

**Agreement No. CE 59/2020 (EP)
Environmental Monitoring and
Audit for Disposal Facility to the
East of Sha Chau (2021-2026)
- Investigation**

Monthly EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
– May 2021

June 2021

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**Dredging, Management and Capping of Contaminated Sediment Disposal
Facility at Sha Chau
Environmental Certification Sheet
Environmental Permit No. 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 - May 2021
Date of Report:	7 June 2021
Date prepared by ET:	7 June 2021
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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 10 working days 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 verified by the Independent Auditor. Additional copies of the submission shall be provided to the Director upon request by the Director.
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ET Certification

I hereby certify that the above referenced document/ plan complies with the above referenced condition of EP-312/2008/A.	
Ir Thomas Chan, Environmental Team Leader (ETL): 	Date: 7 June 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 (IA): 	Date: 7 June 2021

Issue and Revision Record

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1 Introduction

1.1 Background

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.

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.

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 **Appendix A**.

The present EM&A programme under Agreement No. CE 59/2020 (EP) covers the dredging, disposal and capping operations of the ESC CMP V (see **Appendix A** for the EM&A programme.) Detailed works schedule for ESC CMP V is shown in **Table 1.1**. In May 2021, the following works were undertaken:

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

Table 1.1: Works Schedule for ESC CMP V

Pit	Operation	2017					2018												2019												2020												2021				
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May									
ESC CMP V	Dredging																																														
	Disposal																																														
	Capping																																														

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.

1.2 Reporting Period

This *Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – May 2021* covers the EM&A activities for the reporting period of May 2021 (from 1 to 31 May 2021).

1.3 Details of Sampling and Laboratory Testing Activities

The following monitoring activities were undertaken for ESC CMP V during the reporting period:

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

2 Brief Discussion of Monitoring Results for ESC CMP V

2.1 Introduction

This section presents a brief discussion of the results obtained from the following monitoring activities for ESC CMP V during the reporting period:

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

2.2 Water Column Profiling of ESC CMP Vb – in May 2021

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 5 May 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 wet season period (April to October) of 2010 – 2019 from stations in the North Western Water Control Zone (WCZ), where the ESC CMPs are located.³ 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 **Appendix B** for details).

2.2.1 In-situ Measurements

Analyses of results for May 2021 indicated that levels of Salinity, pH and DO complied with the WQOs at both Downstream and Upstream stations (**Table B2** of **Appendix B**). Levels of DO and Turbidity at all stations complied with the Action and Limit Levels (**Tables B1 and B2** of **Appendix B**).

2.2.2 Laboratory Measurements for Suspended Solids (SS)

Analyses of results for May 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 **Appendix B**).

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.

2.3 Routine Water Quality Monitoring of ESC CMPs – in May 2021

Routine Water Quality Monitoring of ESC CMPs was undertaken on 6 May 2021. The monitoring results have been assessed for compliance with the WQOs (see **Section 2.2** above for details). The monitoring results are shown in **Tables B3 and B4** of **Appendix B** and **Figures 1 to 10** of **Appendix C**. A total of sixteen (16) monitoring stations were sampled in May 2021 as shown in **Figure 2.1**.

³ <http://epic.epd.gov.hk/EPICRIVER/marine/?lang=en>

2.3.1 In-situ Measurements

Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in **Figures 1 to 6 of Appendix C**. Analyses of results indicated that the levels of pH, Salinity and DO complied with the WQOs at most stations during the reporting period, except for higher levels of Salinity were recorded at Ma Wan station. The higher Salinities recorded at Ma Wan station are likely to be caused by the larger separation distance to Pearl River Delta mouth, which releases a large amount of freshwater runoff in the area during wet season, when compared to the Reference stations.

The levels of DO and Turbidity complied with the Action and Limit Levels at all stations (**Table B3 of Appendix B; Figures 3 and 6 of Appendix C**).

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 May 2021.

2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Chromium, Copper, Lead, Nickel and Zinc were detected in the samples at all stations and their concentrations were generally similar across stations, except the concentrations of Zinc were higher at Ma Wan Station (**Table B4 of Appendix B; Figure 7 of Appendix C**).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at the Reference (RFF), Impact (IPF) and Intermediate (INF) stations were higher than the WQO (0.5 mg/L) (**Table B4 of Appendix B; Figure 8 of Appendix 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.⁴ 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 (NH₃-N) and Biochemical Oxygen Demand (BOD₅) were slightly higher at Ma Wan station in the reporting month (**Table B4 of Appendix B; Figure 8 and 9 of Appendix C**).

Analyses of results for the reporting period indicated that the SS levels at all stations complied with the wet season WQO (11.8 mg/L) and the Action and Limit Levels (**Tables B1 and B4 of Appendix B; Figure 10 of Appendix C**).

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 during the reporting period. Detailed statistical analysis will be presented in the Quarterly Report to investigate any spatial and temporal trends of potential concern.

2.4 Pit Specific Sediment Chemistry of ESC CMP Vb – in May 2021

Monitoring locations for Pit Specific Sediment Chemistry for ESC CMP Vb are shown in **Figure 2.2**. A total of six (6) monitoring stations were sampled on 4 May 2021.

The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs), except for Arsenic (**Figures 11 and 12 of Appendix C**). The concentrations of Arsenic were higher than the LCEL at Pit-Edge stations ESC-NECA and ESC-NECB and Active-Pit station ESC-NPCA.

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

⁴ http://www.epd.gov.hk/epd/misc/marine_quality/1986-2005/textonly/eng/index.htm

sediments.⁵ It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments,⁶ 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.

For organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Active-Pit station ESC-NPCA during the reporting period (**Figure 13 of Appendix 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 Appendix C**). The concentrations of Tributyltin (TBT) were higher at Active-Pit stations ESC-NPCA and ESC-NPCB (**Figure 15 of Appendix 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 during the reporting period.

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 during the reporting period.

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.

⁵ Sewell RJ (1999) Geochemical Atlas of Hong Kong. Geotechnical Engineering Office, Government of the Hong Kong Special Administrative Region

