

**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
– September 2021

October 2021

Mott MacDonald
3/F International Trade
Tower
348 Kwun Tong Road
Kwun Tong
Kowloon
Hong Kong

T +852 2828 5757
mottmac.hk

Civil Engineering and
Development Department
Fill Management Division
5/F, Civil Engineering and
Development Building
101 Princess Margaret
Road
Homantin, Kowloon

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Monthly EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
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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 – September 2021
Date of Report:	8 October 2021
Date prepared by ET:	8 October 2021
Date received by IA:	8 October 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 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: 8 October 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: 8 October 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 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 September 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	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 – September 2021* covers the EM&A activities for the reporting period of September 2021 (from 1 to 30 September 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.

1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for the reporting month (September 2021).

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 September 2021

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 7 September 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 September 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 September 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 September 2021

Routine Water Quality Monitoring of ESC CMPs was undertaken on 9 September 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 ten (10) monitoring stations were sampled in September 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 all stations in September 2021.

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 September 2021.

2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Chromium, Copper, Lead, Mercury, Nickel, Silver 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 Copper and Nickel which were higher at Impact (IPF) and Ma Wan stations respectively (**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 concentration of Ammonia Nitrogen (NH₃-N) was generally similar across stations (**Table B4 of Appendix B; Figure 8 of Appendix C**). The concentration of Biochemical Oxygen Demand (BOD₅) was slightly higher at Ma Wan station in the reporting month (**Table B4 of Appendix B; Figure 9 of Appendix C**).

Analyses of results for the reporting period indicated that the SS level at Ma Wan station complied with the wet season WQO (11.8 mg/L) and the Action and Limit Levels. SS levels at Reference (RFF), Impact (IPF) and Intermediate (INF) stations were above the wet season WQO 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 September 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 2 September 2021.

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

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 LCEs at all stations (**Figure 14 of Appendix C**). The

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

concentrations of Tributyltin (TBT) were higher at Near-Pit station ESC-NNCA and Pit-Edge station ESC-NECB (**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

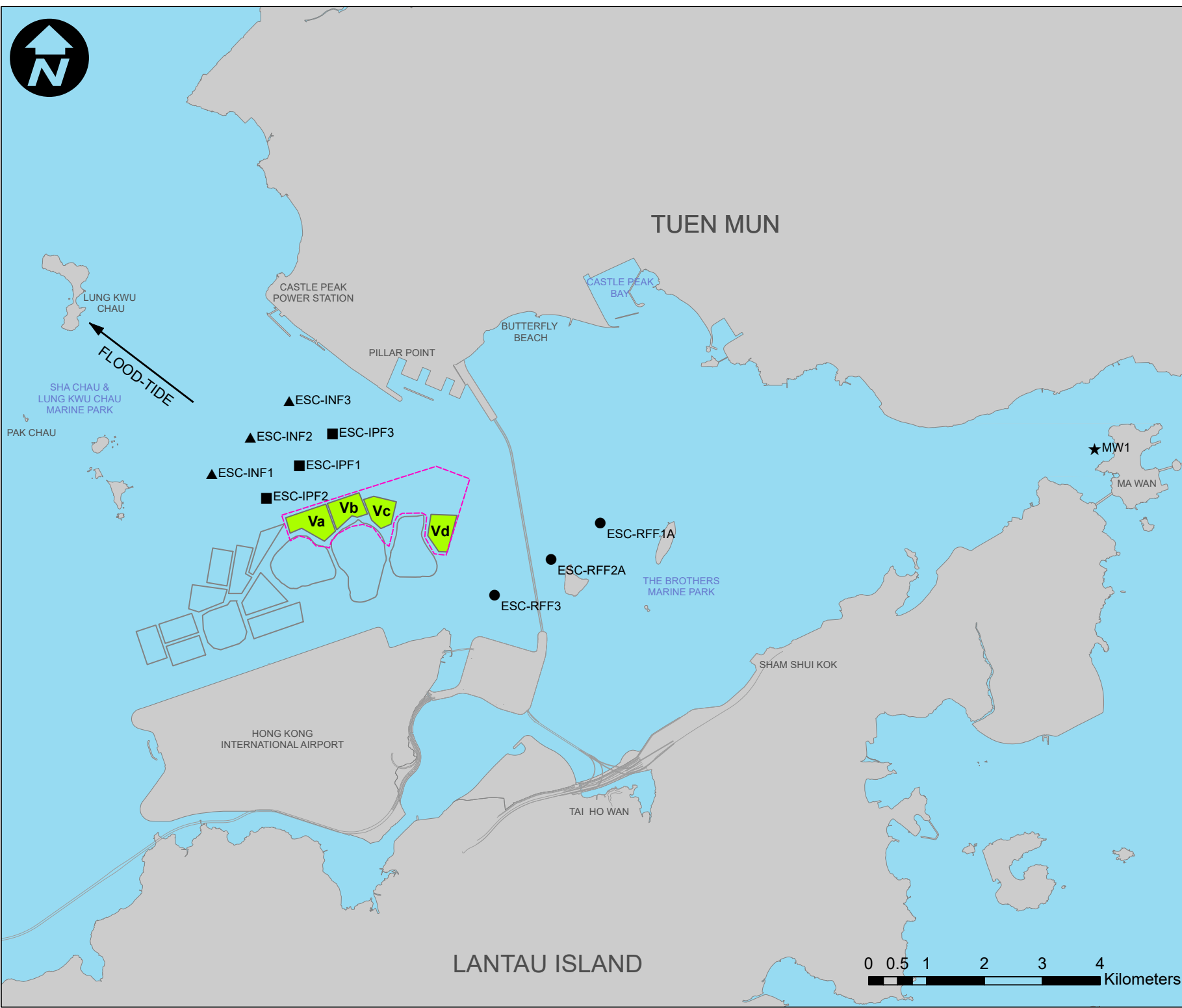
The following monitoring activities will be conducted in the next reporting period of October 2021 for ESC CMP V (see **Appendix A** for the sampling schedule):

