



**Agreement No. CE 63/2016 (EP)
Environmental Monitoring and Audit
for Disposal Facility to the East of
Sha Chau (2017-2020) – Investigation**

**Monthly EM&A Report for Contaminated
Mud Pits to the East of Sha Chau –
June 2020**

Revision 0

July 2020

Environmental Resources Management
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Client: Civil Engineering and Development Department (CEDD)		Project No: 0400720			
Summary: This document presents the Monthly EM&A Report for <i>Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau</i> .		Date: 14 July 2020			
		Approved by:  Craig A. Reid Partner			
v0	Monthly EM&A Report for ESC CMPs	GS	RC	CAR	14/07/20
Revision	Description	By	Checked	Approved	Date
<p>This report has been prepared by Environmental Resources Management the trading name of 'ERM Hong-Kong, Limited', with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.</p> <p>We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.</p> <p>This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.</p>		<p>Distribution</p> <p><input type="checkbox"/> Internal</p> <p><input checked="" type="checkbox"/> Public</p> <p><input type="checkbox"/> Confidential</p> <div style="text-align: right;">   </div>			

Dredging, Management and Capping of Contaminated Sediment Disposal Facility at Sha Chau

Environmental Certification Sheet 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 - June 2020
Date of Report:	14 July 2020
Date prepared by ET:	14 July 2020
Date received by IA:	14 July 2020

Reference EP Condition

Environmental Permit Condition:

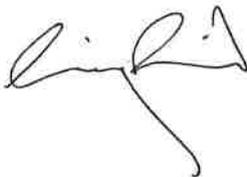
Condition 3.4 of EP-312/2008/A:

4 hard copies and 1 electronic copy of monthly EM&A Report shall be submitted to the Director within 2 weeks 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 certified by the ET Leader and 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

Craig Reid,
Environmental Team Leader:



Date: 14/07/2020

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:



Date: 14/07/2020

CONTENTS

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 AND/OR ANALYSIS	2
1.5	BRIEF DISCUSSION OF THE MONITORING RESULTS FOR ESC CMP V	2
1.6	ACTIVITIES SCHEDULED FOR THE NEXT MONTH	6
1.7	STUDY PROGRAMME	6

ANNEXES

ANNEX A	SAMPLING SCHEDULE
ANNEX B	WATER QUALITY MONITORING RESULTS
ANNEX C	GRAPHICAL PRESENTATIONS
ANNEX D	STUDY PROGRAMME

Agreement No. CE 63/2016 (EP)
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MONTHLY EM&A REPORT FOR JUNE 2020

1.1 BACKGROUND

1.1.1 The Civil Engineering and Development Department (CEDD) is managing a number of marine disposal facilities in Hong Kong waters, including the Contaminated Mud Pits (CMPs) to the South of The Brothers (SB) and to the East of Sha Chau (ESC) for the disposal of contaminated sediment, and open-sea disposal grounds located to the South of Cheung Chau (SCC), East of Tung Lung Chau (ETLC) and East of Ninepins (ENP) for the disposal of uncontaminated sediment. Two Environmental Permits (EPs), EP-312/2008/A and EP-427/2011/A, were issued by the Environmental Protection Department (EPD) to the CEDD, the Permit Holder, on 28 November 2008 and 23 December 2011 for the Dredging, Management and Capping of Contaminated Sediment Disposal Facilities at ESC CMP V and SB CMPs, respectively.

1.1.2 Under the requirements of the two EPs for ESC CMP V and SB CMPs, EM&A programmes which encompass water and sediment chemistry, fisheries assessment, tissue and whole body analysis, sediment toxicity and benthic recolonisation studies as set out in the EM&A Manuals are required to be implemented. EM&A programmes have been continuously carried out during the operation of the CMPs at ESC and SB. A review of the collection and analysis of such environmental data from the monitoring programme demonstrated that there had not been any adverse environmental impacts resulting from disposal activities ⁽¹⁾ ⁽²⁾. The current programme will assess the impacts resulting from dredging, disposal and capping operations of CMP V as well as capping operations of SB CMPs.

1.1.3 The present EM&A programme under *Agreement No. CE 63/2016 (EP)* covers the dredging, disposal and capping operations of the ESC CMP V as well as the capping operations of the SB CMPs (see *Annex A* for the EM&A programme). The scheduled EM&A programme for SB CMPs was completed in December 2018. Detailed works schedule for ESC CMP V is shown in *Figure 1.1*. In June 2020, 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.

