

- Investigation

Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau - December 2022

January 2023

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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 – December 2022

January 2023





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 - December 2022

Date of Report:

9 January 2023

Date prepared by ET:

9 January 2023

Date received by IA:

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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.

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: 9 January 2023

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: 9 January 2023

i

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. 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 December 2022, the following works were undertaken:

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

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.

Table 1.1: Works Schedule for ESC CMP V

Die	Operation				- 2	2021									202	22										20	23									20	024					Т					202	5					20	26
Pit	Operation	Apr	May	Jun	Jul	Aug	Sep	Oct N	lov D	ec Ja	n Fe	Mai	Apr	May	Jun	Jul .	Aug :	Sep C	lct N	lov E	Dec Ja	an F	eb Ma	ar Ap	r May	Jun	Jul A	lug So	рОс	Nov	Dec	Jan	Feb M	ar Ap	or May	Jun	Jul	Aug	Sep	Oct N	ov D	ec Ja	Feb	Mar	Apr	May	Jun .	ul Au	g Sep	Oct	Nov	Dec	Jan F	eb Mar
	Dredging	Т	П	П			П		Т	Т		Т	Т			П	П	Т	Т	Т	Т	Т	Т	Т	П				Т	Т			Т	Т	Т	Т	П	П		Т	Т	Т	П	П	П	П			Т	П			Т	\Box
ESC CMP V	Disposal		Т					П	П	Т	Т	Т	Т					П		Т	Т	Т	Т						Т	Т			Т	Т	Т	Т	П	П		Т	Т	Т											Т	
	Capping		Т						Т	Т	Т	Т	Т					Т			Т		Т						Т	Т				Т	Т	Т		П		Т	Т	Т											Т	

1.2 Reporting Period

This Monthly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – December 2022 covers the EM&A activities for the reporting period of December 2022 (from 1 to 31 December 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
- · Cumulative Impact Sediment Chemistry of ESC CMPs.

1.4 Details of Outstanding Sampling or Analysis

No outstanding sampling remained for December 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;
- 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 December 2022

Water Column Profiling was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 6 December 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 December 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 December 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 December 2022

Routine Water Quality Monitoring of ESC CMPs was undertaken on 1 December 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 December 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, Salinities and DO complied with the WQOs at all stations in December 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 December 2022.

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, Silver and Zinc were detected in the samples at all stations. The concentrations of Arsenic, Cadmium, Copper, Mercury, Nickel, Silver and Zinc were generally similar across stations; the concentrations of Lead were higher at Intermediate stations; and the concentrations of Chromium were higher at Ma Wan station. (Table B4 of Appendix B; Figure 7 and 8 of Appendix C).

For nutrients, concentrations of Total Inorganic Nitrogen (TIN) were slightly higher than the WQO (0.5 mg/L) at Reference (RFF), Impact (IPF) and Intermediate (INF) 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. 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 similar at all stations (**Table B5** of **Appendix B**; **Figure 9** of **Appendix C**). The concentrations of Biochemical Oxygen Demand (BOD₅) were similar across stations. (**Table B5** of **Appendix B**; **Figure 10** of **Appendix C**).

Analyses of results for the reporting period indicated that the SS levels complied with the Action and Limit Levels at all stations, while SS level were higher than the dry season WQO (13.1 mg/L) at Reference (RFF) stations, where Reference stations are located at upstream of the ESC CMPs and thus this is considered to be presenting the background water quality condition during the time of sampling. (Tables B1 and B5 of Appendix B; Figure 11 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 December 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 2 December 2022.

The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at some/ all stations, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge stations ESC-NECA, ESC-NECB and Active-Pit station ESC-NPCA (Figures 12 and 13 of Appendix C).

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

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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 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 concentrations of Total Organic Carbon (TOC) were higher at Near-Pit station ESC-NNCA and Pit-Edge ESC-NECB. (**Figure 14** of **Appendix C**). The concentrations of Low Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were higher than UCEL (Upper Chemical Exceedance Level) at Active-Pit station ESC-NPCA (**Figure 15** of **Appendix C**). The concentrations of Tributyltin (TBT), 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.

Considering that the higher levels of Low Molecular Weight and High Molecular Weight PAHs occurred within Active-Pit stations ESC-NPCA 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 December 2022

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 December 2022.

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-RNA, ESC-RNB1, Mid-field station ESC-RMA and Far-field stations ESC-RFA, ESC-RFB (**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 Mid-field station ESC-RMA, Far-field station ESC-RFB and Ma Wan station MW1 (**Figure 18** of **Appendix C**). The concentrations of High Molecular Weight PAHs were higher at Far-field station ESC-RFA (**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 and Low Molecular Weight PAHs 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.

