

**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
– January 2022

February 2022

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Contents

1	Introduction	1
1.1	Background	1
1.2	Reporting Period	2
1.3	Details of Sampling and Laboratory Testing Activities	2
1.4	Details of Outstanding Sampling or Analysis	2
2	Brief Discussion of Monitoring Results for ESC CMP V	3
2.1	Introduction	3
2.2	Water Column Profiling of ESC CMP Vb – in January 2022	3
2.2.1	In-situ Measurements	3
2.2.2	Laboratory Measurements for Suspended Solids (SS)	3
2.3	Routine Water Quality Monitoring of ESC CMPs – in January 2022	3
2.3.1	In-situ Measurements	4
2.3.2	Laboratory Measurements	4
2.4	Pit Specific Sediment Chemistry of ESC CMP Vb – in January 2022	4
3	Future Key Issues	6
3.1	Activities Scheduled for the Next Reporting Period	6
3.2	Study Programme	6

Tables

Table 1.1 Works Schedule for ESC CMP V

Figures

Figure 2.1 Routine & Capping Water Quality Sampling Stations (Flood-Tide) for ESC CMPs

Figure 2.2 Pit Specific Sediment Quality Monitoring Stations for CMP V

Appendices

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

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 East of Sha Chau (ESC) for the disposal of contaminated sediment, and various 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.

Environmental Permits (EPs) (Ref. No. EP-312/2008/A) was issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 for the Project - Disposal of Contaminated Sediment – Dredging, Management and Capping of Sediment Disposal Facility at Sha Chau.

Under the requirements of the EP, 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. 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.

A proposal on the change of number of sample replication of water quality and sediment monitoring as well as 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 January 2022, 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	2021			2022			2023			2024			2025			2026										
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		
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 – January 2022* covers the EM&A activities for the reporting period of January 2022 (from 1 to 31 January 2022).

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;
- Pit Specific Sediment Chemistry of ESC CMP Vb; and
- Demersal Trawling for ESC CMPs.

1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for the reporting month (January 2022). The following analyses are in progress and will be presented in the corresponding quarterly report:

- Species identification of the biota samples collection from Demersal Trawling for ESC CMPs in January 2022.

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 January 2022

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 11 January 2022. 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 2011 – 2020 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 January 2022 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 January 2022 indicated that the SS level 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 January 2022

Routine Water Quality Monitoring of ESC CMPs was undertaken on 6 January 2022. 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 ten (10) monitoring stations were sampled in January 2022 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 all stations in January 2022.

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 January 2022.

2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Copper, Lead, Nickel and Zinc were detected in the samples at some/all stations and their concentrations of most metals and metalloids were generally similar across stations, except the concentrations of Lead and Zinc which were lower at Impact (IPF) station (**Table B4 of Appendix B; Figure 7 of Appendix C**).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) at all stations complied with the WQO (0.5 mg/L) (**Table B4 of Appendix B; Figure 8 of Appendix C**). The concentration of Ammonia Nitrogen (NH₃-N) was higher at Intermediate (INF) station (**Table B4 of Appendix B; Figure 8 of Appendix C**). The concentration of Biochemical Oxygen Demand (BOD₅) were lower at Impact (IPF) station (**Table B4 of Appendix B; Figure 9 of Appendix C**).

Analyses of results for the reporting period indicated that the SS levels at Reference (RFF), Impact (IPF), Intermediate (INF) and Ma Wan stations were above the dry season WQO (13.1 mg/L) but in compliance with 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 EM&A Report to investigate any spatial and temporal trends of potential concern.

2.4 Pit Specific Sediment Chemistry of ESC CMP Vb – in January 2022

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 January 2022.

The concentrations of all inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at all stations (**Figures 11 and 12 of Appendix C**).

For organic contaminants, the concentration of Total Organic Carbon (TOC) was higher at Pit-Edge station ESC-NECA 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 LCELs at all stations (**Figure 14 of Appendix C**). The concentrations of Tributyltin (TBT) were higher at Near-Pit station ESC-NNCA, Pit-Edge station ESC-NECB and Active-Pit station ESC-NPCA (**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 EM&A Report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.

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 February 2022 for ESC CMP V (see **Appendix A** for the sampling schedule):