⁶ 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

3 Future Key Issues

3.1 Activities Scheduled for the Next Reporting Period

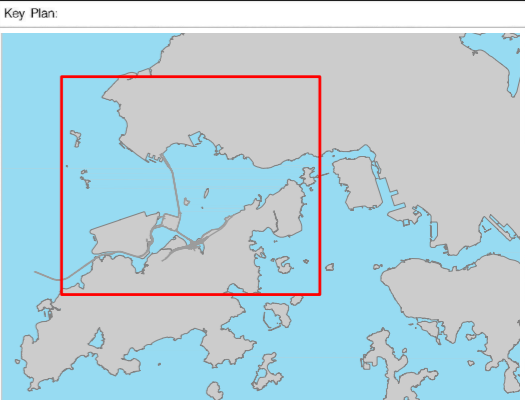
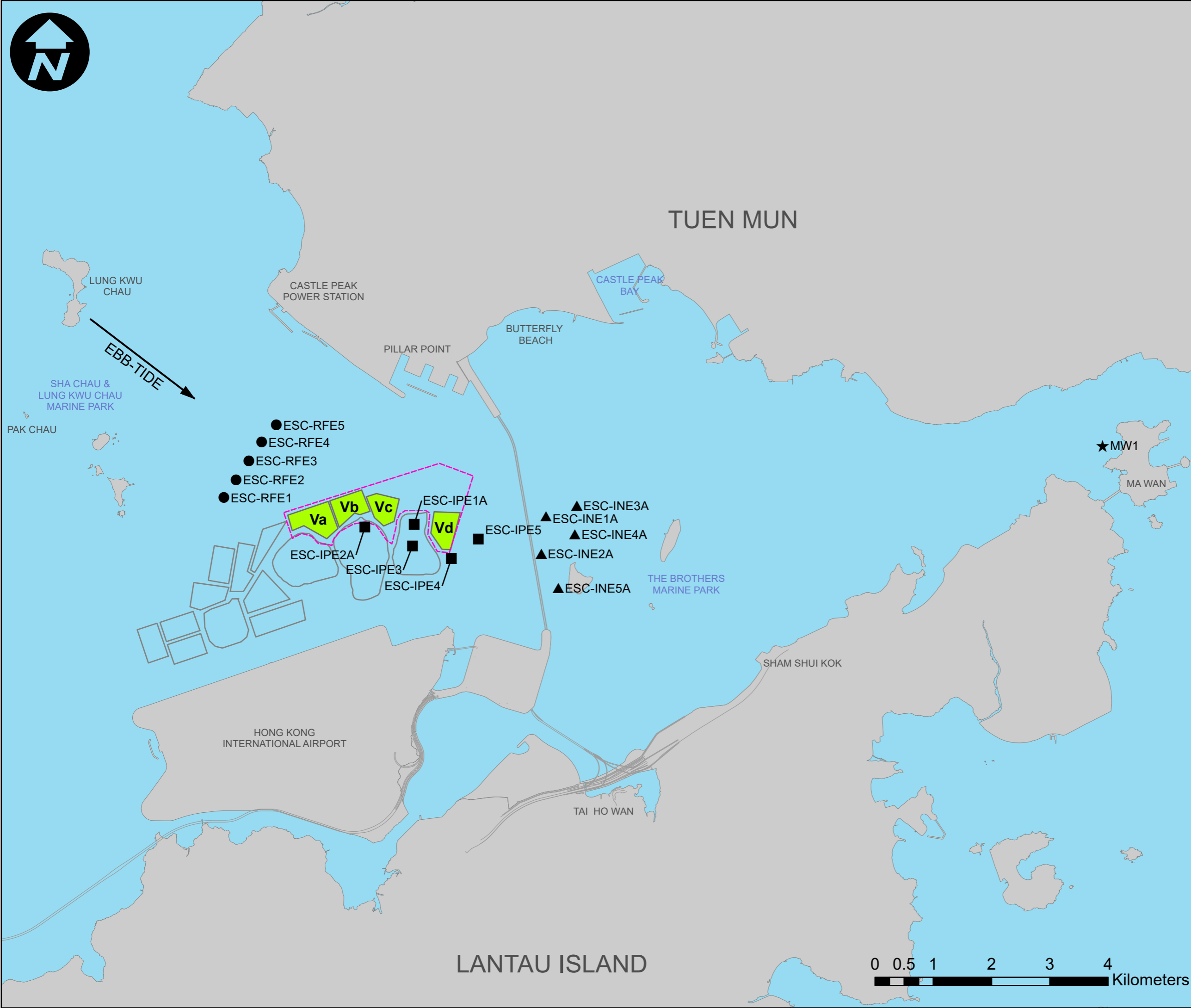
The following monitoring activities will be conducted in the next reporting period of June 2021 for ESC CMP V (see **Appendix A** for the sampling schedule):

- 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.

3.2 Study Programme

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

Figures



Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

WATER QUALITY SAMPLING STATIONS

- IMPACT STATION
- INTERMEDIATE STATION
- REFERENCE STATION
- MA WAN STATION

Rev	Date	Drawn	Description	Ch'kd	App'd
P1	APR 2021	KN			

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TO THE EAST OF SHA CHAU (2021-2026)
- INVESTIGATION

Title
ROUTINE & CAPPING WATER QUALITY
SAMPLING STATIONS (EBB-TIDE)
FOR ESC CMPS

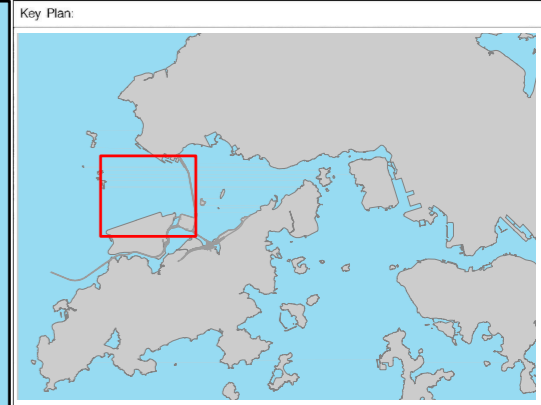
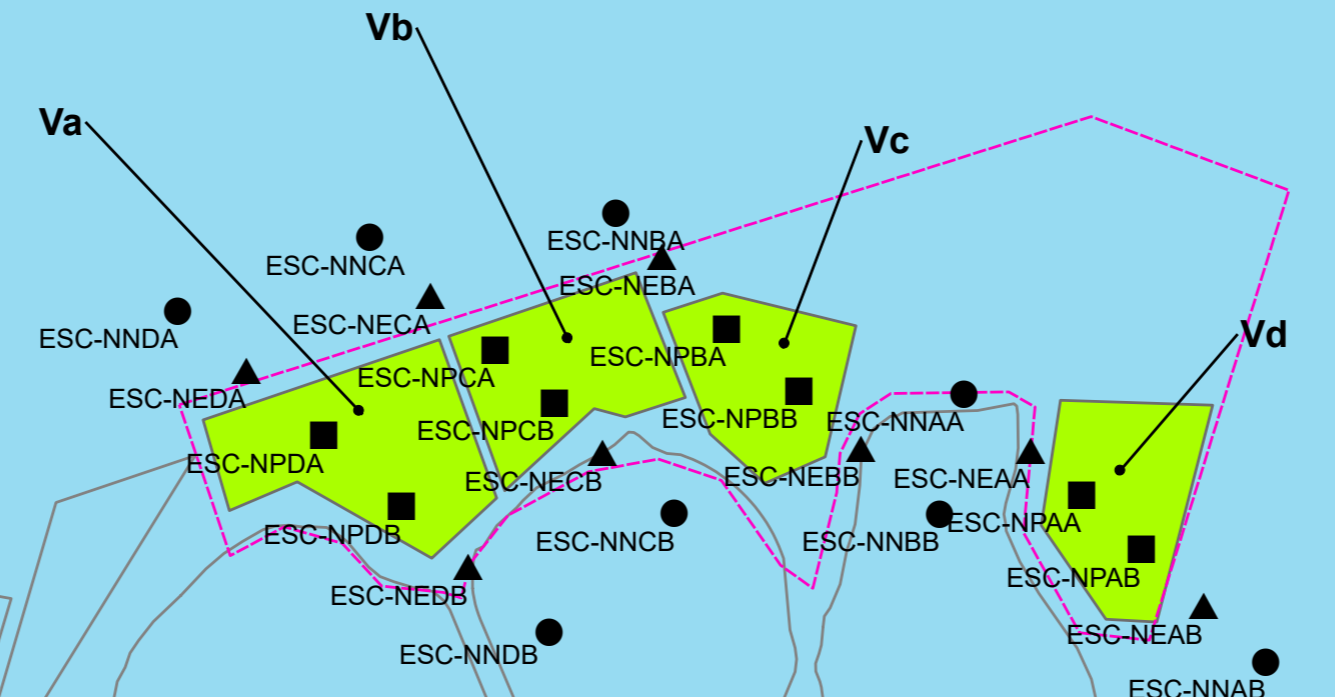
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Drawn		Coordination	
Dwg check		Approved	
Scale at A3	Status	Rev	