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

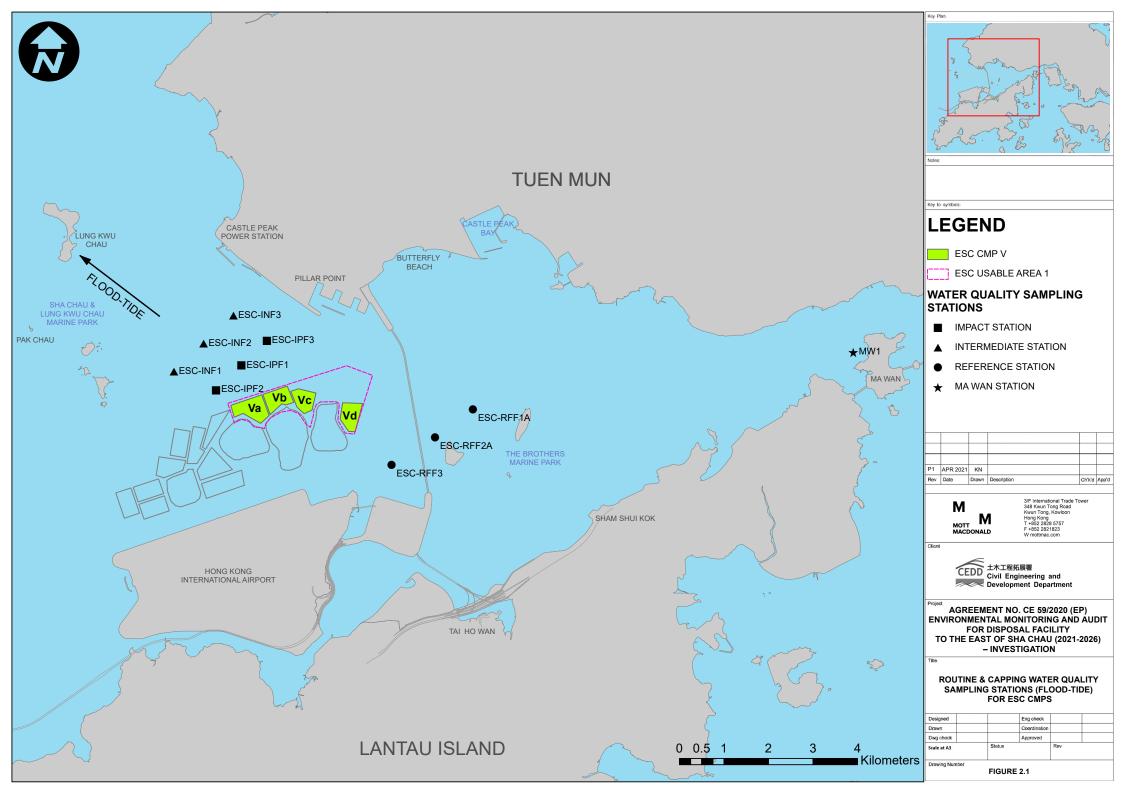
The following monitoring activities will be conducted in the next reporting period of January 2023 for ESC CMP V (see **Appendix A** for the sampling schedule):

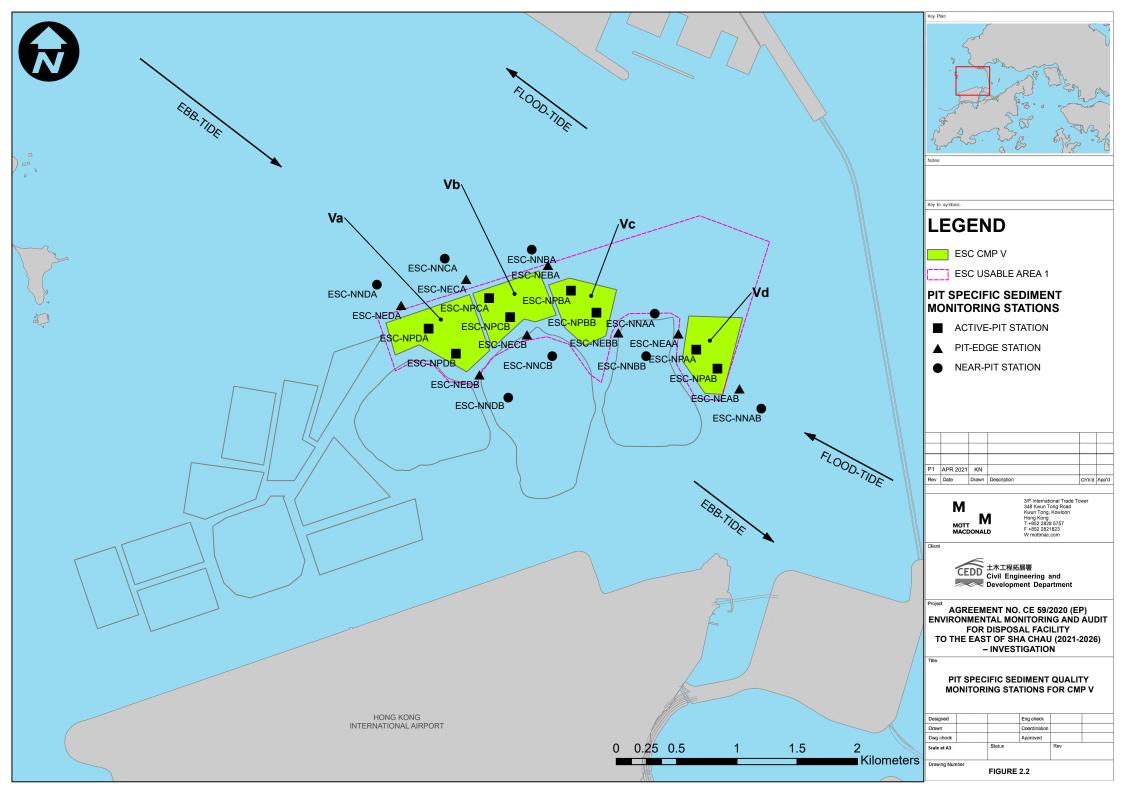
- Water Column Profiling of ESC CMP Vb;
- Routine Water Quality Monitoring of ESC CMPs;
- Pit Specific Sediment Chemistry of ESC CMP Vb; and
- Demersal Trawling for ESC CMPs.