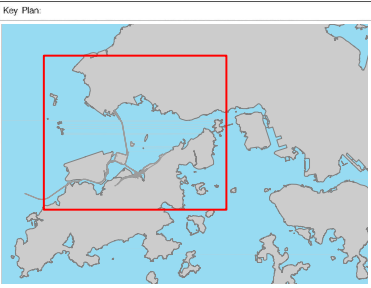
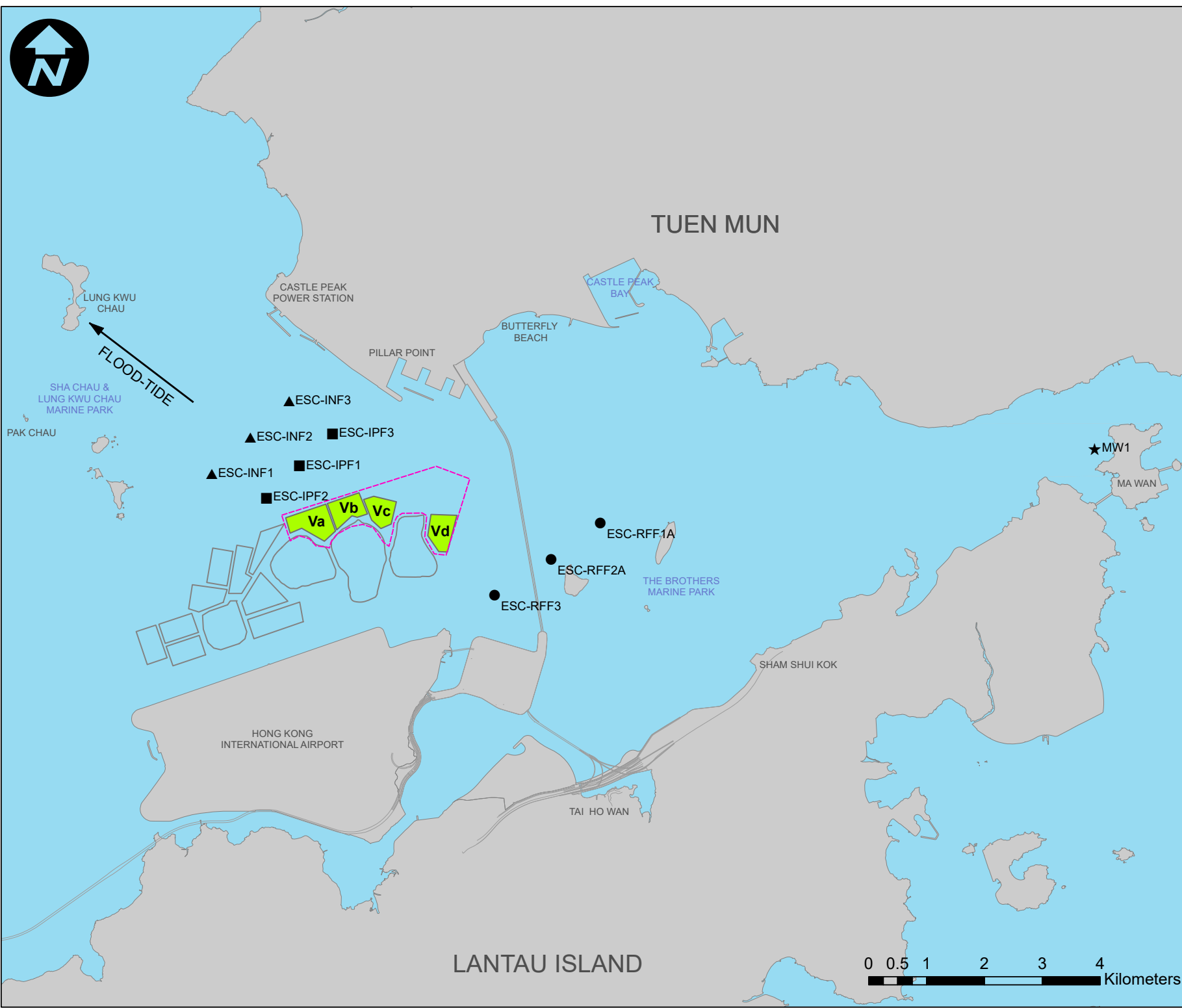
- Water Column Profiling of ESC CMP Vb;
- Routine Water Quality Monitoring of ESC CMPs;
- Pit Specific Sediment Chemistry of ESC CMP Vb;
- Cumulative Impact Sediment Chemistry of ESC CMPs; and
- Demersal Trawling for ESC CMPs.

Due to the logistic problem induced by the pandemic which adversely affecting the supply of international species adopted in testing programme of Sediment Toxicity tests, as such, Sediment Toxicity Tests of ESC CMPs originally scheduled in February 2022 will be tentatively postponed to March 2022 (subject to logistic conditions at that time).

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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ENVIRONMENTAL MONITORING AND AUDIT
FOR DISPOSAL FACILITY
TO THE EAST OF SHA CHAU (2021-2026)
- INVESTIGATION**

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

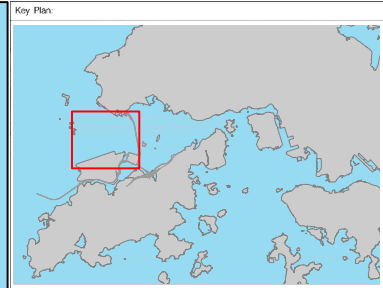
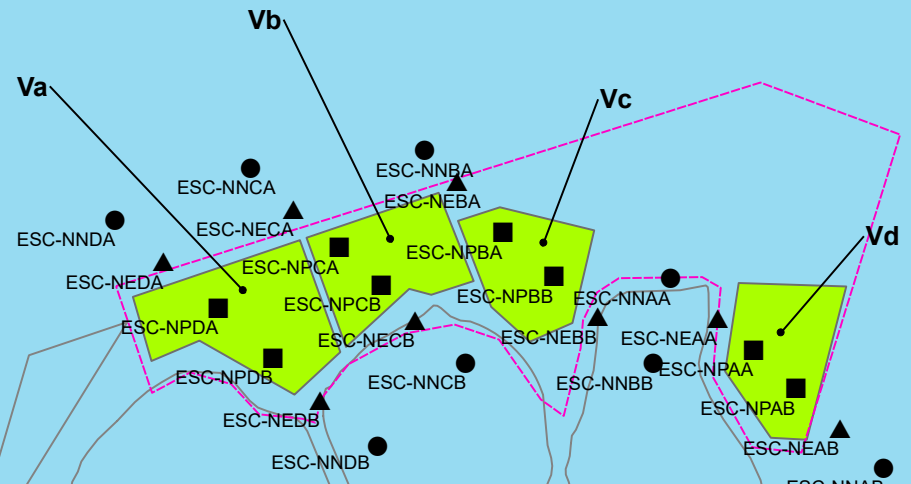
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Drawn		Coordination	
Dwg check		Approved	
Scale at A3	Status	Rev	