1.5.2 ***Water Column Profiling of ESC CMP Vb – June 2020***

1.5.3 *Water Column Profiling* was undertaken at a total of two sampling stations (Upstream and Downstream stations) on 11 June 2020. 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 2009 - 2018 from stations in the Northwestern Water Control Zone (WCZ), where the ESC CMPs are located ⁽¹⁾. 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 Annex B* for details).

In-situ Measurements

1.5.4 Analyses of results for June 2020 indicated that levels of Salinity, pH and DO complied with the WQOs at both Downstream and Upstream stations (*Table B2 of Annex B*). Levels of DO and Turbidity at all stations complied with the Action and Limit Levels (*Tables B1 and B2 of Annex B*).

Laboratory Measurements for Suspended Solids (SS)

1.5.5 Analyses of results June 2020 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 Annex B*).

1.5.6 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.

1.5.7 ***Pit Specific Sediment Chemistry of ESC CMP Vb – June 2020***

1.5.8 Monitoring locations for *Pit Specific Sediment Chemistry for ESC CMP Vb* are shown in *Figure 1.2*. A total of six (6) monitoring stations were sampled on 3 June 2020.

1.5.9 The concentrations of most inorganic contaminants were lower than the Lower Chemical Exceedance Levels (LCELs) at most stations, except for Arsenic (*Figures 1 and 2 of Annex C*). The concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge station ESC-NECA and Active-Pit station ESC-NPCB.