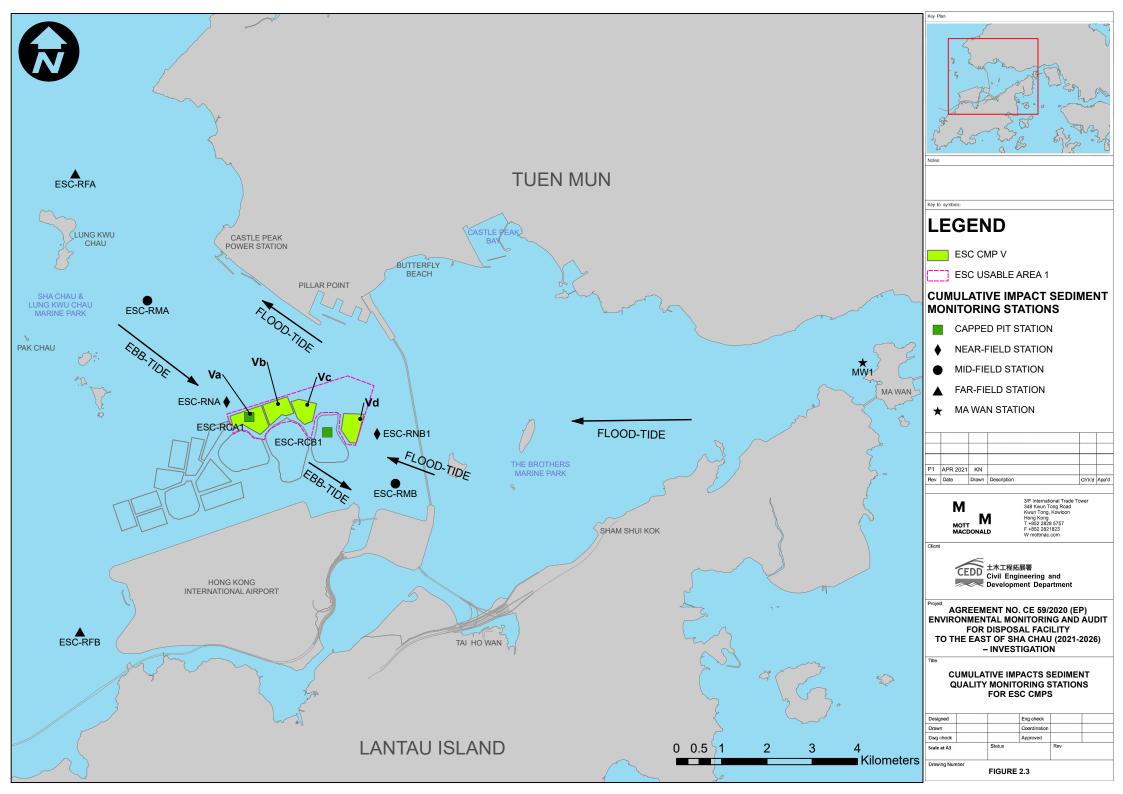
3.2 Study Programme

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

East of Sha Chau CMPs Environmental Monitoring and Audit Sampling Schedule (January 2021 - March 2026)