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'kd	App'd
P1	APR 2021	KN			

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ENVIRONMENTAL MONITORING AND AUDIT
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

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

Appendix A. Sampling Schedule

Appendix 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) ⁽⁶⁾	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	99%-ile of baseline data = 38.32 and 130% 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 January 2022

Station	Temp. (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L ⁻¹)	pH	Suspended Solids (mg L ⁻¹)
WCP 1 (Downstream)	19.75	33.88	5.50	88.28	6.60	8.06	7.9
WCP 2 (Upstream)	19.87	33.81	7.25	88.91	6.64	8.03	8.2
WQO (Dry Season)	N/A	30.43-37.19 [#]	N/A	N/A	>4	6.5 - 8.5	13.1

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 January 2022

Station	Temp. (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L ⁻¹)	pH
RFF (Reference)	20.00	32.02	20.27	91.47	6.88	7.95
IPF (Impact)	20.03	31.75	18.51	91.75	6.91	7.92
INF (Intermediate)	20.01	31.57	24.43	91.39	6.90	7.92
Ma Wan	20.00	32.43	27.16	87.49	6.57	7.95
WQO (Dry Season)	N/A	28.82-35.23 [#]	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 January 2022

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	2.23	<LOR	<LOR	2.06	0.71	<LOR	0.68	<LOR	22.62	0.10	0.36	2.63	28.0
IPF	2.24	<LOR	<LOR	2.48	0.60	<LOR	0.75	<LOR	21.63	0.11	0.42	1.08	22.2
INF	2.35	<LOR	<LOR	2.74	1.32	<LOR	1.03	<LOR	23.26	0.12	0.44	2.18	32.6
Ma Wan	2.35	<LOR	<LOR	2.63	1.45	<LOR	0.65	<LOR	24.08	0.11	0.35	2.55	31.6

WQO of TIN: 0.5 mg/L
 Dry Season WQO of SS: 13.1 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.