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

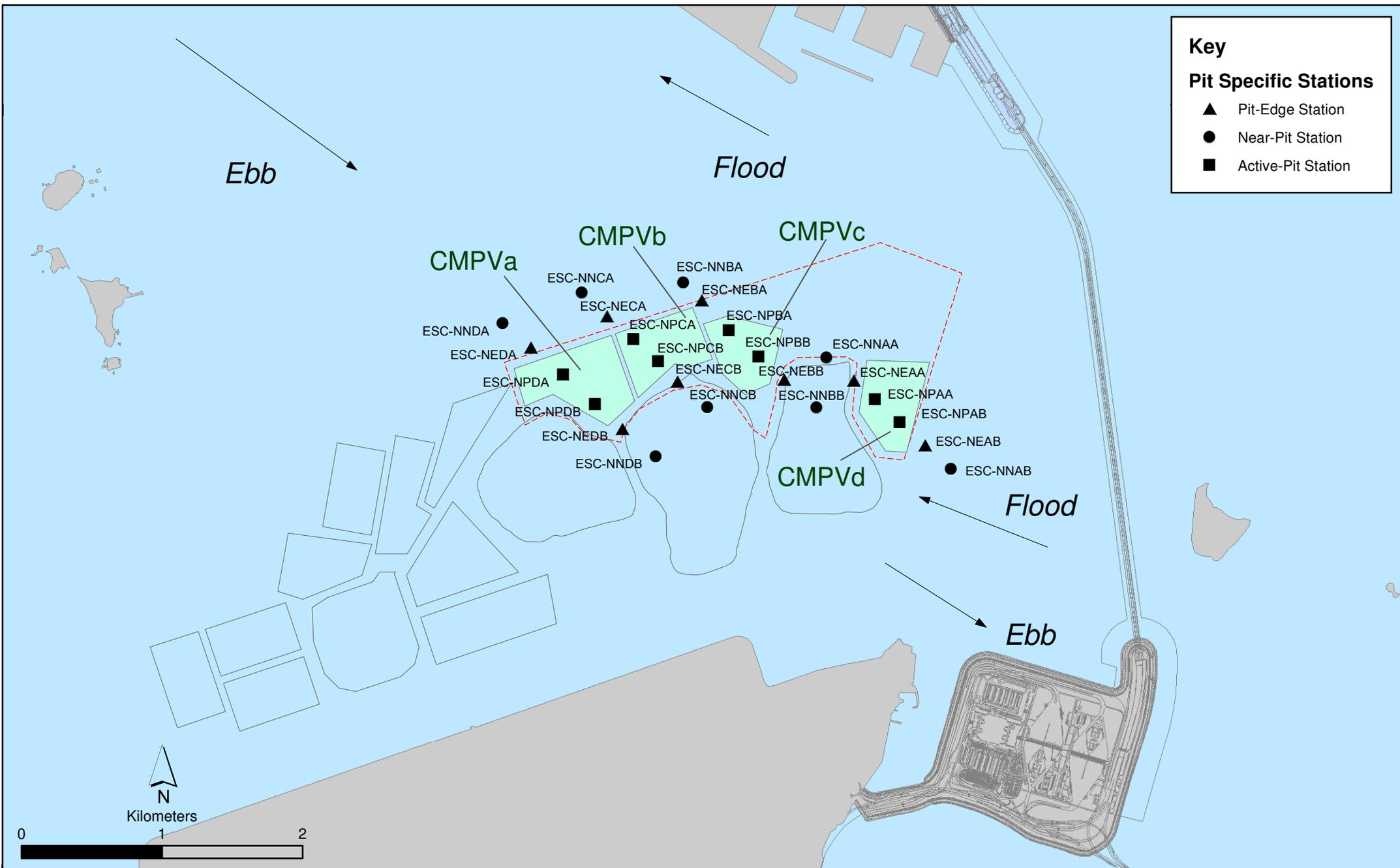


Figure 1.2

Pit Specific Sediment Quality Monitoring Stations for CMPV

- 1.5.10 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 ⁽¹⁾. It is presumed that the natural concentrations of Arsenic are similar in onshore and offshore sediments ⁽²⁾, and relatively high Arsenic levels may thus occur throughout Hong Kong. Therefore, the LECL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vb but rather as a result of naturally occurring deposits.
- 1.5.11 For organic contaminants, the concentrations of Total Organic Carbon (TOC) were higher at Active-Pit station ESC-NPCB in June 2020 (*Figure 3 of Annex C*). The concentrations of Low Molecular Weight and High Molecular Weight Polycyclic Aromatic Hydrocarbons (PAHs) were lower than the LCELs at all stations (*Figure 4 of Annex C*). The concentration of Tributyltin (TBT) was higher at Active-Pit station ESC-NPCA (*Figure 5 of Annex 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 in June 2020.
- 1.5.12 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 in June 2020. Statistical analysis will be undertaken and presented in the corresponding quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.
- 1.5.13 ***Cumulative Impact Sediment Chemistry of ESC CMPs – June 2020***
- 1.5.14 Monitoring locations for Cumulative Impact Sediment Chemistry for ESC CMPs are shown in *Figure 1.3*. A total of nine (9) monitoring stations were sampled on 4 and 5 June 2020.
- 1.5.15 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 in June 2020, except concentrations of Arsenic were higher than the LCEL at Mid-field stations ESC-RMA, ESC-RMB and Capped Pit station ESC-RCB1 (*Figures 6 and 7 of Annex C*). As discussed in *Section 1.5.10*, the LECL exceedances of Arsenic are unlikely to be caused by the disposal operations at ESC CMP Vb but rather as a result of naturally occurring deposits.