Parameter / Station Type Pit Specific Sediment Ch		Frequency	2021 Jan Feb	Mar Apr	May Jur	n Jul Au	ıg Sep Oct	t Nov D	2022 ec Jan Fe	b Mar A	pr May Ju	ın Jul A	ug Sep (Oct Nov D	2023 ec Jan F	eb Mar A	Apr May	Jun Jul A	lug Sep	Oct Nov [2024 Dec Jan	Feb Mar A	pr <mark> May Jun</mark>	Jul Aug	Sep Oct	Nov Dec	2025 Jan Feb	Mar Apr	May Jur	Jul Aug	g Sep Oct		2026 Jan Feb Ma
Active-Pit	ESC-NPAA ESC-NPAB	Monthly Monthly																															2 2 2 2 2 2
Pit-Edge	ESC-NEAA ESC-NEAB	Monthly Monthly																															2 2 2 2 2 2
Near-Pit	ESC-NNAA ESC-NNAB	Monthly Monthly	6 6				6 6													2 2 2 2					2 2 2 2								2 2 2 2 2 2
Cumulative Impact Sedin Near-field Stations			Jan Feb	Mar Apr	May Jur	n Jul Au	ıg Sep Oct		ec Jan Fe	b Mar A	pr May Ju	ın Jul A	ug Sep C	Oct Nov D		eb Mar A	Apr May		Sep	Oct Nov [Dec Jan	Feb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	Jan Feb	Mar Apr	May Jur	Jul Aug	Sep Oct	Nov Dec	Jan Feb Ma
Mid-field Stations	ESC-RNA ESC-RNB1	4 times per year 4 times per year	6		6				6 6				2		2	2 2		2	2			2	2	2		2	2		2			2	2 2
Capped Pit Stations	ESC-RMB	4 times per year 4 times per year 4 times per year	6		6	6			6 6				2		2	2 2		2	2 2		2	2	2 2	2		2	2		2	2		2	2
Far-field Stations	ESC-RCA1 ESC-RCB1	4 times per year	6		6	6						5	2		2	2 2		2	2 2		2	2 2	2 2	2		2 2	2 2		2	2		2 2	2
Ma Wan Station	ESC-RFA ESC-RFB	4 times per year 4 times per year 4 times per year	6		6	6			6 6			5	2		2	2 2		2	2 2		2	2 2	2 2	2		2 2	2		2	2		2 2	2
Sediment Toxicity Tests		4 times per year	Jan Feb																				pr May Jun										
Near-pit Stations	ESC-TDA ESC-TDB1	2 times per year 2 times per year	5			5		Н		5" 5"		-	5	\blacksquare	\rightarrow	5 5	\Box	\rightarrow	5			5		5			5			5			5
Reference Stations	ESC-TRA ESC-TRB	2 times per year 2 times per year	5			5				5" 5"			5 5			5 5		\rightarrow	5			5 5		5			5			5			5 5
Ma Wan Station	MW1	2 times per year	5			5				5"			5			5			5			5		5			5			5			5
Tissue / Whole Body San Near-pit Stations	mpling ESC-INA	2 times per year	Jan Feb	Mar Apr	May Jur	n Jul Au	ıg Sep Oct	t Nov D	ec Jan Fe	b Mar A	pr May Ju	ın Jul A	ug Sep C	Oct Nov D	ec Jan F	eb Mar A	pr May	Jun Jul A	kug Sep	Oct Nov I	Dec Jan	eb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	Jan Feb	Mar Apr	May Jur	Jul Aug	Sep Oct	Nov Dec	Jan Feb Ma
Reference North	ESC-INB TNA	2 times per year											*			*		+	*			*		*			*		+	*			*
Reference South	TNB	2 times per year 2 times per year					,			,			1.1			*			*			*											*
Demorcal Traveling	TSB	2 times per year	lan Fah	Mar Ann	May lur	a lul Au	IG San Oct	t Nov D	ec lan Fe	h Mar A	nr May II	ın lul A	* Sep (Oct Nov D	oc lan F	* Mar A	nr May	lun lui 4	* Sen	Oct Nov I	Dec Jan	* Mar A	nr May lun	tul Aug	San Oct	Nov Dec	lan Feb	Mar Apr	May Jur	tul Au	Sen Oct	Nov Dec	Jan Feb Ma
Demersal Trawling Near-pit Stations	ESC-INA ESC-INB	4 times per year 4 times per year	5 5 5 5			5 5 5 5			5 5				3^ 5^ 5^ 5^		5 5	5		5 5	5		5 5	5	, oull	5 5 5 5			5 5 5 5		, out	5 5 5 5			5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Reference North	TNA TNB	4 times per year 4 times per year 4 times per year	5 5 5			5 5			5 5				5^ 5^ 5^ 5^		5 5	5		5 5	5		5 5	5		5 5 5			5 5 5		+	5 5			5 5 5 5 5
Reference South	TSA TSB	4 times per year	5 5			5 5			5 5				^ 5^ 6^ 5^		5	5		5	5		5	5		5 5			5 5			5 5			5 5 5
Capping * Ebb Tide	.50	4 times per year	5 5 Jan Feb		May Jur			t Nov D	5 5 ec Jan Fe		pr May Ju			Oct Nov D	ec Jan F		Apr May	Jun Jul A		Oct Nov I	Dec Jan		pr May Jun	5 5 Jul Aug			5 5 Jan Feb		May Jur	5 5			Jan Feb Ma
Impact Station Downcurr	ESC-IPE1A	4 times per year * 4 times per year *														1																	
	ESC-IPE3 ESC-IPE4 ESC-IPE5	4 times per year * 4 times per year * 4 times per year *																															
Intermediate Station Dow	vncurrent ESC-INE1A	4 times per year * 4 times per year *																															
	ESC-INE3A ESC-INE4A	4 times per year *													\pm																		
Reference Station Upcur	rent ESC-RFE1	4 times per year *																															
	ESC-RFE3 ESC-RFE4	4 times per year * 4 times per year * 4 times per year *																															
Ma Wan Station	ESC-RFE5	4 times per year * 4 times per year *																															
Flood Tide Impact Station Downcurr	rent ESC-IPF1	4 41																															
Intermediate Station Development	ESC-IPF2 ESC-IPF3	4 times per year * 4 times per year * 4 times per year *													\pm			\pm								\pm							