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

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			

M M
MOTT
MACDONALD

3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W motmac.com

Client

CEDD 土木工程拓展署
Civil Engineering and
Development Department

Project **AGREEMENT NO. CE 59/2020 (EP)
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FOR DISPOSAL FACILITY
TO THE EAST OF SHA CHAU (2021-2026)
- INVESTIGATION**

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

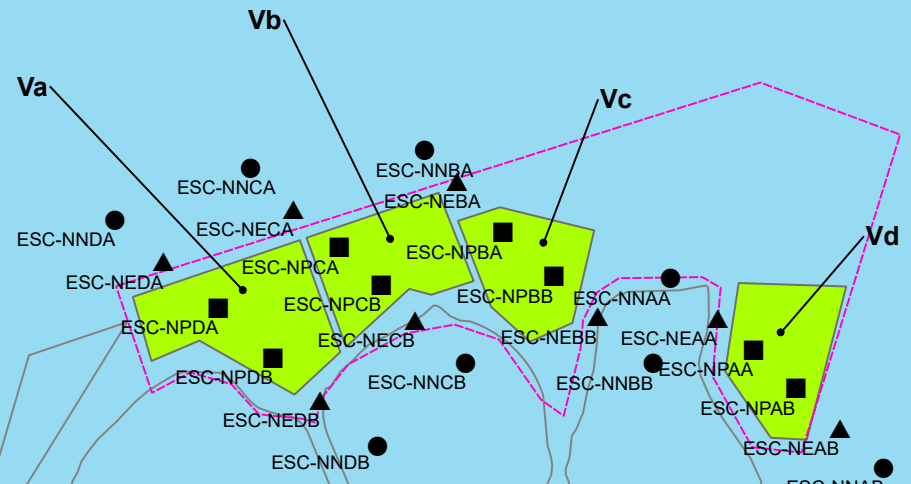
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Drawn		Coordination	
Dwg check		Approved	
Scale at A3	Status	Rev	

Drawing Number **FIGURE 2.1**

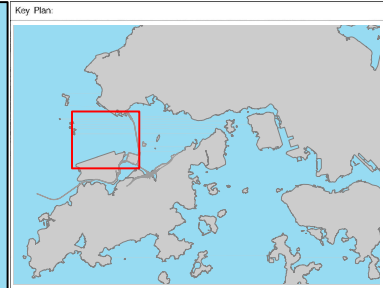


EBB-TIDE

FLOOD-TIDE



HONG KONG INTERNATIONAL AIRPORT



Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1
- ACTIVE-PIT STATION
- PIT-EDGE STATION
- NEAR-PIT STATION

PIT SPECIFIC SEDIMENT MONITORING STATIONS

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

M M
MOTT
MACDONALD

3/F International Trade Tower
348 Kwun Tong Road
Kwun Tong, Kowloon
Hong Kong
T +852 2828 5757
F +852 2821823
W motmac.com

Client

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

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**

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) ⁽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	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 September 2021

Station	Temp. (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L ⁻¹)	pH	Suspended Solids (mg L ⁻¹)
WCP 1 (Downstream)	28.52	28.14	9.27	86.10	5.71	8.00	6.3
WCP 2 (Upstream)	28.53	28.01	16.01	84.61	5.62	8.00	11.5
WQO (Wet Season)	N/A	25.21 - 30.81 [#]	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 September 2021

Station	Temp. (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%)	(mg L ⁻¹)	pH
RFF (Reference)	28.50	28.72	17.78	75.07	4.97	7.94
IPF (Impact)	28.36	28.94	22.73	72.92	4.83	7.91
INF (Intermediate)	28.47	28.86	23.87	74.12	4.90	7.89
Ma Wan	28.08	29.48	4.94	72.03	4.78	7.89
WQO (Wet Season)	N/A	25.85 - 31.60 [#]	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 September 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	5.20	<LOR	2.78	23.26	1.52	0.27	6.06	0.56	40.95	0.15	0.59	1.33	16.1
IPF	3.45	<LOR	1.95	31.43	2.23	<LOR	1.08	<LOR	39.44	0.19	0.89	1.46	22.6
INF	4.44	<LOR	2.68	19.34	1.78	<LOR	2.58	<LOR	39.47	0.17	0.54	1.44	21.5
Ma Wan	5.45	<LOR	2.53	16.25	0.78	<LOR	9.15	<LOR	43.55	0.16	0.44	1.58	7.3

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.