Drawing Number **FIGURE 2.1**



EBB-TIDE

FLOOD-TIDE



Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

PIT SPECIFIC SEDIMENT MONITORING STATIONS

- ACTIVE-PIT STATION
- PIT-EDGE STATION
- NEAR-PIT STATION

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	APR 2021	KN			

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 FOR DISPOSAL FACILITY
 TO THE EAST OF SHA CHAU (2021-2026)
 – INVESTIGATION**

Title
**PIT SPECIFIC SEDIMENT QUALITY
 MONITORING STATIONS FOR CMP V**

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Drawn		Coordination	
Dwg check		Approved	
Scale at A3	Status	Rev	

Drawing Number **FIGURE 2.2**

HONG KONG
INTERNATIONAL AIRPORT



Appendices

- A. Sampling Schedule
- B. Water Quality Monitoring Results
- C. Graphical Presentations
- D. Study Programme

A. Sampling Schedule

B. Water Quality Monitoring Results

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

Parameters	Action	Limit
Dissolved Oxygen (DO) in mg L ⁻¹ (Surface, Middle & Bottom) ⁽¹⁾	Surface and Middle Depth⁽²⁾ 5%-ile of baseline data for surface and middle layer = 3.76 and Significantly less than the reference station's mean DO (at the same tide of the same day)	Surface and Middle Depth⁽²⁾ 1%-ile of baseline data for surface and middle layer = 3.11 ⁽³⁾ and Significantly less than the reference station's mean DO (at the same tide of the same day)
	Bottom 5%-ile of baseline data for surface and middle layer = 2.96 and Significantly less than the reference station's mean DO (at the same tide of the same day)	Bottom The average of the impact station readings are < 2 and Significantly less than the reference station's mean DO (at the same tide of the same day)
Suspended Solids (SS) in mg L ⁻¹ (depth-averaged) ⁽⁴⁾⁽⁵⁾	95%-ile of baseline data for depth-averaged = 37.88 and 120% of control station's SS at the same tide of the same day	99%-ile of baseline data for depth-averaged = 61.92 and 130% of control station's SS at the same tide of the same day
	Turbidity in NTU (depth-averaged) ⁽⁴⁾⁽⁵⁾	95%-ile of baseline data = 28.14 and 120% of control station's Turbidity 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. Action and Limit Levels for DO for Surface and 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 and 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 May 2021

Station	Temp. (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L ⁻¹)	pH	Suspended Solids (mg L ⁻¹)
WCP 1 (Downstream)	25.69	26.76	4.08	91.09	6.39	8.10	7.9
WCP 2 (Upstream)	25.98	25.90	3.59	95.09	6.67	8.06	6.9
WQO (Wet Season)	N/A	23.31 – 28.49 [#]	N/A	N/A	>4	6.5 – 8.5	11.8

Notes:

1. [#] Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.
2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.
3. Cell shaded grey indicates value exceeding the WQO.

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

Station	Temp. (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L ⁻¹)	pH
RFF (Reference)	25.67	28.27	3.42	90.67	6.31	8.07
IPF (Impact)	25.66	28.13	2.02	91.11	6.34	8.09
INF (Intermediate)	25.35	29.66	2.06	91.16	6.33	8.14
Ma Wan	24.96	32.10	2.65	88.17	6.07	8.11
WQO (Wet Season)	N/A	25.45 – 31.10 [#]	N/A	N/A	>4	6.5 – 8.5

Notes:

1. [#] Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.
2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.
3. Cell shaded grey indicates value exceeding the WQO.

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

Station	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)
RFF	2.70	<LOR	1.69	13.01	1.88	<LOR	2.00	<LOR	26.27	0.12	0.63	1.62	5.4
IPF	2.48	<LOR	2.13	11.22	3.08	<LOR	1.98	<LOR	22.32	0.12	0.62	1.47	6.7
INF	2.63	<LOR	2.05	12.04	2.92	<LOR	2.64	<LOR	26.69	0.13	0.54	1.79	5.8
Ma Wan	2.73	<LOR	2.13	7.03	1.55	<LOR	2.18	<LOR	31.45	0.16	0.34	1.95	6.3

WQO of TIN: 0.5 mg/L
 Wet Season WQO of SS: 11.8 mg/L

Notes:

1. "<LOR" indicates the concentrations of metals and metalloids are below the limit of reporting.
2. Cell shaded yellow / red indicates value exceeding the Action/Limit levels.
3. Cell shaded grey indicates value exceeding the WQO.