Intermediate Station Dow	ESC-INF1 ESC-INF2	4 times per year * 4 times per year *																															
Reference Station Upcur	ESC-RFF1A	4 times per year *																															
Ma Wan Station	ESC-RFF3	4 times per year * 4 times per year *					<u> </u>						#					#											#				
Routine Water Quality Mo	MW1	4 times per year *	Jan Feb	Mar Apr	May Jur	n Jul Au	ıg Sep Oct	t Nov D	ec Jan Fe	b Mar A	pr May Ju	ın Jul A	ug Sep C	Oct Nov D	ec Jan F	eb Mar A	pr May	Jun Jul A	lug Sep	Oct Nov I	Dec Jan	eb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	Jan Feb	Mar Apr	May Jur	Jul Aug	Sep Oct	Nov Dec	Jan Feb Ma
Ebb Tide Impact Station Downcurr	ESC-IPE1A	Monthly*			4 4			4	4		4 4 4			2	2	2 2 :	2 2	2 2	2 2	2 2	2 2	2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2
	ESC-IPE2A ESC-IPE3 ESC-IPE4	Monthly* Monthly* Monthly*		4	4 4 4 4 4 4	4	4	4 4	4	l .	4 4 4 4 4 4 4 4 4	l l	2	2 2 2			2 2 2 2 2 2	2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2	2 2 2 2 2 2		2 2 2 2 2 2	2 2 2 2 2 2 2 2 2										
Intermediate Station Dow	ESC-INE1A	Monthly* Monthly*		4	4 4	4	4	4	4		4 4 4		2	2 2	2		2 2		2 2	2 2		2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2
	ESC-INE2A ESC-INE3A ESC-INE4A	Monthly* Monthly* Monthly*		4	4 4 4 4 4 4	4	4	4 4	4	l .	4 4 4 4 4 4 4 4 4	l l	2	2 2 2	2 2 2	2 2 : 2 2 : 2 2 :	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2 2 2 2 2 2 2				
Reference Station Upcur	ESC-RFE1	Monthly*		4	4 4	4	4	4	4		4 4 4		2	2	2	2 2 :	2 2	2 2	2 2	2 2	2 2	2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2
	ESC-RFE2 ESC-RFE3 ESC-RFE4	Monthly* Monthly* Monthly*		4	4 4 4 4 4 4	4	4	4 4	4		4 4 4 4 4 4 4 4 4	l l	2	2 2 2	2 2 2	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2 2 2 2	2 2 2 2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2	2 2 2 2 2 2 2 2 2				
Ma Wan Station	ESC-RFE5	Monthly*			4 4			4	4		4 4 4		2		2	2 2 :	2 2	2 2	2 2	2 2	2 2	2 2 3	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2
Flood Tide Impact Station Downcurr		Manualic		4									1			0.1	0.1 - 7	0.1 = 1	0.1.		0	21				0.7	6.1				1615	0.1	2 2
	ESC-IPF1 ESC-IPF2 ESC-IPF3	Monthly* Monthly* Monthly*	4 4 4 4 4 4	4		4 4 4	4 4		4 4 4 4 4 4	4 4 4		2 2 2	2 2 2	2	2 2		2 2	2 2	2 2	2 2	2 2	2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2 2 2 2 2 2 2
Intermediate Station Dow	ESC-INF1 ESC-INF2	Monthly* Monthly*	4 4 4	4		4	4		4 4 4	4		2 2	2 2	2 2	2 2 2 2	2 2 2	2 2 2 2	2 2 2 2	2 2 2	2 2 2	2 2 2 2	2 2 2	2 2 2 2 2 2 2 2 2	2 2 2	2 2 2	2 2 2 2	2 2 2	2 2 2	2 2 2	2 2 2	2 2 2 2	2 2 2 2	2 2 2 2 2 2 2 2 2
Reference Station Upcur	ESC-RFF1A	Monthly*	4 4	4		4	4		4 4	4		2	2	2	2 2	2 2 :	2 2	2 2	2 2	2 2	2 2	2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2
Ma Wan Station	ESC-RFF2A ESC-RFF3	Monthly*	4 4 4	4		4 4	4		4 4	4		2 2	2 2	2	2 2	2 2 :	2 2	2 2	2 2	2 2	2 2	2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2 2
Water Column Profiling *	MW1	Monthly*	Jan Feb				4 Ig Sep Oct			4 b Mar A		2 In Jul A																					2 2 2 Jan Feb Ma
Plume Stations	WCP1 WCP2	Monthly* Monthly*	2 2 2 2 2	2 2	2 2	2 2		2 :	2 2 2	2 :	2 2 2	2	2 2	2 2	2 2	2 2 :	2 2	2 2	2 2		2 2	2 2 :	2 2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2 2 2 2 2
Benthic Recoloinisation Capped Stations at CMP	٧		Jan Feb	Mar Apr	May Jur	n Jul Au	ıg Sep Oct	t Nov D	ec Jan Fe	b Mar A	pr May Ju	ın Jul A	ug Sep C	Oct Nov D	ec Jan F	eb Mar A	Apr May	Jun Jul A	lug Sep	Oct Nov [Dec Jan	eb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	Jan Feb	Mar Apr	May Jur	Jul Aug	Sep Oct	Nov Dec	Jan Feb Ma
	ESCV-CPA ESCV-CPB ESCV-CPC	2 times per year 2 times per year 2 times per year																															
Reference Stations	ESCV-CPD RBA	2 times per year 2 times per year																															
	RBB RBC1	2 times per year 2 times per year																											\pm				
Impact Monitoring for Drugstream Stations	edging US1	3 times per week	Jan Feb	Mar Apr	May Jur	n Jul Au	ig Sep Oct	t Nov D			pr May Ju		ug Sep (Oct Nov D	ec Jan F	eb Mar A	Apr May	Jun Jul A	lug Sep	Oct Nov I	Dec Jan	eb Mar A	pr May Jun	Jul Aug	Sep Oct	Nov Dec	Jan Feb	Mar Apr	May Jur	Jul Aug	Sep Oct	Nov Dec	Jan Feb Ma
Downstream Stations	US2	3 times per week							2	2 :		!	+	+		+	+	#				+				\dashv			+				
	DS1 DS2 DS3 DS4	3 times per week 3 times per week 3 times per week 3 times per week					+		2	2 2	2 2 2 2		\mp			+	+	+				+				\blacksquare			\pm				
ĺ	DS4 DS5	3 times per week 3 times per week				Ш			2	2	2 2 2 2				#													Ш			ш		
Ma Wan Station	MW1	3 times per week				1 1		1 1	-	1 - 1	2 2 2				-	1 1	-	1 1									-		-				