Appendix C. Graphical Presentations

Routine Water Quality Monitoring for ESC CMP V - September 2021

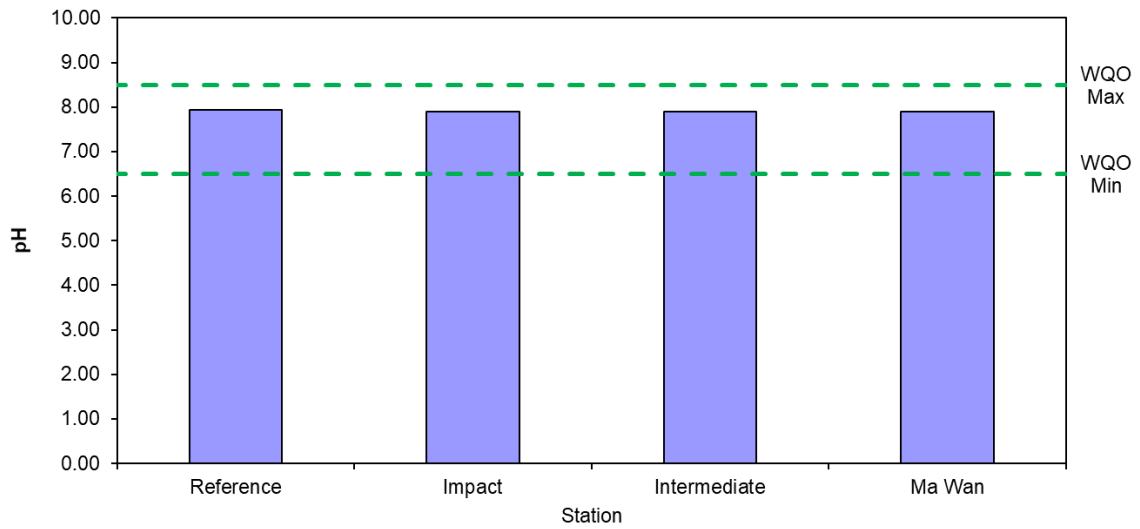


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Routine Water Quality Monitoring for ESC CMP V - September 2021