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

(2) 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

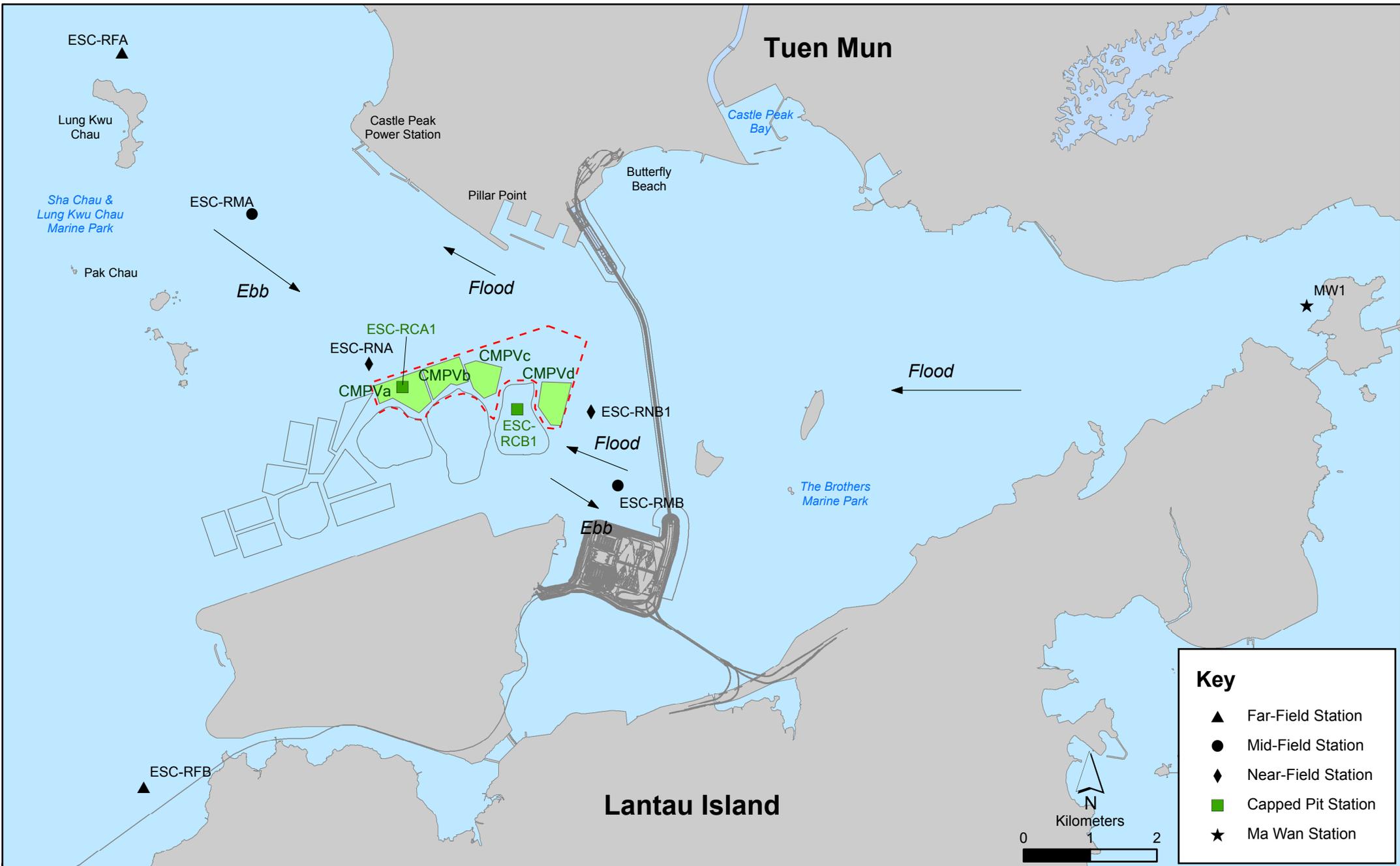


Figure 1.3

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

- 1.5.16 For organic contaminants, the concentrations of TOC varied between stations in June 2020, with generally higher concentrations of TOC recorded at Mid-field station ESC-RMA and Ma Wan station (*Figure 8 of Annex C*). The concentrations of TBT were below the limit of reporting at most stations, except at Far-field station ESC-RFA, Capped-pit station ESC-RCA1 and Ma Wan station, and higher concentrations were recorded at Ma Wan station (*Figure 9 of Annex C*). The concentrations of High Molecular Weight PAHs were below the LCEL at all stations (*Figure 10 of Annex 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 in June 2020.
- 1.5.17 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 in June 2020. Statistical analysis will be undertaken and presented in the corresponding quarterly report to investigate whether there are any unacceptable impacts in the area caused by the contaminated mud disposal.
- 1.5.18 ***Water Quality Monitoring during Capping of ESC CMPs – June 2020***
- 1.5.19 The monitoring results obtained during June 2020 sampling in the wet season have been assessed for compliance with the WQOs (see *Section 1.5.3* for details). A total of ten (10) monitoring stations were sampled on 12 June 2020 as shown in *Figure 1.4*.
- In-situ Measurements*
- 1.5.20 Graphical presentation of the monitoring results (Temperature, DO, pH, Salinity and Turbidity) is shown in *Figures 11-18 of Annex C*. Levels of pH at all stations in June 2020 complied with the WQO while the Levels of Salinity were higher than WQO at Impact, Intermediate and Ma Wan Stations, and the levels of DO of Surface and Mid water average were lower than the WQO at Ma Wan station (*Table B3 of Annex B*). Levels of DO and Turbidity complied the Action and Limit levels at most stations, except the averaged levels of DO recorded for surface and mid-depth water at Ma Wan station was below Action level (*Tables B1 and B3 of Annex B*).
- 1.5.21 The higher Salinities recorded at Ma Wan station are likely to be caused by the larger separation distance to Pearl River mouth, which release a large amount of freshwater runoff in the area during wet season, when compared to the Reference stations. The Reference stations are located relatively closer to nearby islands (e.g. Hong Kong Boundary Crossing Facilities, Tai Mo To, Siu Mo To) and localised freshwater runoff from the nearby islands might be resulted during wet season, resulting in lower Salinities at Reference stations.
- 1.5.22 Since action level exceedance of DO (surface and mid-depth water) was recorded at Ma Wan station only and Ma Wan is located further away from ESC CMPs comparing to other stations where levels of DO complied with the action and limit levels, the LECL exceedance of DO (surface and mid-depth water) is unlikely to be caused by the capping operations at ESC CMPs.