Appendix C. Graphical Presentations

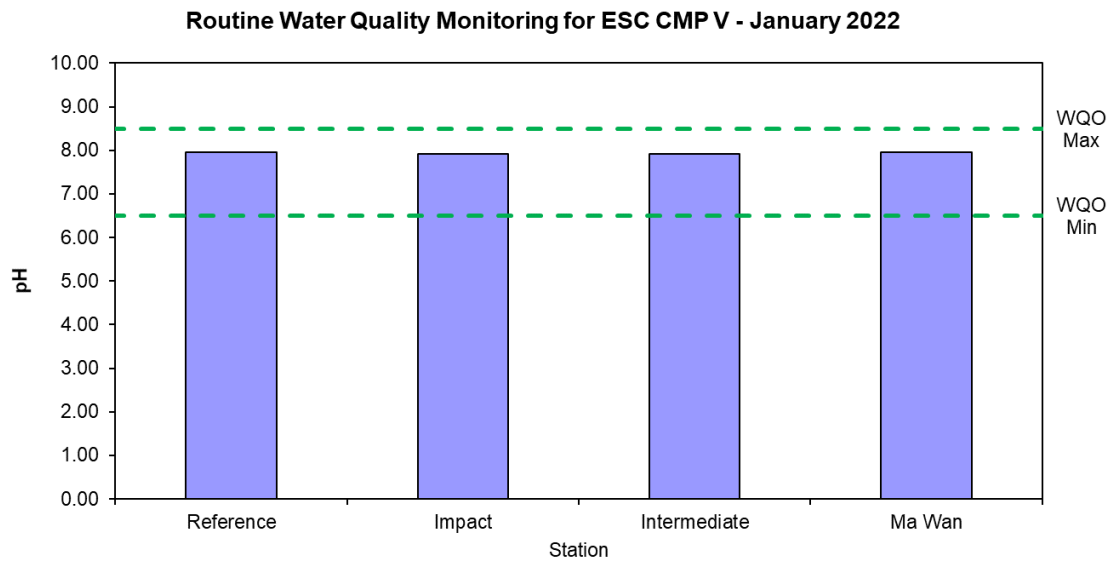


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

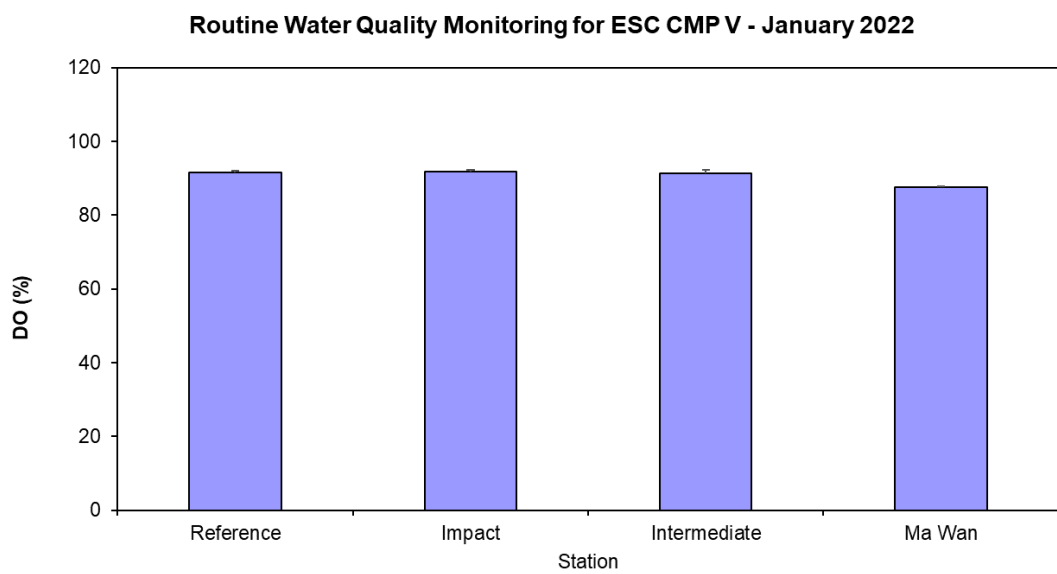


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

¹ The mean and standard deviation (SD) for in-situ data are the mean and SD for water columns within the area.

Routine Water Quality Monitoring for ESC CMP V - January 2022

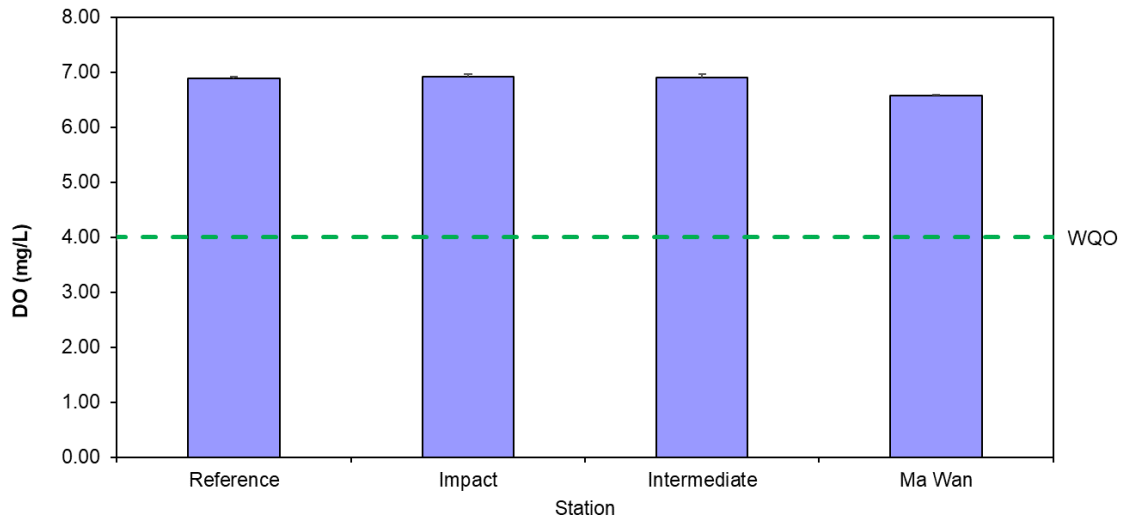


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

Routine Water Quality Monitoring for ESC CMP V - January 2022

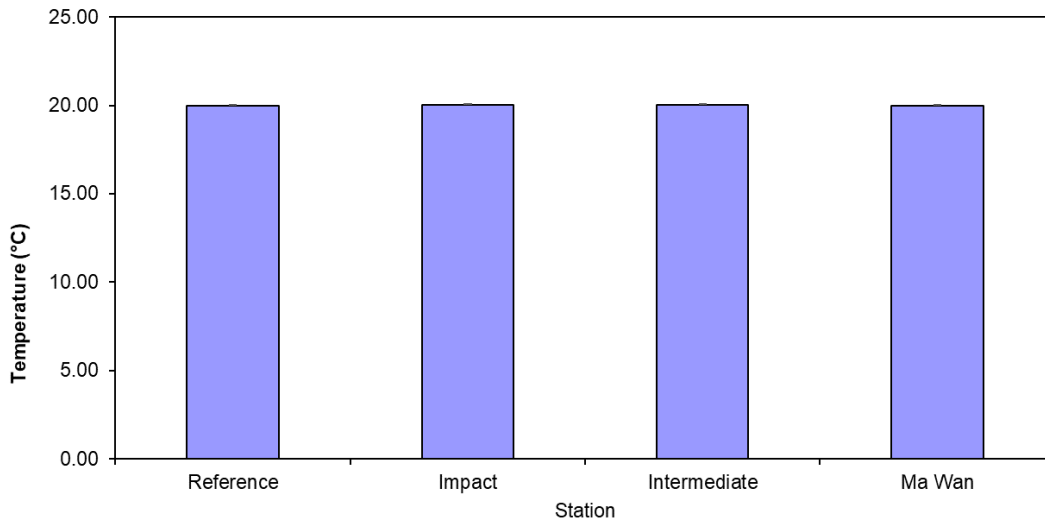


Figure 4: Level of Temperature (°C; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

¹ The mean and standard deviation (SD) for in-situ data are the mean and SD for water columns within the area.