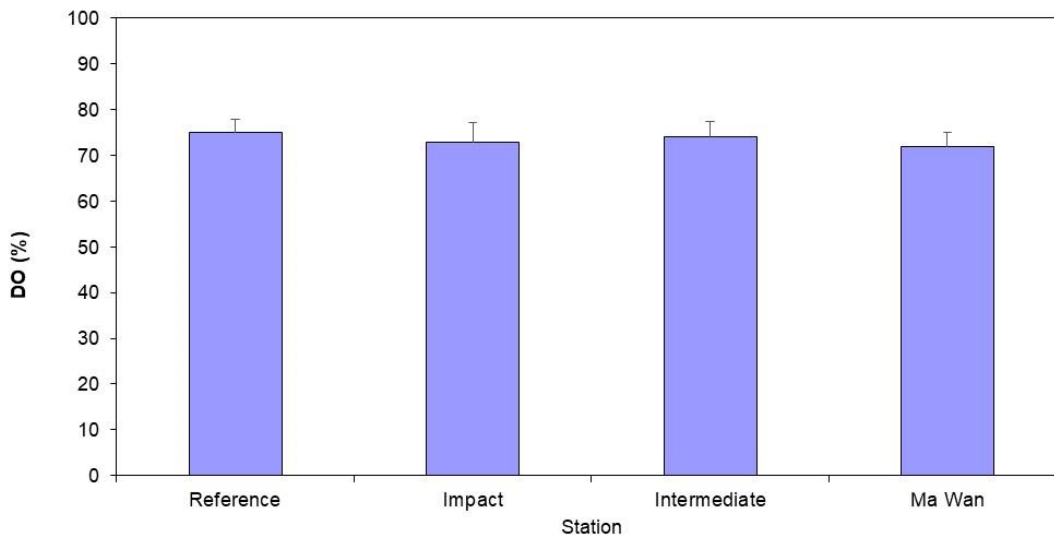


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

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 - September 2021

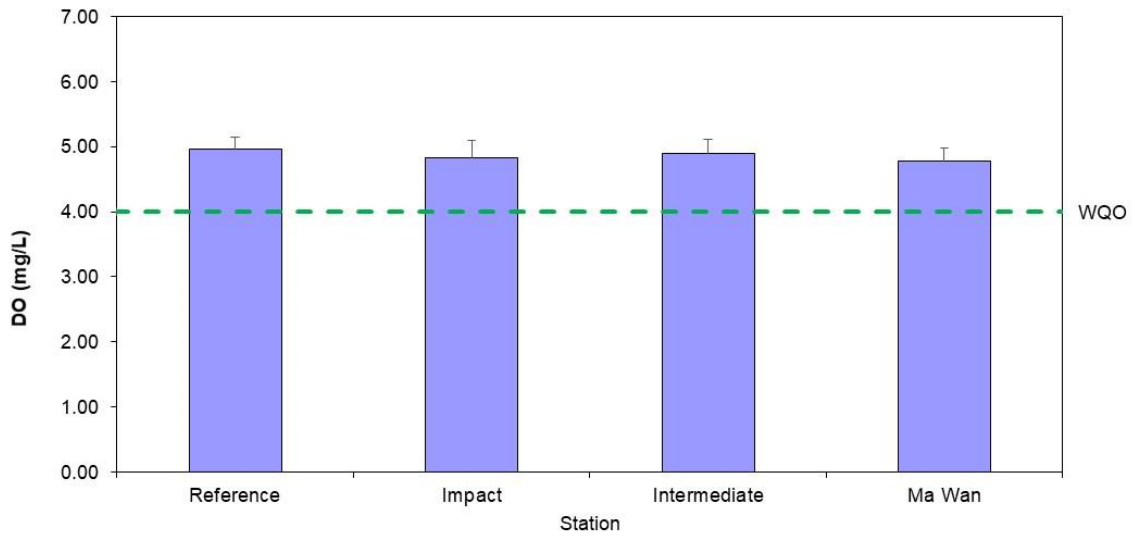


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Routine Water Quality Monitoring for ESC CMP V - September 2021

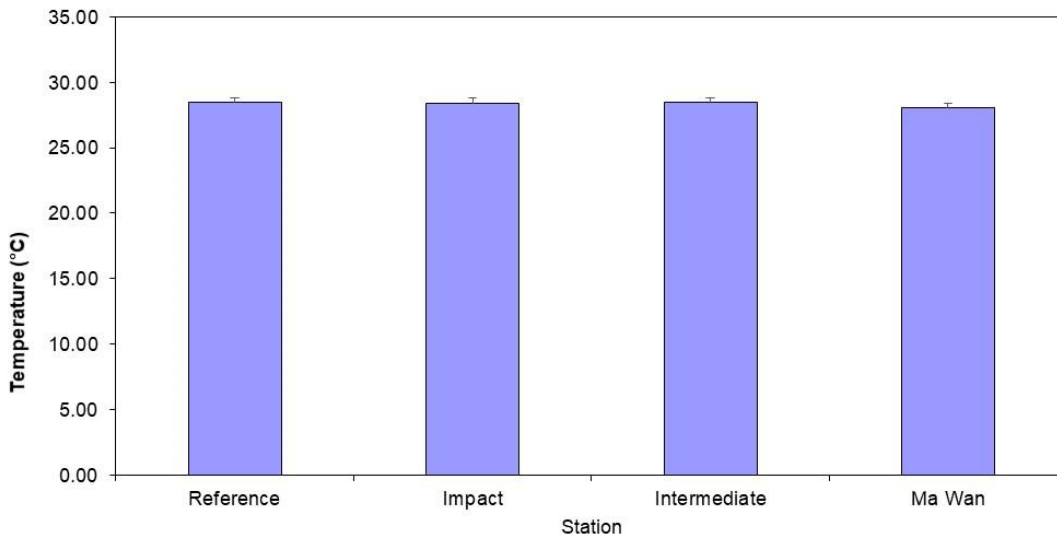


Figure 4: Level of Temperature (°C; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

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 - September 2021

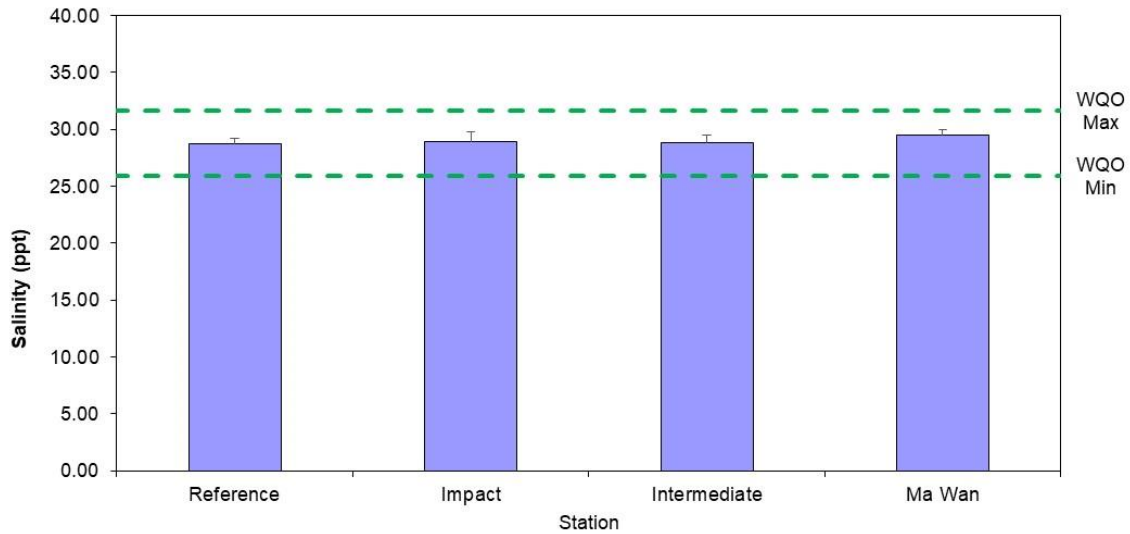


Figure 5: Level of Salinity (ppt; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Routine Water Quality Monitoring for ESC CMP V - September 2021