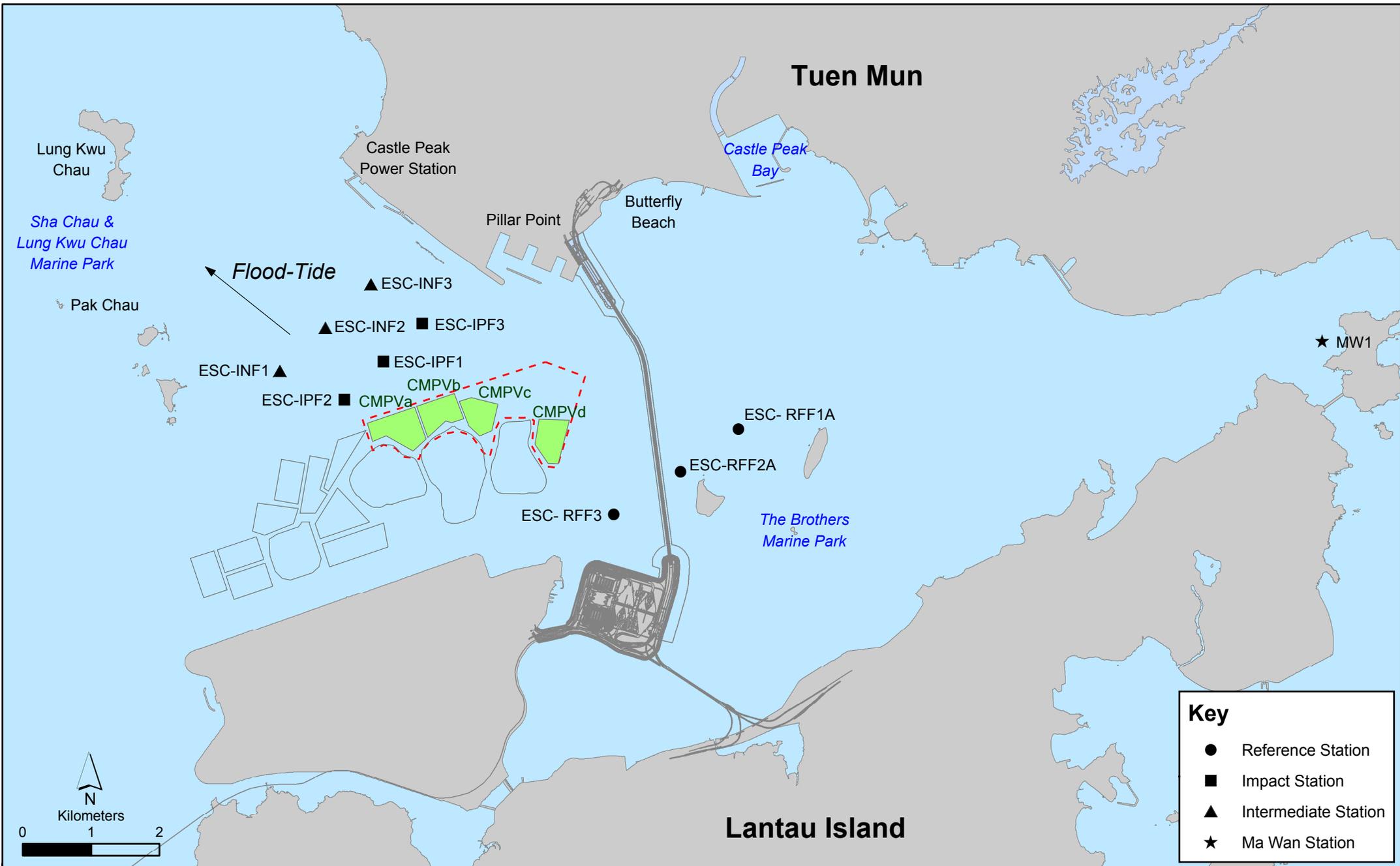


Figure 1.4

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

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Date: 25/4/2017

Key	
●	Reference Station
■	Impact Station
▲	Intermediate Station
★	Ma Wan Station

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Laboratory Measurements for Suspended Solids (SS)

1.5.23 Concentrations of SS complied with the WQO at all stations. Concentrations of SS complied with the Action and Limit Levels at all stations in June 2020 (*Table B3 of Annex B; Figure 17 of Annex C*).