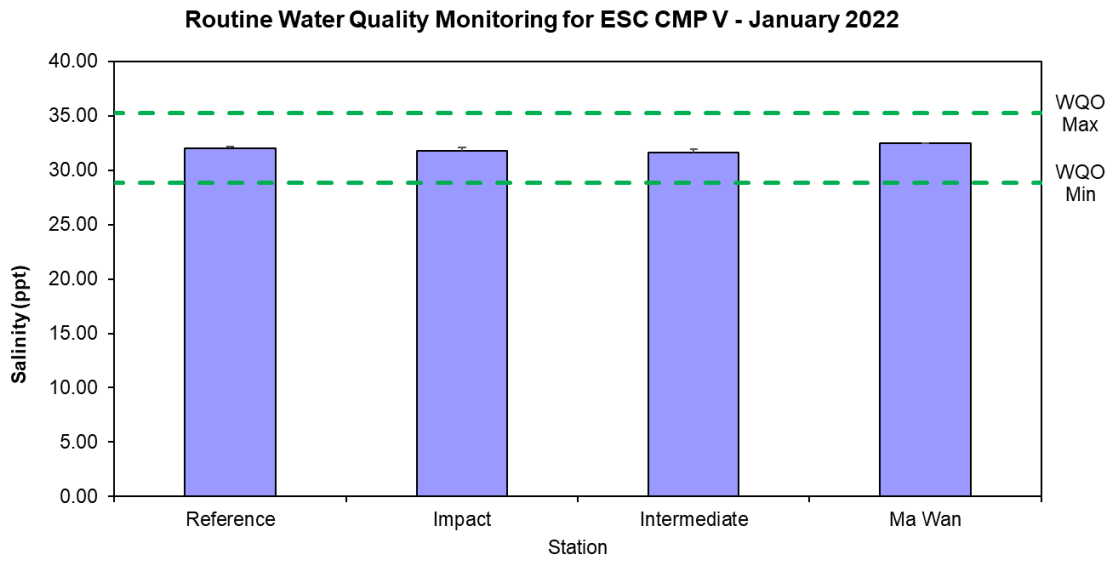


Figure 5: Level of Salinity (ppt; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

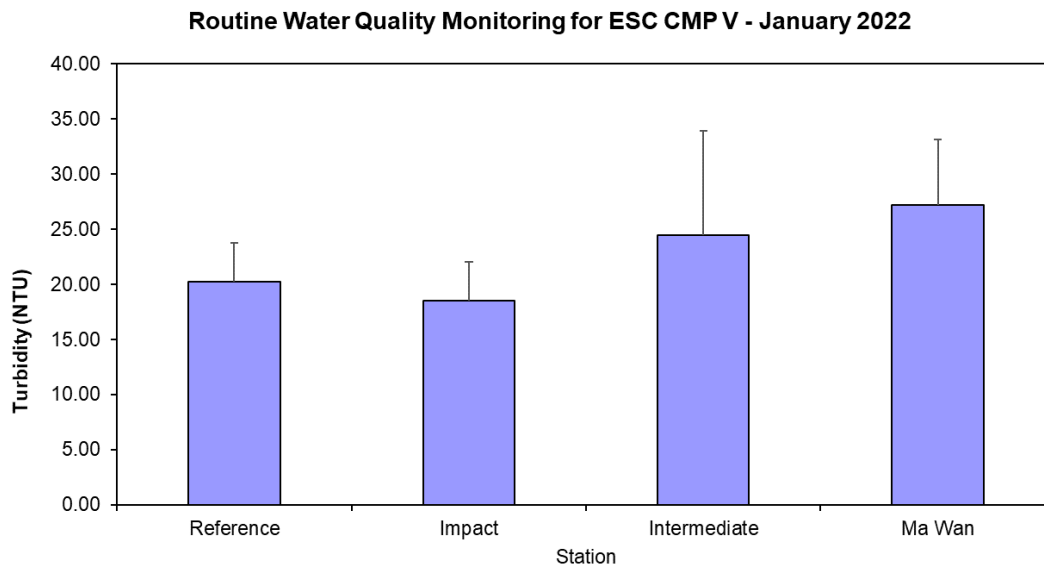


Figure 6: Level of Turbidity (NTU; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

¹ The mean and standard deviation (SD) for in-situ data are the mean and SD for water columns within the area.

Routine Water Quality Monitoring for ESC CMP V January 2022

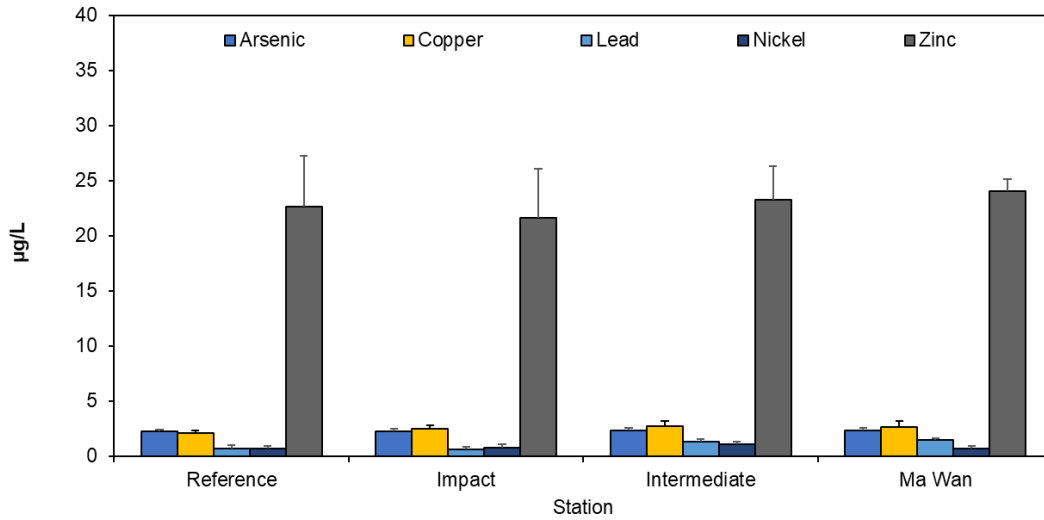


Figure 7: Concentration of Arsenic, Copper, Lead, Nickel, and Zinc (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