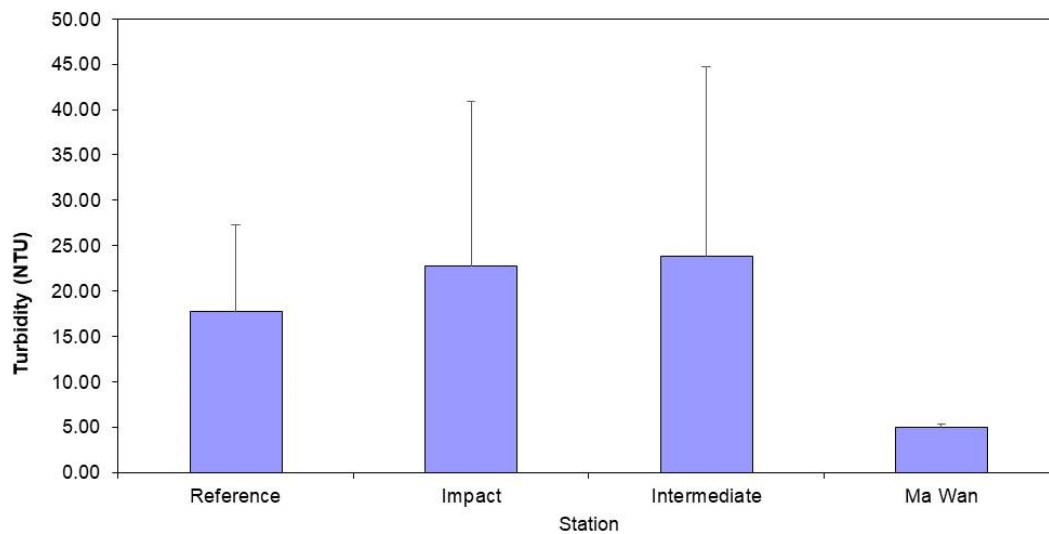


Figure 6: Level of Turbidity (NTU; mean + SD)¹ recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

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 September 2021

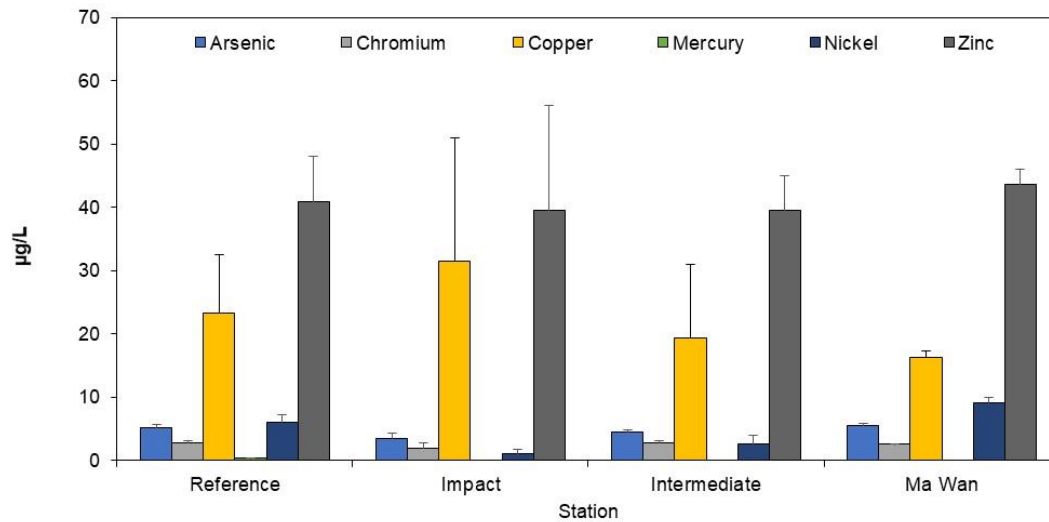


Figure 7: Concentration of Arsenic, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Routine Water Quality Monitoring for Nutrients - September 2021