MW1 3 times per week | 2 2 2 2 2 | Notes:
(1) The number shown in each cell represents the numbers of replicates per monitoring station. The number shown in green bolded text represented monitoring works have been conducted before/ during the reporting period of this Monthly EM&A Report, while the number shown in black represent planned monitoring works after the reporting period of this Monthly EM&A Report.

⁽²⁾ For the planned Routine Water Quality Monitoring (i.e. the numbers of replicates per monitoring station shown in black), the monitoring will be conducted at mid-ebb OR mid-flood tide. The yearly tidal selection of this monitoring will be based on a principle to obtain 6 months monitoring data at mid-ebb, and 6 months monitoring data at mid-flood.

⁽³⁾ Impact Monitoring for Dredging will be scheduled when dredging operations commence.

⁽⁴⁾ Benthic Recolonisation Studies for CMP V will be scheduled when capping operations commence.

(4) Benthic Recolonisation Studies for CMP V will be scheduled when capping operation for CMP V is completed.

Remarks:

* A proposal on the change of number of sample replication of water quality & sediment monitoring and combination of routine water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes have been implemented for the EM&A activities since December 2020. Water Quality Monitoring during Capping Operation and Routine Water Quality Monitoring have been conducted monthly starting in December 2020. 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 was provided to EPD in April 2022. Phase 2 optimization of sample replication in divided by the pandemic which adversely affecting the supply of international species adopted in testing programme of Sediment Toxicity Tests, as such, Sediment Toxicity Tests as such sediment Toxicity Tests as such

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)	Surface and Middle Depth ⁽²⁾	Surface and Middle Depth ⁽²⁾
in mg L ⁻¹ (Surface, Middle & Bottom) ⁽¹⁾	5%-ile of baseline data for surface and middle layer = 3.76	1%-ile of baseline data for surface and middle layer = 3.11 ⁽³⁾
	and	and
	Significantly less than the reference station's mean DO (at the same tide of the same day)	Significantly less than the reference station's mean DO (at the same tide of the same day)
	Bottom	Bottom
	5%-ile of baseline data for surface and middle layer = 2.96	The average of the impact station readings are < 2
	and	and
	Significantly less than the reference station's mean DO (at the same tide of the same day)	Significantly less than the reference station's mean DO (at the same tide of the same day)
Suspended Solids (SS) in mg L ⁻¹	95%-ile of baseline data for depth- averaged = 37.88	99%-ile of baseline data for depth- averaged = 61.92
(depth-averaged) ⁽⁵⁾	and	and
	120% of control station's SS at the same tide of the same day	130% of control station's SS at the same tide of the same day
Turbidity	95%-ile of baseline data = 28.14	99%-ile of baseline data = 38.32
in NTU	and	and
(depth-averaged) ⁽⁴⁾⁽⁵⁾	120% of control station's Turbidity at the same tide of the same day	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 December 2022

Station	Temp.	Salinity	Turbidity	Dissolve	ed Oxygen	рН	Suspended Solids
	(°C)	(ppt)	(NTU)	(%)	(mg L ⁻¹)		(mg L ⁻¹)
WCP 1 (Downstream)	21.67	32.57	8.17	91.85	6.69	8.14	5.5
WCP 2 (Upstream)	21.94	32.61	6.41	90.46	6.55	8.17	7.0
WQO (Dry Season)	N/A	29.35-35.87#	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 December 2022

Station	Temp.	Salinity	Turbidity	Dissolve	ed Oxygen	рН
	(°C)	(ppt)	(NTU)	(%)	(mg L ⁻¹)	
RFF (Reference)	23.88	30.40	11.01	85.55	6.06	8.00
IPF (Impact)	23.93	30.15	8.67	85.52	6.07	7.96
INF (Intermediate)	23.92	29.90	8.12	85.98	6.11	8.02
Ma Wan	23.76	32.13	8.13	85.20	5.99	8.08
WQO (Dry Season)	N/A	27.36-33.44	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 Dissolved Metals and Metalloid in Routine Water Quality Monitoring of ESC CMPs in December 2022

Station	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn
	(µg/L)								
RFF	1.75	0.03	0.09	0.71	0.05	0.018	0.81	ND	0.13
IPF	1.90	0.03	0.09	0.74	0.23	0.013	0.83	0.01	0.29
INF	1.76	0.04	0.09	0.76	0.28	0.014	0.90	0.02	0.19
Ma Wan	1.68	0.02	0.13	0.59	0.20	0.016	0.51	ND	0.28

Note:

Table B5: Laboratory Results for Nutrients and Suspended Solid in Routine Water Quality Monitoring of ESC CMPs in December 2022

Station	NH ₃	TIN	BOD₅	SS
	(mg/L)	(mg/L)	(mg/L)	(mg/L)
RFF	0.12	0.53	0.50	15.5
IPF	0.12	0.53	0.52	12.0
INF	0.12	0.57	0.57	12.0
Ma Wan	0.16	0.33	0.55	10.5

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

Notes:

- 1. "<LOR" indicates the concentrations of contaminants 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.

^{1. &}quot;ND" indicates the concentrations of metals and metalloids are not detected.

Appendix C. Graphical Presentations

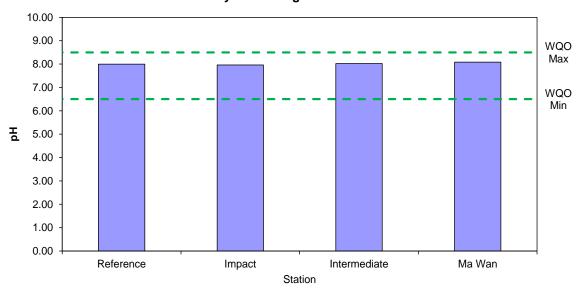


Figure 1: Level of pH recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

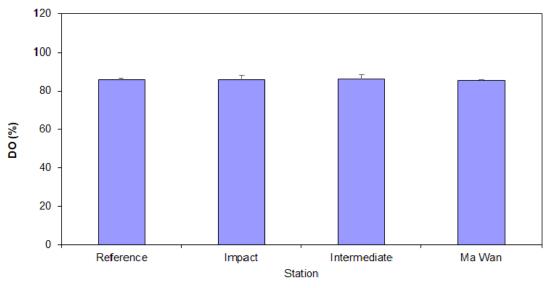


Figure 2: Level of Dissolved Oxygen (DO) (% saturation; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