Routine Water Quality Monitoring for Nutrients - January 2022

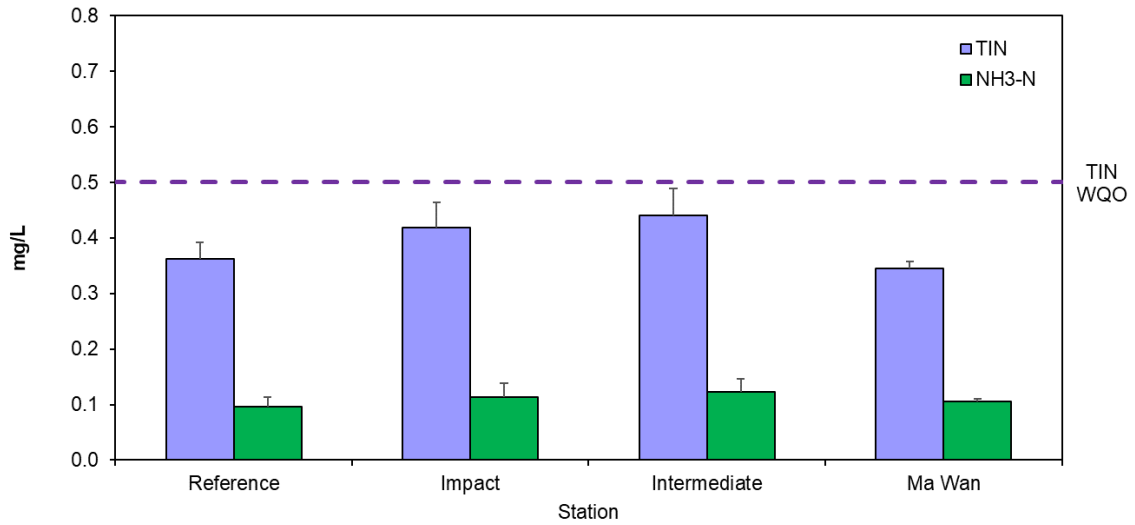


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

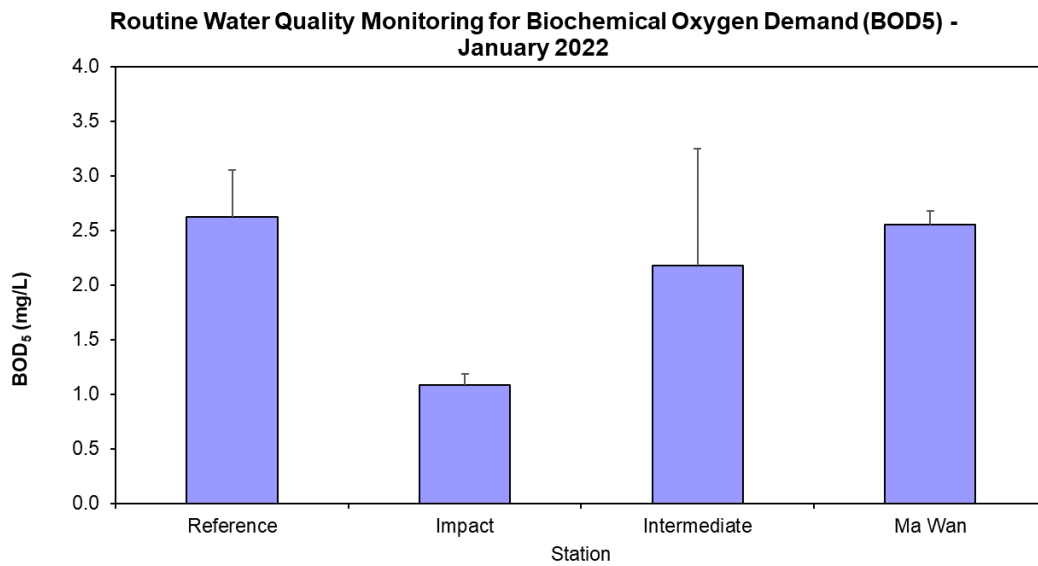


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

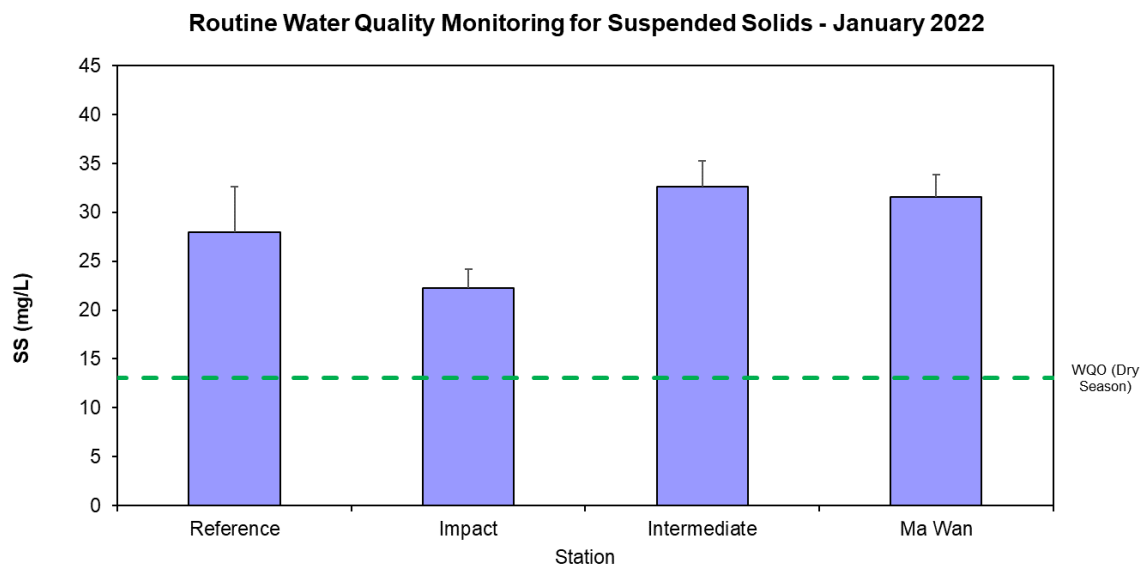