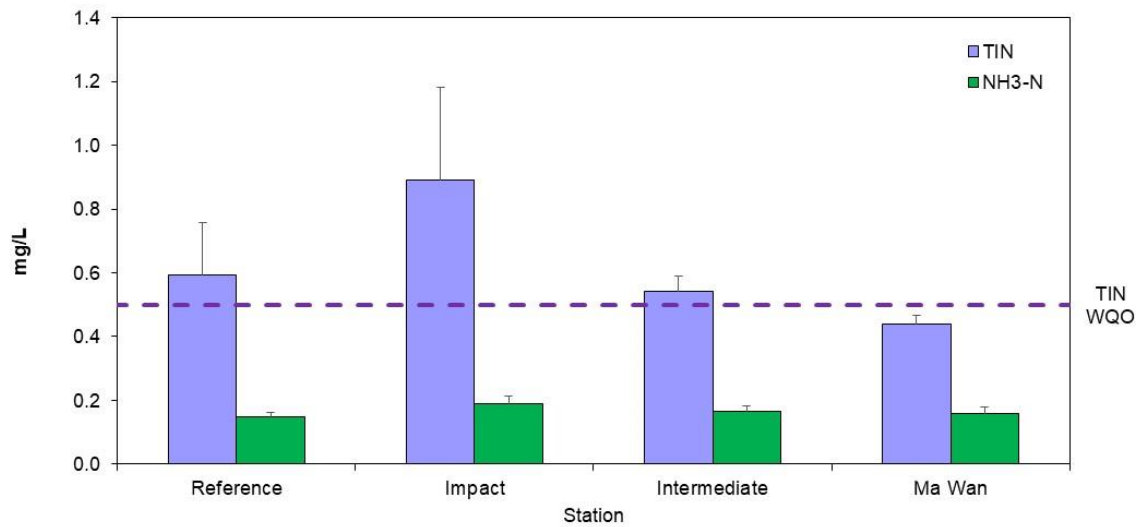


Figure 8: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Routine Water Quality Monitoring for Biochemical Oxygen Demand (BOD₅) - September 2021

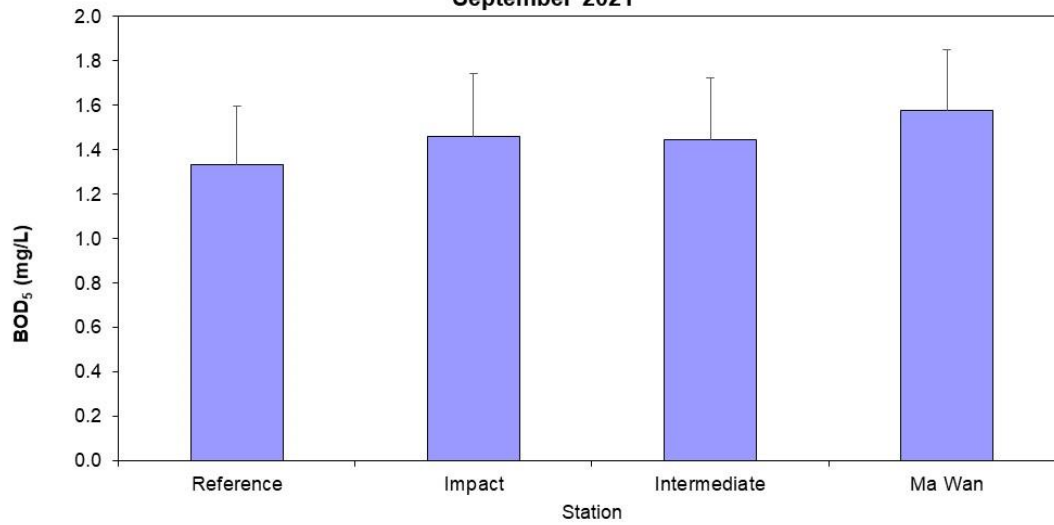


Figure 9: Level of Biochemical Oxygen Demand (BOD₅) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Routine Water Quality Monitoring for Suspended Solids - September 2021

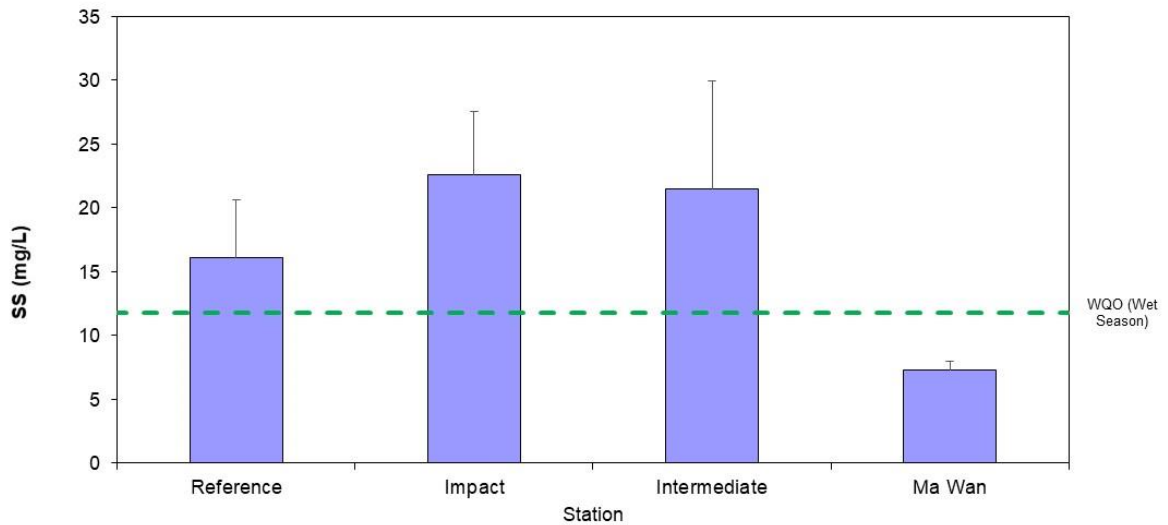


Figure 10: Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in September 2021

Pit Specific Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMP Vb - September 2021

