



**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  
– June 2023

July 2023



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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.<sup>1,2</sup> 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. In early 2022, after implementing the Phase 1 optimisation for at least one year, a further data review was conducted. The monitoring data has been reviewed and demonstrated that the data robustness and representativeness are maintained. Therefore, a technical note presenting the data review results served as a supplementary information was submitted to EPD and presented that Phase 2 optimization of sample replication of water quality and sediment monitoring for the Project will be implemented in 2022. EPD expressed no comment on the review and note the implementation of Phase 2 optimization of sample replication on 18 May 2022, and thus this optimization has been effective for the EM&A activities since July 2022.

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 June 2023, the following works were undertaken:

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

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<sup>1</sup> 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.

<sup>2</sup> 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.

**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	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar			
ESC CMP V	Dredging																																							
	Disposal																																							
	Capping																																							

## 1.2 Reporting Period

This *Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – June 2023* covers the EM&A activities for the reporting period of June 2023 (from 1 to 30 June 2023).

## 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
- Cumulative Impact Sediment Chemistry of ESC CMPs.

## 1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for the reporting month (June 2023).



## 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;
- Pit Specific Sediment Chemistry of ESC CMP Vb; and
- Cumulative Impact Sediment Chemistry of ESC CMPs.

### 2.2 Water Column Profiling of ESC CMP Vb – in June 2023

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 6 June 2023. 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 2012 – 2021 from stations in the North Western Water Control Zone (WCZ), where the ESC CMPs are located.<sup>3</sup> 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 June 2023 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 June 2023 indicated that the SS level at the Downstream station was higher than the WQO while the SS level at the Upstream station complied with the WQO. However, both Upstream and Downstream stations complied with 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 June 2023

Routine Water Quality Monitoring of ESC CMPs was undertaken on 8 June 2023. 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, B4 and B5** of **Appendix B** and **Figures 1 to 11** of **Appendix C**. A total of ten (10) monitoring stations were sampled in June 2023 as shown in **Figure 2.1**.

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<sup>3</sup> <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, Salinities and DO complied with the WQOs at all stations in June 2023. 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 June 2023.

### 2.3.2 Laboratory Measurements

Laboratory analysis of samples obtained during the reporting period indicated that the concentrations of Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc were detected in the samples at some/ all stations and their concentrations were generally similar across stations; except the concentrations of Zinc were slightly higher at Ma Wan (MW1) station. The concentrations of Lead were only detected at Impact (IPF) and Intermediate (INF) stations. (**Table B4 of Appendix B; Figure 7 and 8 of Appendix C**).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) were higher than the WQO (0.5 mg/L) at all stations. (**Table B5 of Appendix B; Figure 9 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.<sup>4</sup> 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 (NH<sub>3</sub>-N) were generally similar across stations (**Table B5 of Appendix B; Figure 9 of Appendix C**). The concentrations of Biochemical Oxygen Demand (BOD<sub>5</sub>) were below limit of reporting at all stations. (**Table B5 of Appendix B**).

Analyses of results for the reporting period indicated that the SS levels complied with the wet season WQO (11.7 mg/L) and Action and Limit Levels at all stations. (**Tables B1 and B5 of Appendix B; Figure 10 of Appendix C**).

Based on the available results of the Routine Water Quality Monitoring which 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 June 2023

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 5 June 2023.

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

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<sup>4</sup> [https://www.epd.gov.hk/epd/misc/marine\\_quality/1986-2005/eng/08\\_western\\_content.htm](https://www.epd.gov.hk/epd/misc/marine_quality/1986-2005/eng/08_western_content.htm)

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.<sup>5</sup> It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments,<sup>6</sup> and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the LCEL 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.

Considering that the higher levels of Copper and Silver 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 June 2023.

For organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Active-Pit station ESC-NPCB. (**Figure 13 of Appendix C**). The concentrations of Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were higher than LCEL at Active-Pit station ESC-NPCB; and were higher than UCEL (Upper Chemical Exceedance Level) at Active-Pit station ESC-NPCA. (**Figures 15a and 15b of Appendix C**).

For High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs), the concentrations were higher than LCEL at Active-Pit station ESC-NPCB; and were higher than UCEL at Active-Pit station ESC-NPCA. (**Figures 14a and 14b of Appendix C**). The concentrations of Tributyltin (TBT) was higher at Active Pit station ESC-NPCB (**Figure 15 of Appendix C**).

The concentrations of Total Polychlorinated Biphenyls (PCBs), Total dichloro-diphenyl-trichloroethane (DDT) and 4,4'-dichlorodipenyldichloroethylene (DDE) were below the limit of reporting at all stations during the reporting period.

Considering that the higher levels of Low Molecular Weight and High Molecular Weight PAHs are only occurred within Active-Pit stations ESC-NPCA and ESC-NPCB only, 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.

## 2.5 Cumulative Impact Sediment Chemistry of ESC CMPs – in June 2023

Monitoring locations for Cumulative Impact Sediment Chemistry for ESC CMPs are shown in **Figure 2.3**. A total of nine (9) monitoring stations were sampled on 5 June 2023.

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 during the reporting period, except concentrations of Arsenic were higher than the LCEL at Near-field stations ESC-RNB1, Mid-field stations ESC-RMA, Far-field stations ESC-RFA, ESC-RFB and Ma Wan station MW1 (**Figures 16 and 17 of Appendix C**). As discussed in **Section 2.4**, the LCEL 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 concentration of TOC was higher at Far-field ESC-RFB and Capped Pit ESC-RCA1 stations (**Figure 18 of Appendix C**). The concentrations of High Molecular Weight PAHs were higher at Near-field ESC-RNB1, Far-field ESC-RFA and Capped

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

<sup>6</sup> 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

Pit ESC-RCB1 stations, while the concentrations of Low Molecular Weight PAHs were similar across stations. (**Figure 19 of Appendix C**)

The concentrations of TBT were higher at Ma Wan station MW1 (**Figure 20 of Appendix C**). The concentrations of Total PCBs, Total DDT, 4,4'-DDE, 2,4'-DDT, 4,4'-DDT 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 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 July 2023 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
- Demersal Trawling for ESC CMPs.

### 3.2 Study Programme

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

# Figures

# 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

# Appendix C. Graphical Presentations

# Appendix D. Study Programme