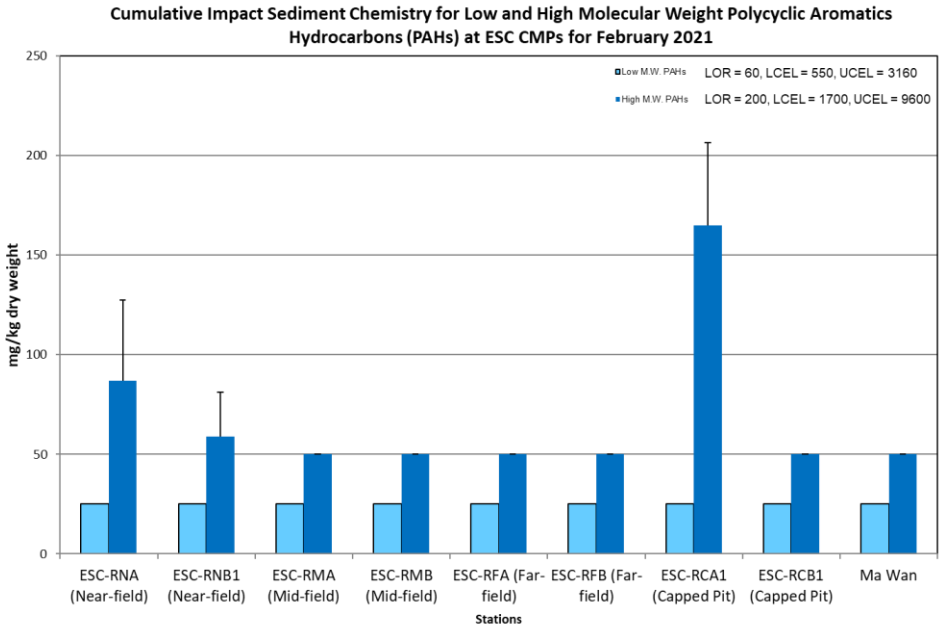
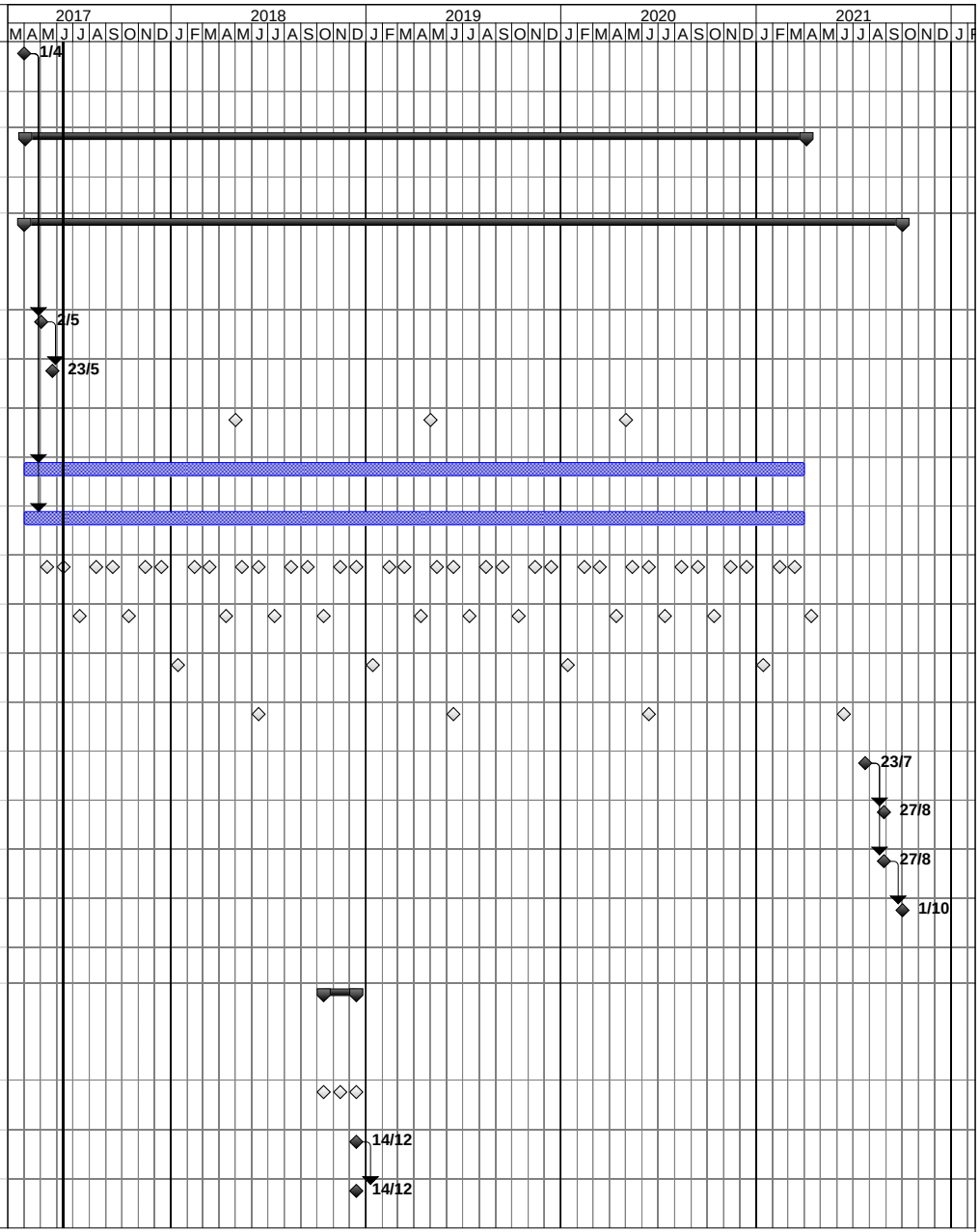