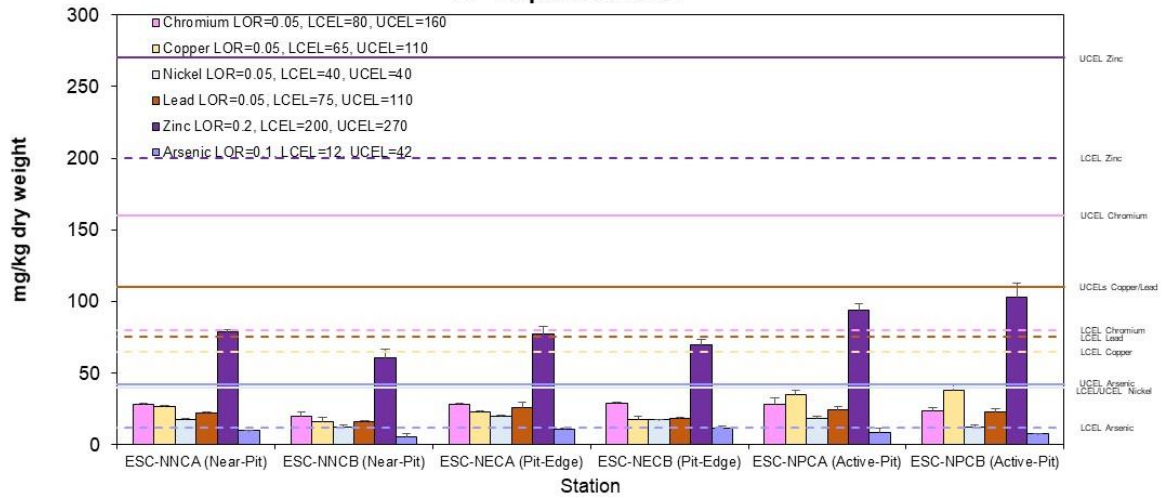


Figure 11: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

Pit Specific Sediment Chemistry for Metal Contaminants at ESC CMP Vb - September 2021

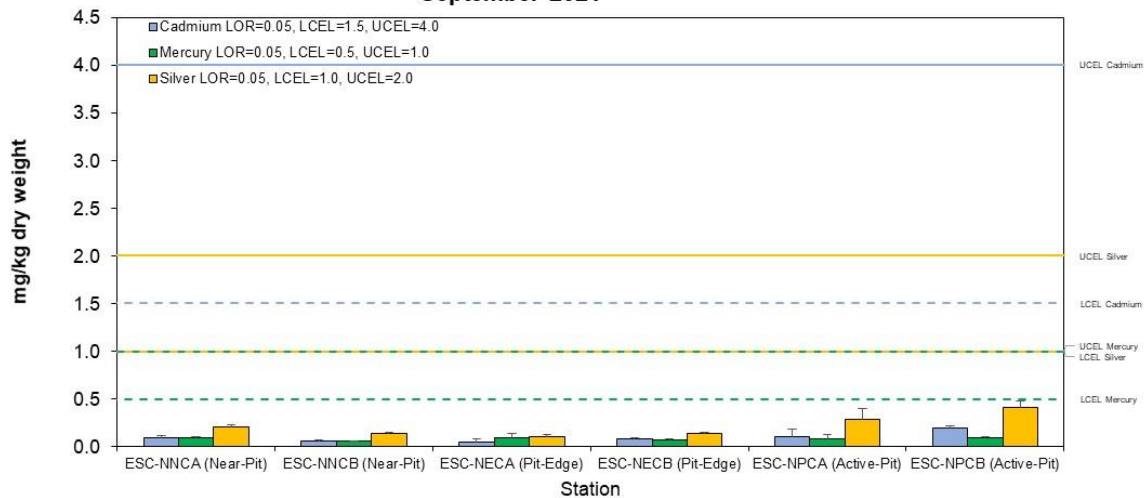


Figure 12: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

Pit Specific Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMP Vb - September 2021