C. Graphical Presentations

Routine Water Quality Monitoring for ESC CMP V - May 2021

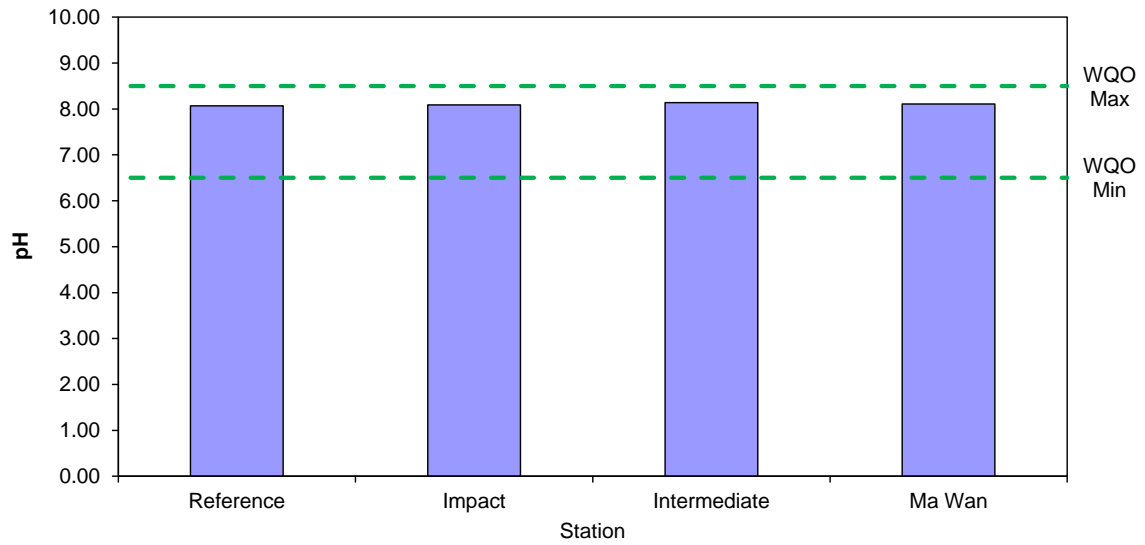


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for ESC CMP V - May 2021

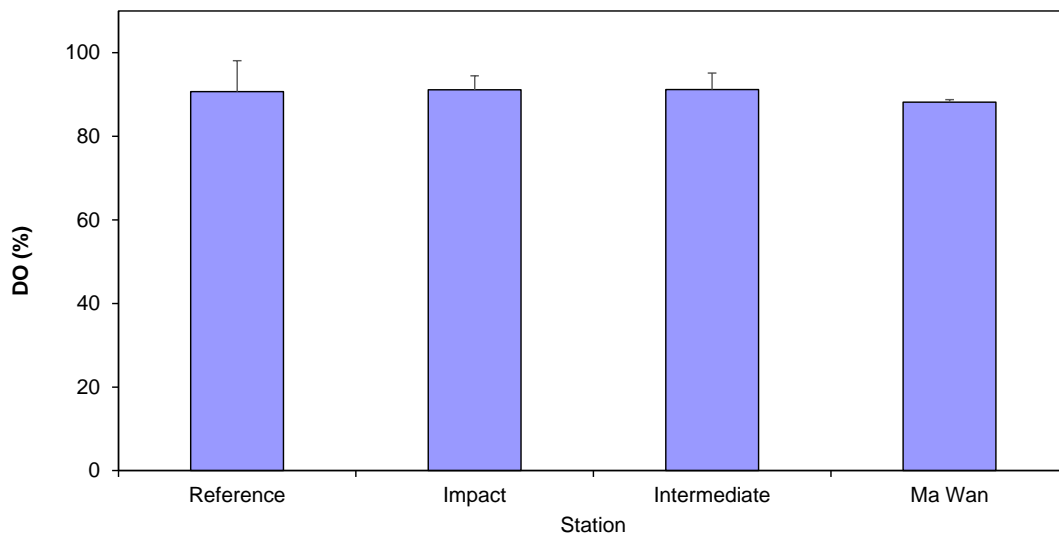


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for ESC CMP V - May 2021

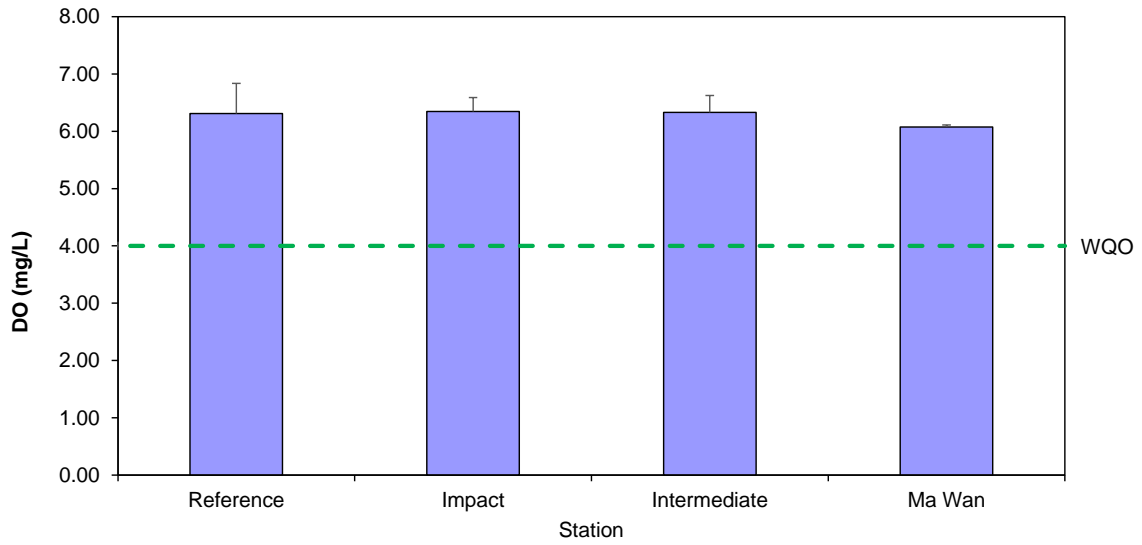


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for ESC CMP V - May 2021

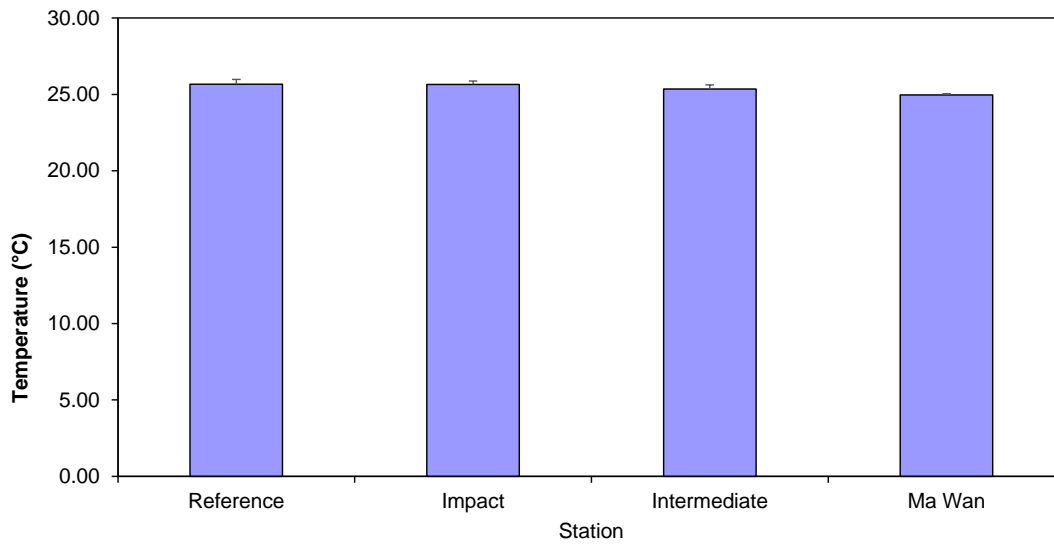


Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for ESC CMP V - May 2021

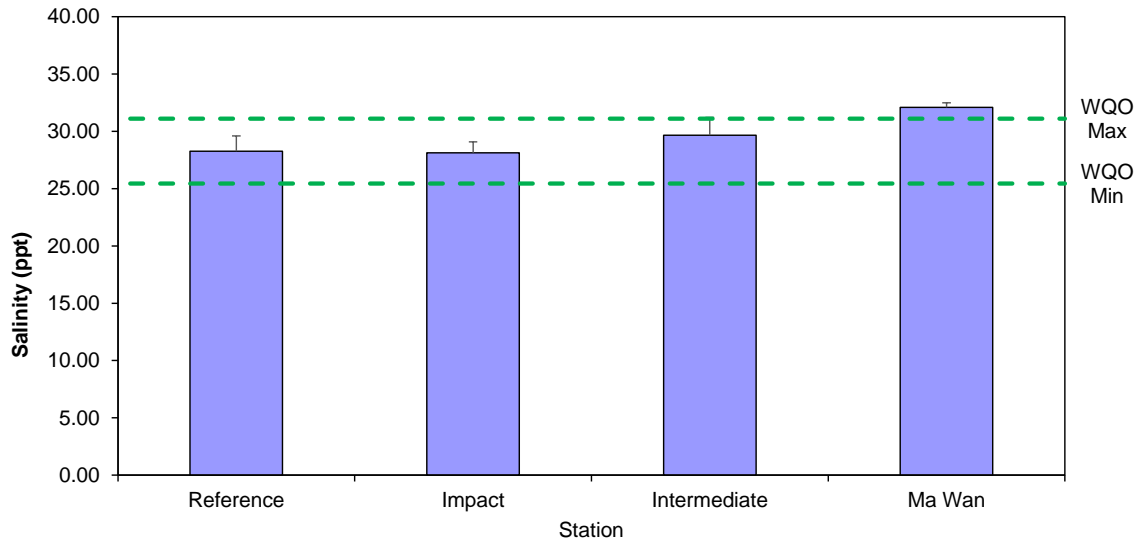


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for ESC CMP V - May 2021

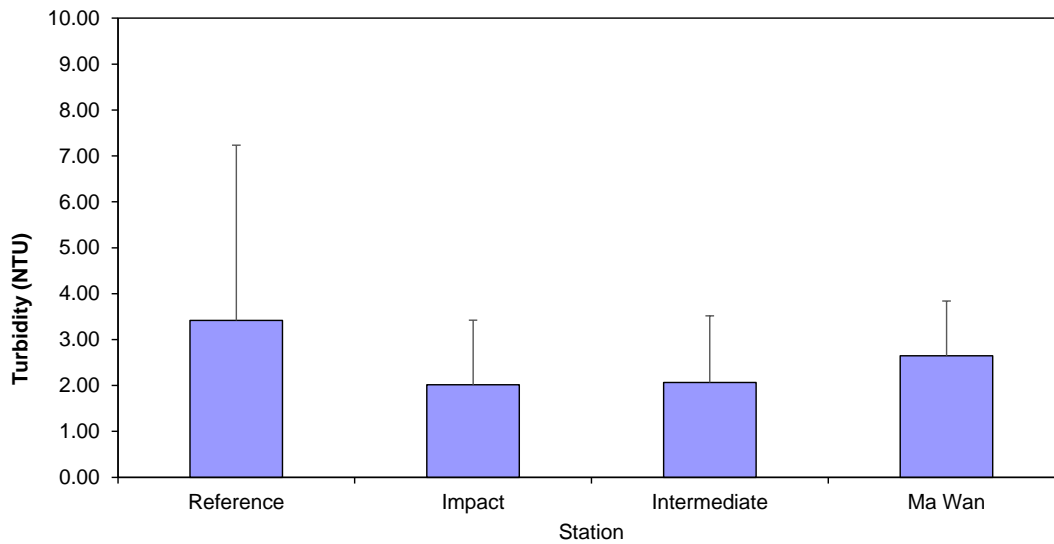


Figure 6: Level of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for ESC CMP V May 2021

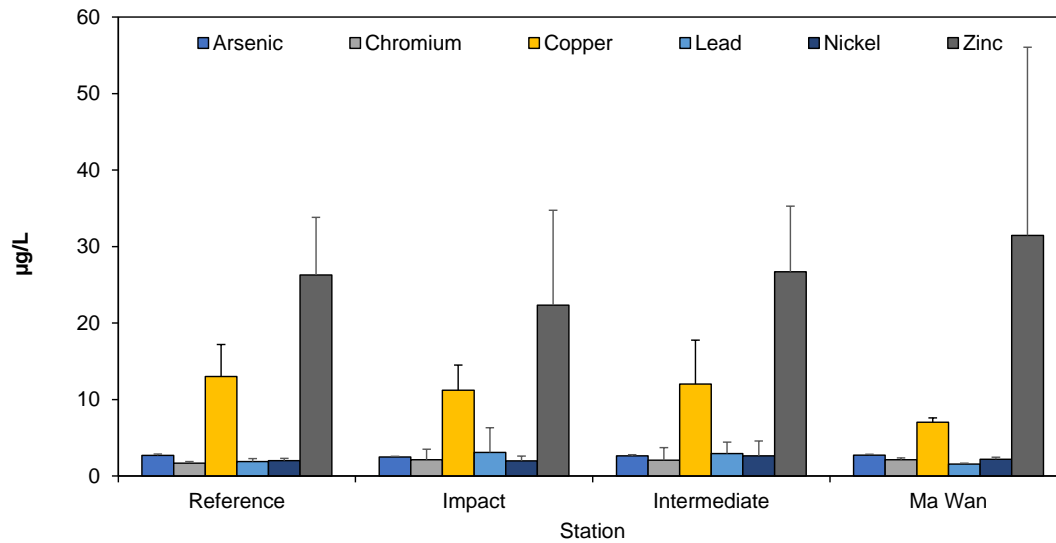


Figure 7: Concentration of Arsenic, Chromium, Copper, Lead, Nickel, and Zinc (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