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in January 2022

Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMP Vb - January 2022

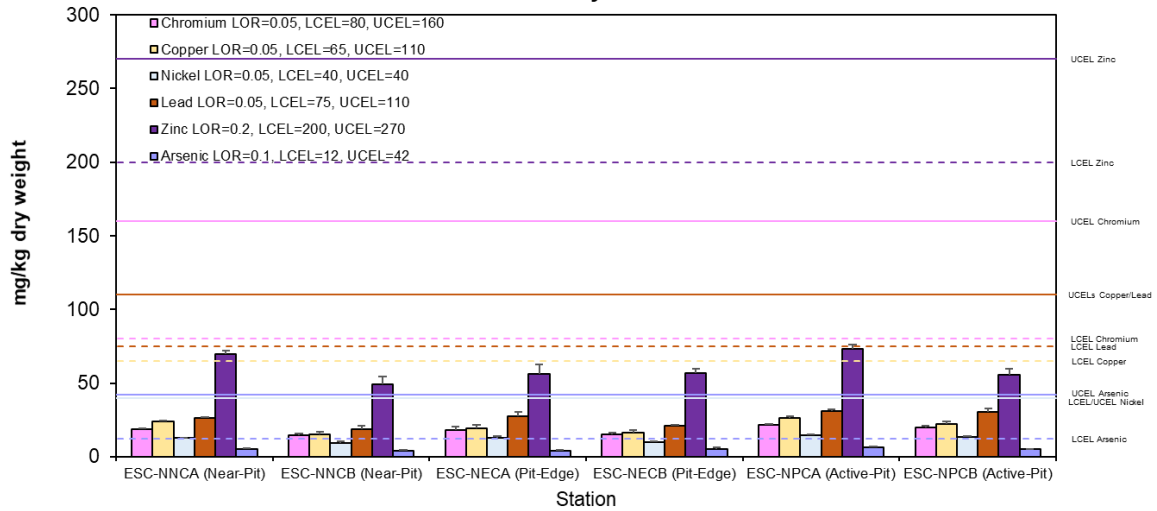


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in January 2022

Pit Specific Sediment Chemistry for Metal Contaminants at ESC CMP Vb - January 2022