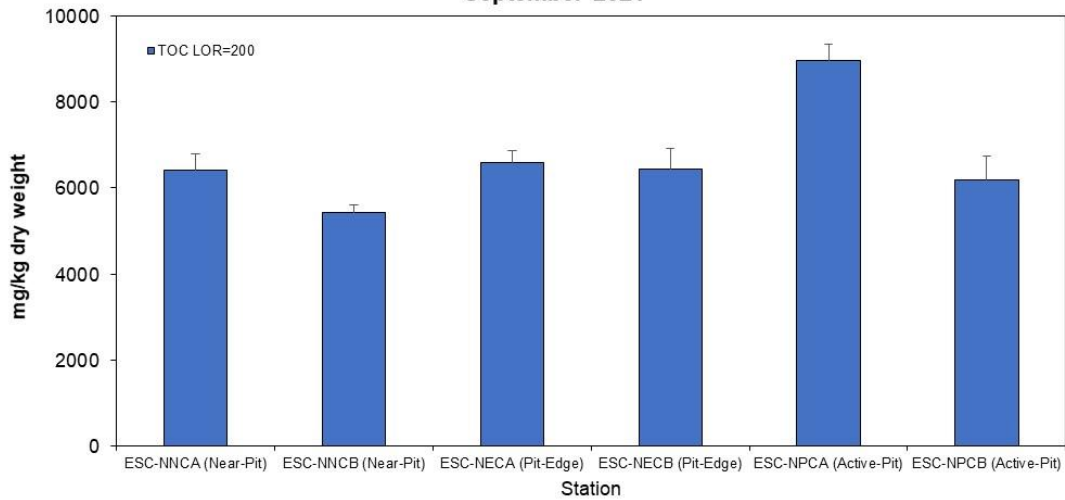


Figure 13: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

Pit Specific Sediment Chemistry for Low and High Molecular Weight Polycyclic Aromatics Hydrocarbons (PAHs) at ESC CMP Vb - September 2021

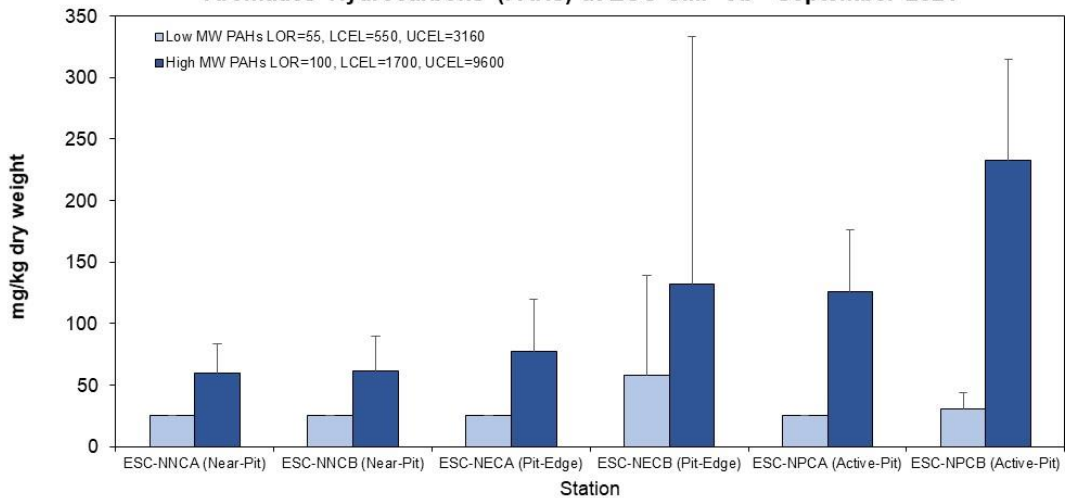


Figure 14: Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

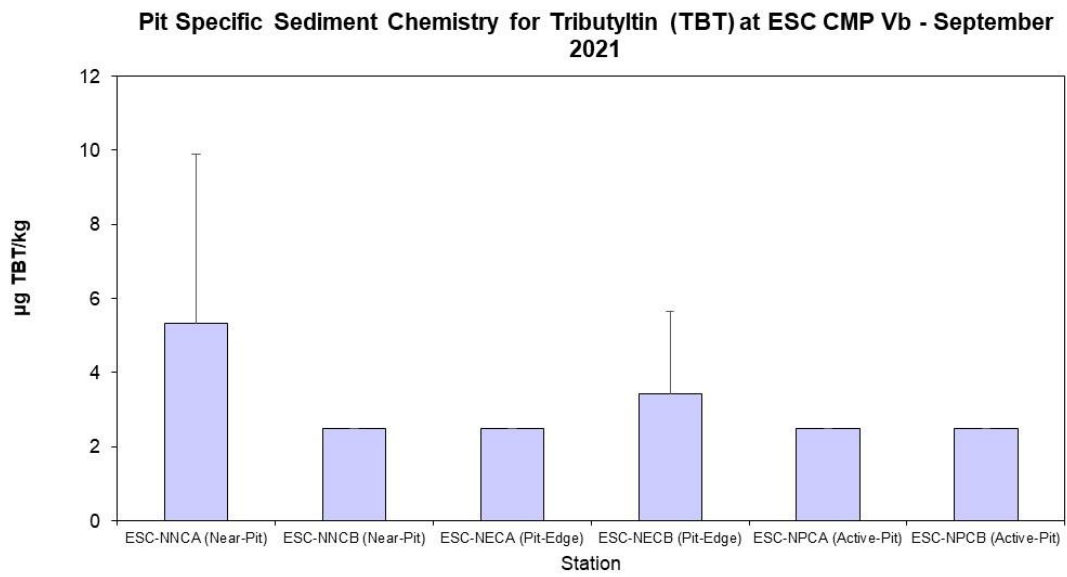


Figure 15: Concentration of Tributyltin (TBT) ($\mu\text{g TBT/kg}$; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in September 2021

Appendix D. Study Programme