Routine Water Quality Monitoring for Nutrients - May 2021

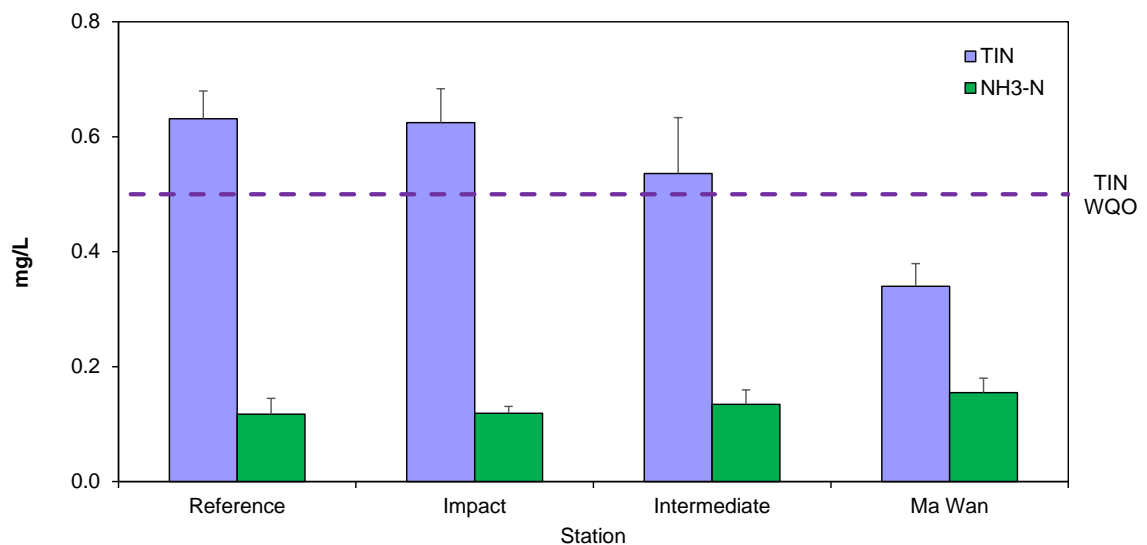


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

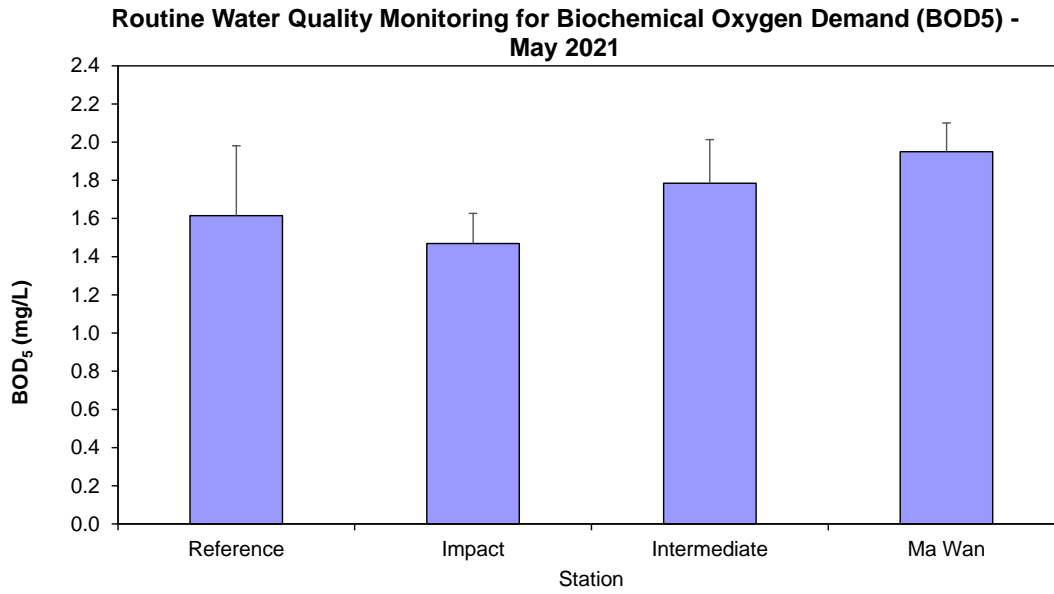