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

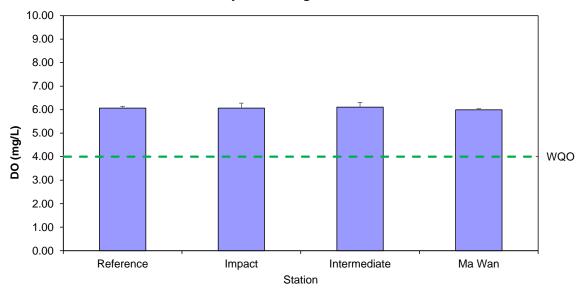


Figure 3: Concentration of Dissolved Oxygen (DO) (mg/L; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

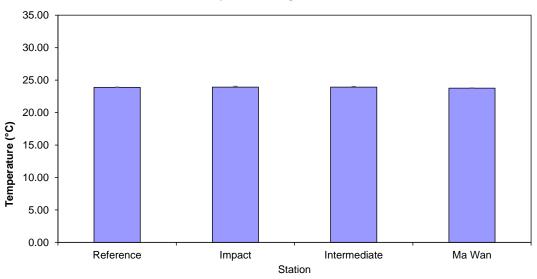


Figure 4: Level of Temperature (°C; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

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

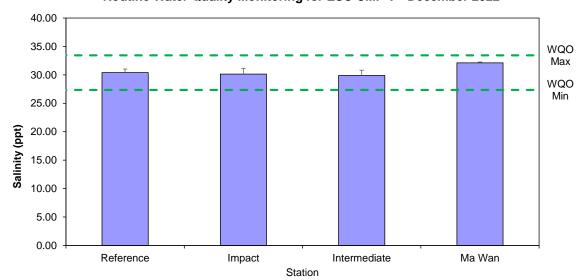


Figure 5: Level of Salinity (ppt; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

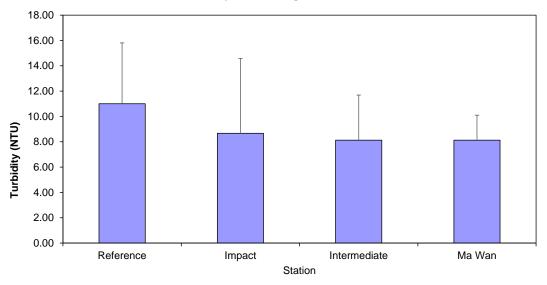


Figure 6: Level of Turbidity (NTU; mean + SD) recorded during Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

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

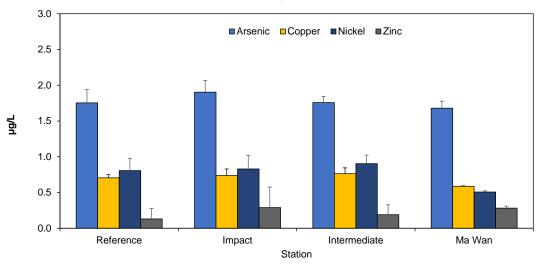


Figure 7: Concentration of Arsenic, Copper, Nickel, and Zinc (μg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

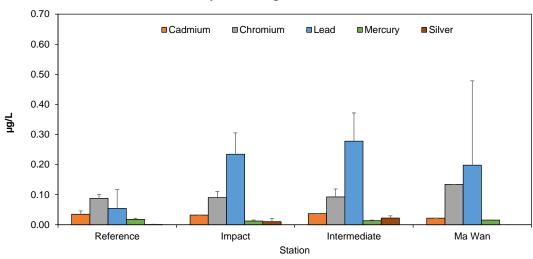


Figure 8: Concentration of Cadmium, Chromium, Lead, Mercury, and Silver, (µg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022



Routine Water Quality Monitoring for Nutrients - December 2022

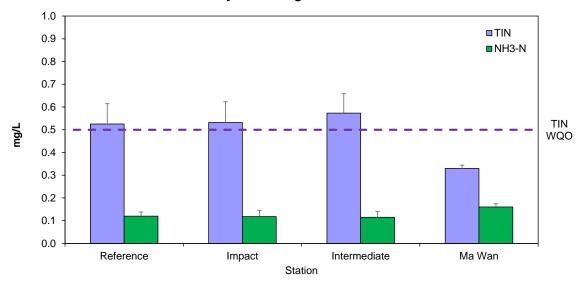


Figure 9: Concentration of Total Inorganic Nitrogen (TIN) and Ammonia Nitrogen (NH3-N) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

Routine Water Quality Monitoring for Biochemical Oxygen Demand (BOD5) December 2022 1.5 1.0 0.0 Reference Impact Intermediate Ma Wan

Figure 10: 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 December 2022



Routine Water Quality Monitoring for Suspended Solids - December 2022

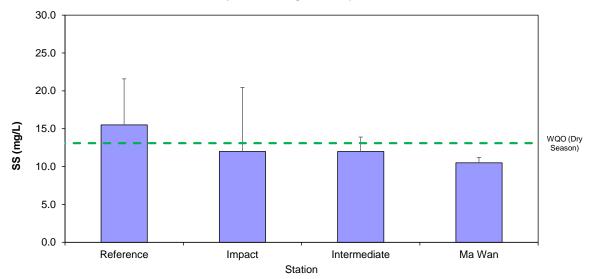


Figure 11 Concentration of Suspended Solids (SS) (mg/L; mean + SD) in water samples collected from Routine Water Quality Monitoring for disposal operations at ESC CMP V in December 2022