Figure 20: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in February 2021.

Annex D

Study Programme

Task Name	Start	Finish
Commencement of Agreement No. CE 63/2016 (EP)	Sat 1/4/17	Sat 1/4/17
Project Management and General Deliverables	**Mon 3/4/17**	**Mon 5/4/21**
For the disposal facilities to the East of Sha Chau (ESC) (between 2017 and 2021) and the South of The Brothers (SB) (between 2017 and 2018)	**Sat 1/4/17**	**Fri 1/10/21**
Draft Report on Review of EM&A Manual	Tue 2/5/17	Tue 2/5/17
Final Report on Review of EM&A Manual	Tue 23/5/17	Tue 23/5/17
Regular Review of EM&A Manual	**Wed 2/5/18**	**Sat 2/5/20**
Regular Site Inspections of CMP Contractors	Sat 1/4/17	Wed 31/3/21
Participate in Liaison Group Meetings/ Consultations as required by CEDD	Sat 1/4/17	Wed 31/3/21
Submission of Monthly EM&A Report	**Sun 14/5/17**	**Sun 14/3/21**
Submission of Quarterly EM&A Report	**Fri 14/7/17**	**Wed 14/4/21**
Submission of Annual EM&A Report	**Sun 14/1/18**	**Thu 14/1/21**
Submission of Annual Risk Assessment Report	**Thu 14/6/18**	**Mon 14/6/21**
Submission of Draft Final Report (including database of all data collected)	Fri 23/7/21	Fri 23/7/21
Submission of Final Report (including database of all data collected)	Fri 27/8/21	Fri 27/8/21
Submission of Draft Executive Summary	Fri 27/8/21	Fri 27/8/21
Submission of Final Executive Summary	Fri 1/10/21	Fri 1/10/21
For East Tung Lung Chau Disposal Facility (subject to the actual disposal programme to be confirmed by CEDD)	**Sun 14/10/18**	**Fri 14/12/18**
Submission of Monthly EM&A Report	**Sun 14/10/18**	**Fri 14/12/18**
Submission of Quarterly EM&A Report	Fri 14/12/18	Fri 14/12/18
Submission of Annual EM&A Report	Fri 14/12/18	Fri 14/12/18



Study Programme
Tue 13/6/17

Task | Milestone | Summary | Rolled Up Milestone