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021

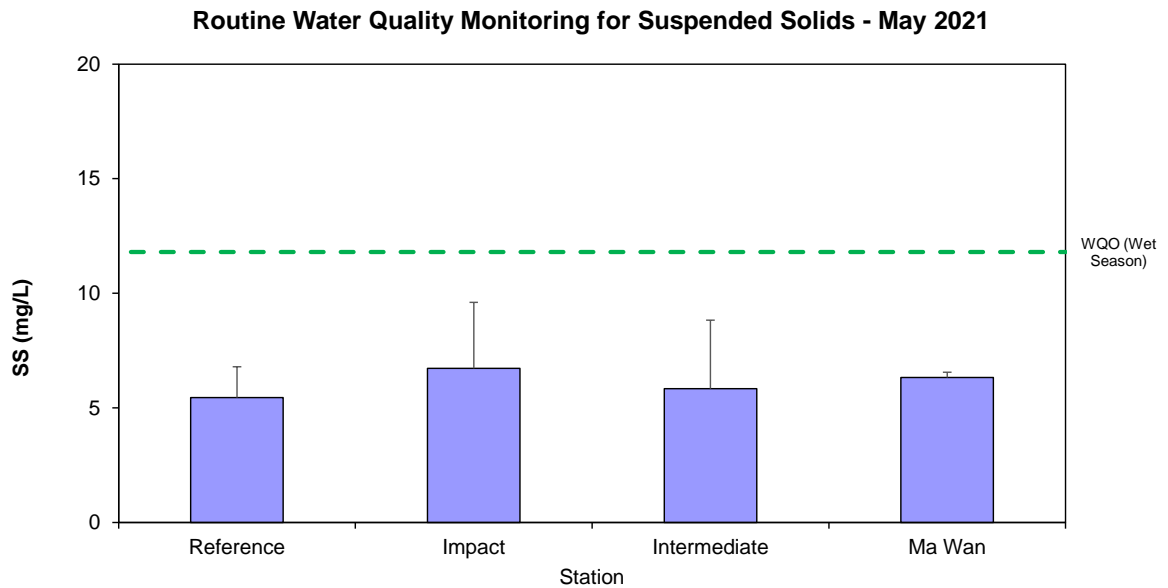
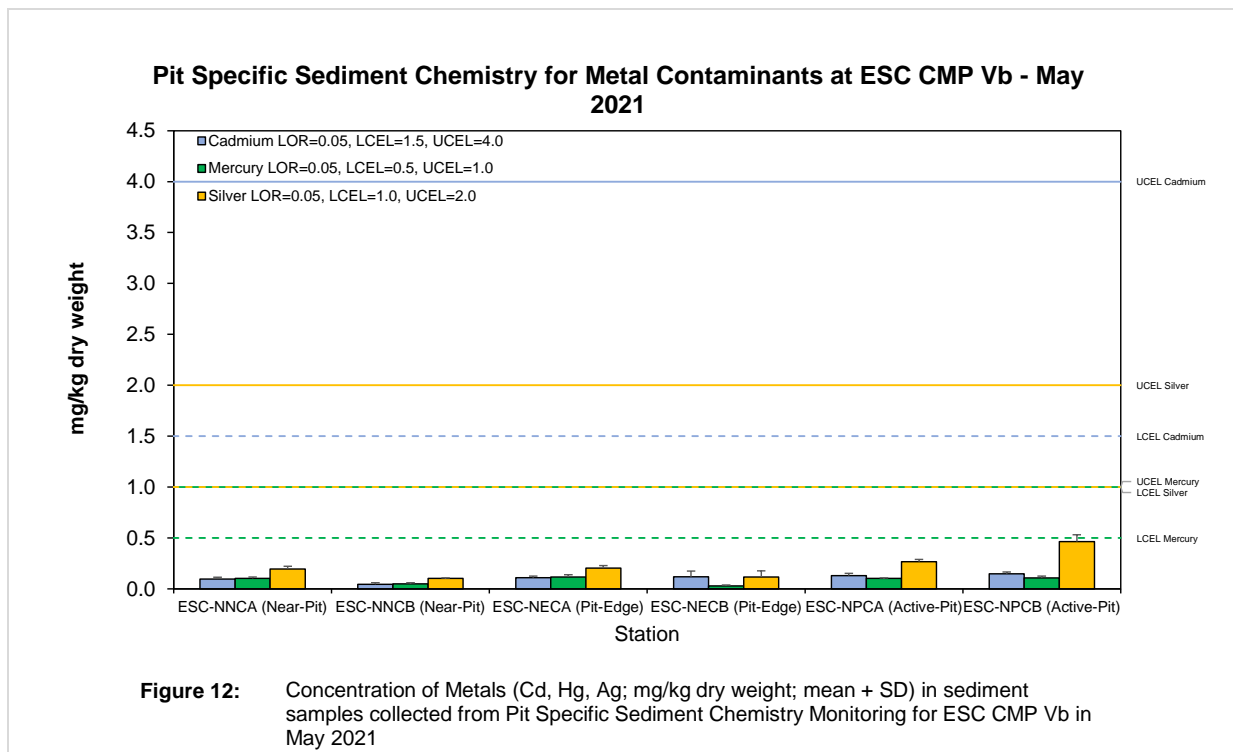
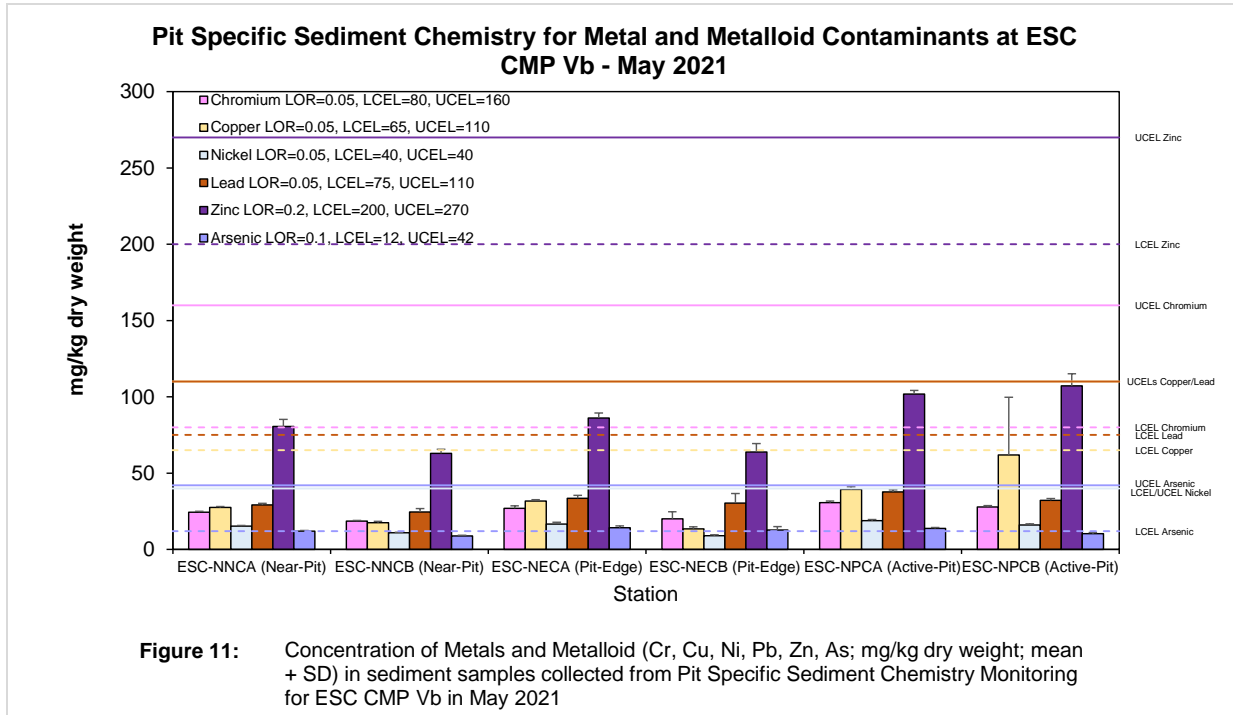