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

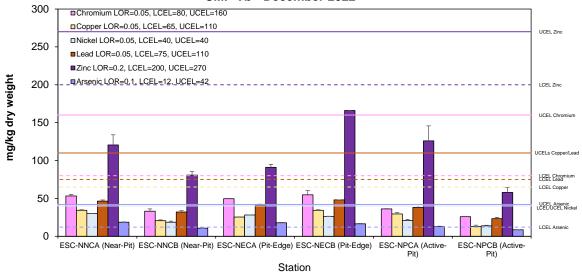


Figure 12: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in December 2022

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

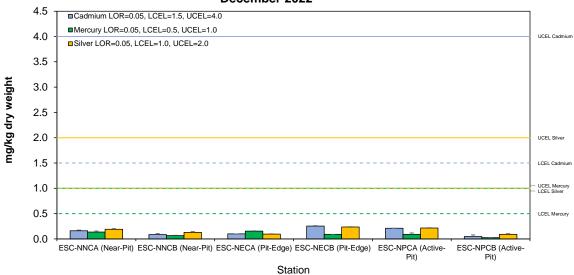


Figure 13: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in December 2022

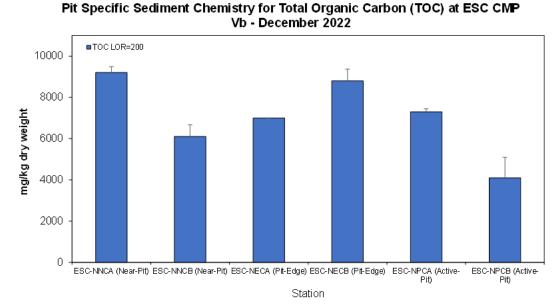


Figure 14: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in December 2022

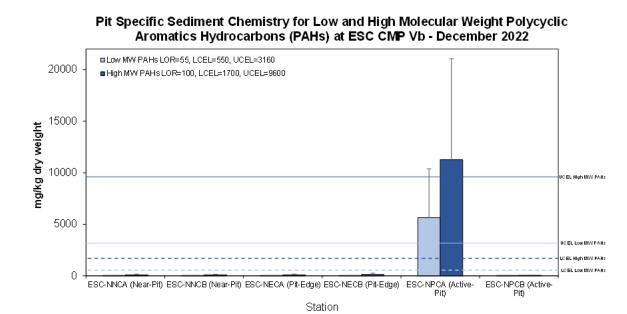


Figure 15: Concentration of Low and High Molecular Weight Polycyclic Aromatic Hydrocarbons (mg/kg dry weight; mean + SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in December 2022

Cumulative Impact Sediment Chemistry for Metal and Metalloid Contaminants

at ESC CMPs - December 2022 300 □Copper LOR=0.05, LCEL=65, UCEL=110 □Nickel LOR=0.05, LCEL=40, UCEL=40 250 ■Lead LOR=0.05, LCEL=75, UCEL=110 ■Zinc LOR=0.2, LCEL=200, UCEL=270 mg/kg dry weight Arsenic LOR=0.1, LCEL=12, UCEL=42 200 UCEL Chromiun 150 100 LCEL Chrom 50 UCEL Arsenic LCEL/UCEL Nicke I CEL Arseni ESC-RNA (Near-field) ESC-RNB1 ESC-RMA ESC-RMB ESC-RFA (Far-ESC-RFB (Far-field) field) ESC-RCA1 (Capped Pit) ESC-RCB1 Station

Figure 16: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2022

Cumulative Impact Sediment Chemistry for Metal Contaminants at ESC CMPs - December 2022

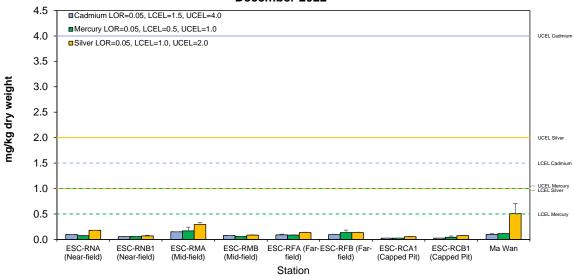


Figure 17: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2022

Cumulative Impact Sediment Chemistry for Total Organic Carbon (TOC) at ESC CMPs - December 2022

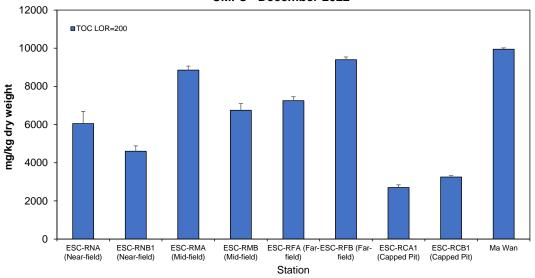


Figure 18: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2022



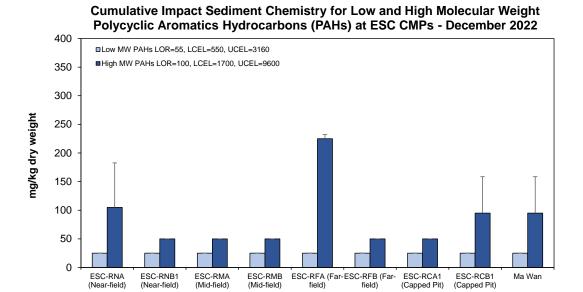


Figure 19: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2022

Station

Cumulative Impact Sediment Chemistry for Tributyltin (TBTs) at ESC CMPs -

December 2022 90 80 70 60 µg TBT/kg 50 40 30 20 10 ESC-RNA ESC-RNB1 ESC-RMA ESC-RMB ESC-RFA (Far-ESC-RFB (Far-ESC-RCA1 ESC-RCB1 Ma Wan (Mid-field) (Mid-field) field) field) Station

Figure 20: Concentration of Tributyltin (TBT) (μg/kg dry weight; mean + SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in December 2022

Appendix D. Study Programme

Study Programme

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

Mott MacDonald Hong Kong Limited