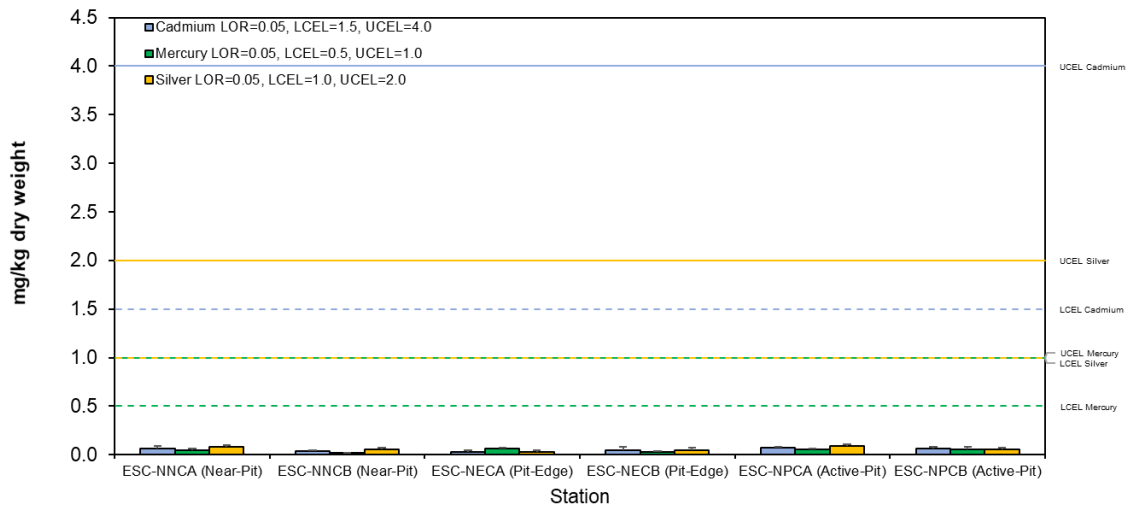


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in January 2022

Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vb - January 2022

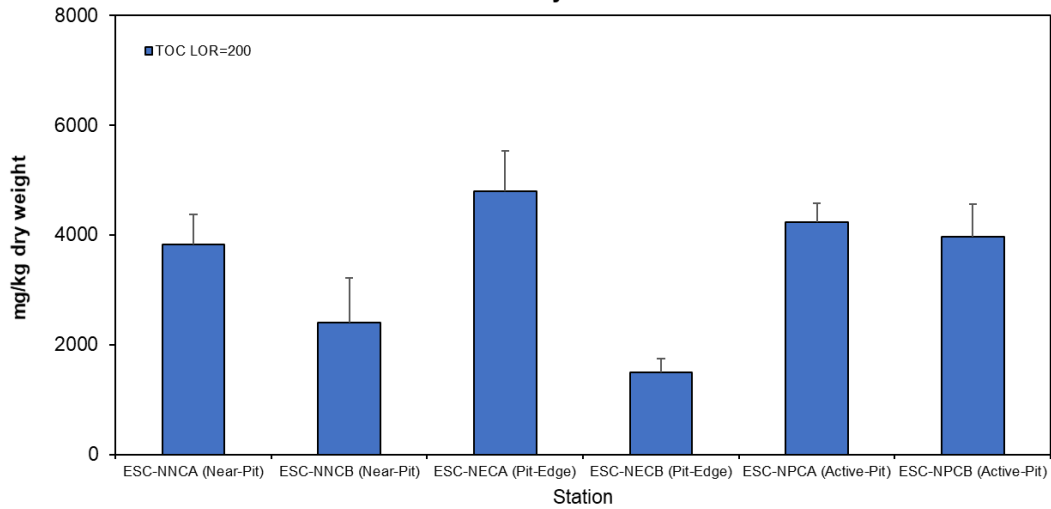


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in January 2022

Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vb - January 2022

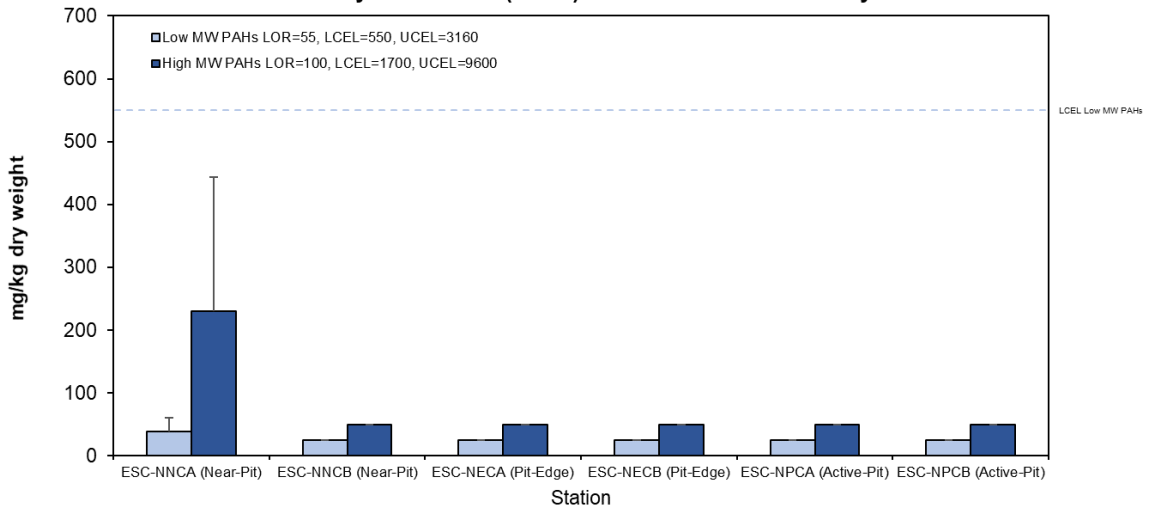


Figure 14: Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in January 2022

Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vb - January 2022

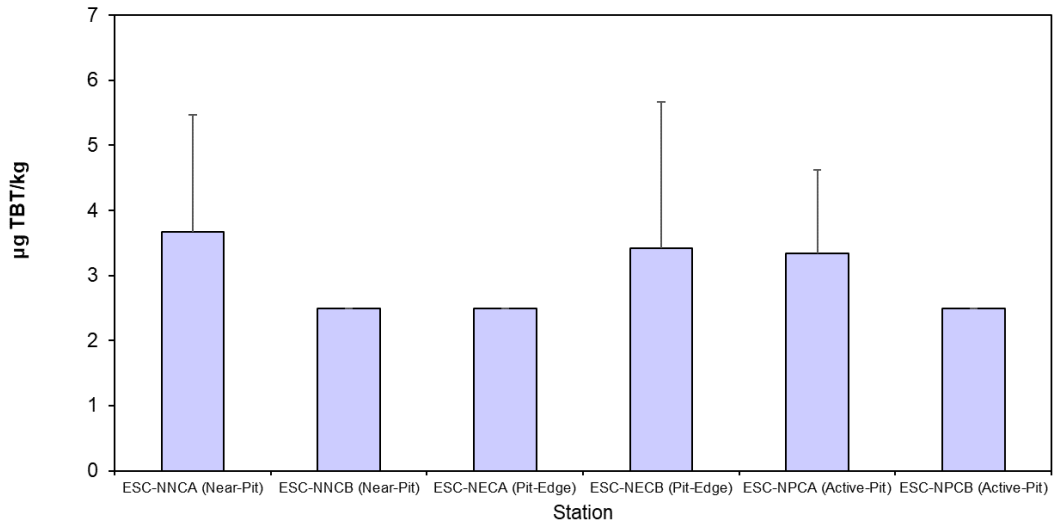


Figure 15: Concentration of Tributyltin (TBT) ($\mu\text{g TBT/kg}$; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in January 2022

Appendix D. Study Programme