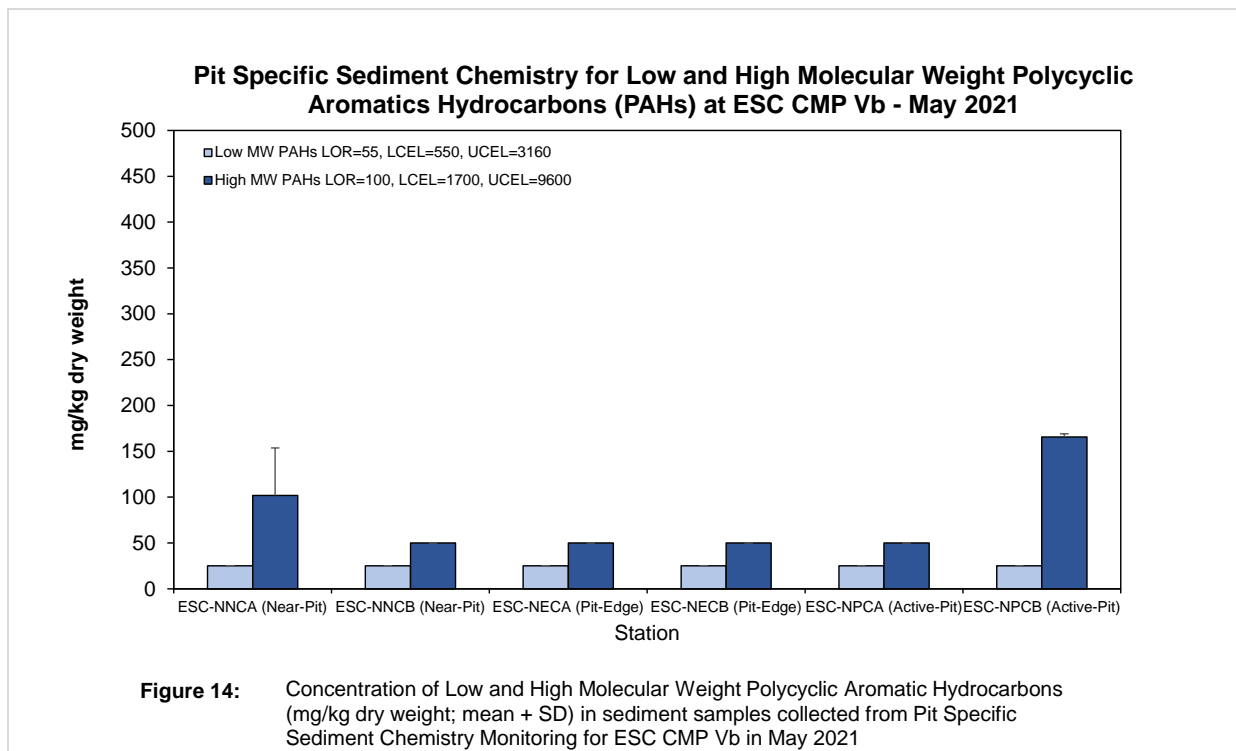
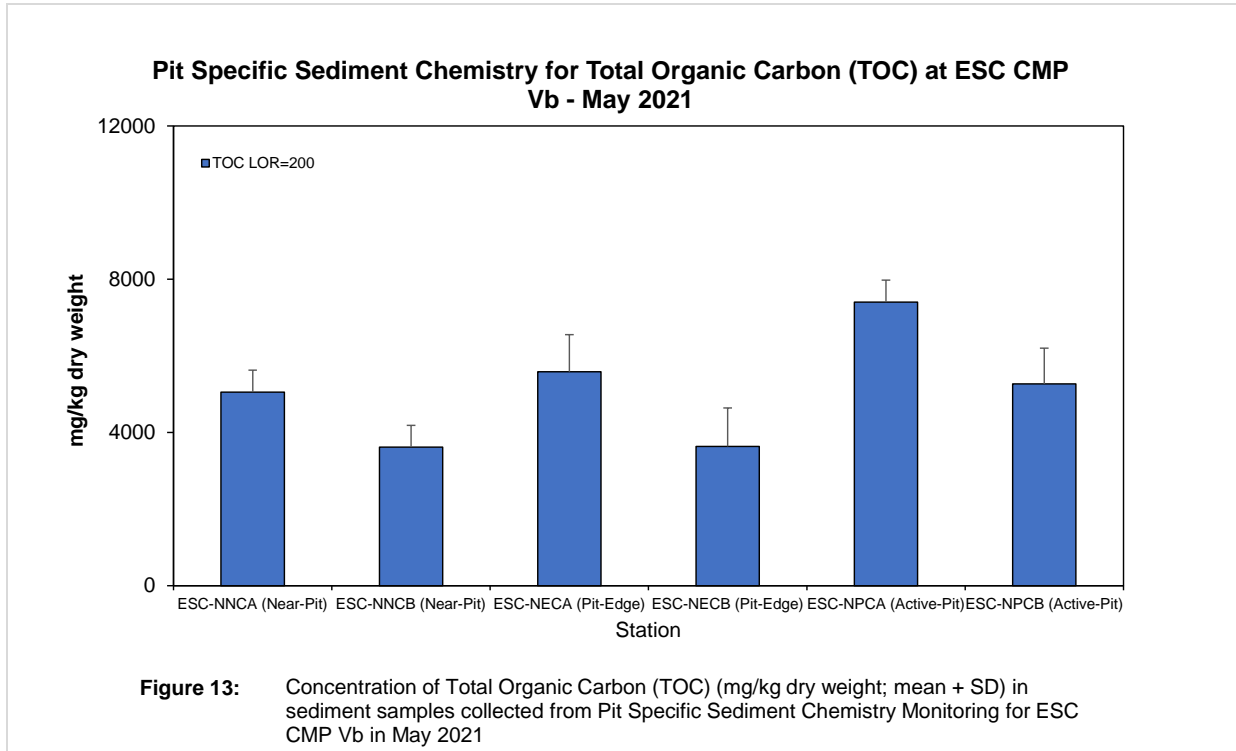
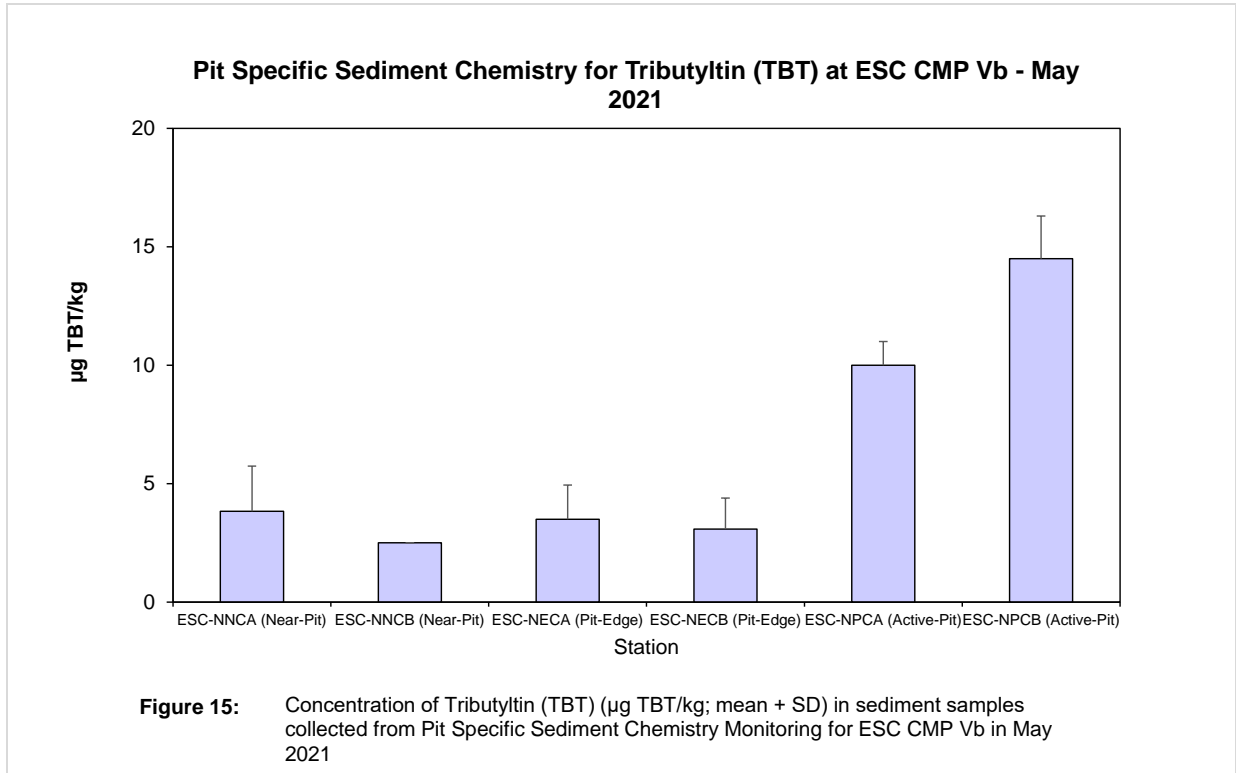


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in May 2021







D. Study Programme