1.5.24 Overall, results of the Water Quality Monitoring during Capping of ESC CMPs indicated that the capping operation at ESC CMP Vd did not appear to cause any unacceptable deterioration in water quality in June 2020. Further statistical analysis will be undertaken in the quarterly report to investigate whether the capping operations at ESC CMP Vd is causing any unacceptable deterioration in water quality of the area.

1.6 ACTIVITIES SCHEDULED FOR THE NEXT MONTH

1.6.1 The following monitoring activities will be conducted in the next monthly period of July 2020 for ESC CMP V (see *Annex A* for the sampling schedule ⁽¹⁾):

- *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.*

1.7 STUDY PROGRAMME

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

(1) The scheduled EM&A Programme for SB CMPs was completed in December 2018.

Annex A

Sampling Schedule

Annex B

Water Quality Monitoring Results

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

Parameter	Action Level	Limit Level
Dissolved Oxygen (DO) ⁽¹⁾	<u>Surface and Mid-depth</u> ⁽²⁾ 5%-ile of baseline data for surface and middle layer = 3.76 mg L⁻¹	<u>Surface and Mid-depth</u> ⁽²⁾ 1%-ile of baseline data for surface and middle layer = 3.11 mg L⁻¹ ⁽³⁾
	and	and
	Significantly less than the reference stations mean DO (at the same tide of the same day)	Significantly less than the reference stations mean DO (at the same tide of the same day)
	<u>Bottom</u> 5%-ile of baseline data for bottom layers = 2.96 mg L⁻¹	<u>Bottom</u> The average of the impact station readings are <2 mg/L⁻¹
	and	and
	Significantly less than the reference stations mean DO (at the same tide of the same day)	Significantly less than the reference stations mean DO (at the same tide of the same day)
Depth-averaged Suspended Solids (SS) ^{(4) (5)}	95%-ile of baseline data for depth average = 37.88 mg L⁻¹	99%-ile of baseline data for depth average = 61.92 mg L⁻¹
	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
Depth-averaged Turbidity (Tby) ^{(4) (5)}	95%-ile of baseline data = 28.14 NTU	99%-ile of baseline data = 38.32 NTU
	and	and
	120% of control station's Tby at the same tide of the same day	130% of control station's Tby 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) The Action and Limit Levels for DO for Surface & 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 & 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 June 2020

Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%) (mg L ⁻¹)		pH	Suspended Solids (mg L ⁻¹)
WCP 1 (Downstream)	27.62	13.86	7.66	62.96	4.60	7.61	5.38
WCP 2 (Upstream)	27.85	12.73	11.42	62.59	4.59	7.53	7.90
WQO (Wet Season)	N/A	11.50-14.01#	N/A	N/A	>4	6.5-8.5	10.8

Note:

#Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.

Cell shaded yellow / red indicate value exceeding the Action/Limit levels.

Cell shaded grey indicate value exceeding the WQO.

Table B3 Monitoring Results for Water Quality Monitoring during Capping of ESC on 12 June 2020

Sampling Period	Stations	Temp (°C)	Salinity (ppt)	Turbidity (NTU)	Dissolved Oxygen (%) (mg L ⁻¹)				pH (mg L ⁻¹)	SS (mg L ⁻¹)
					Surface & Mid-depth water	Bottom Water	Surface & Mid-depth water	Bottom Water		
June 2020	RFF (Reference)	26.64	20.84	5.31	57.87	53.52	4.18	3.77	7.73	6.70
	IPF (Impact)	26.22	23.16	6.08	56.01	52.55	4.02	3.68	7.69	6.48
	INF (Intermediate)	26.21	23.33	6.93	56.11	52.00	4.03	3.65	7.65	6.58
	Ma Wan	24.70	32.33	3.21	50.20	49.37	3.47	3.41	7.83	5.40
	WQO	N/A	18.76-22.92*	N/A	N/A	>4	>2	6.5-8.5	10.8	

Notes:

Not exceeding 2°C of change of the results from the Reference Station.

*Not exceeding 10% of natural ambient level which is the result obtained from the Reference Station.

Cell shaded yellow / red indicate value exceeding the Action/Limit levels.

Cell shaded grey indicate value exceeding the WQO.

Annex C

Graphical Presentation

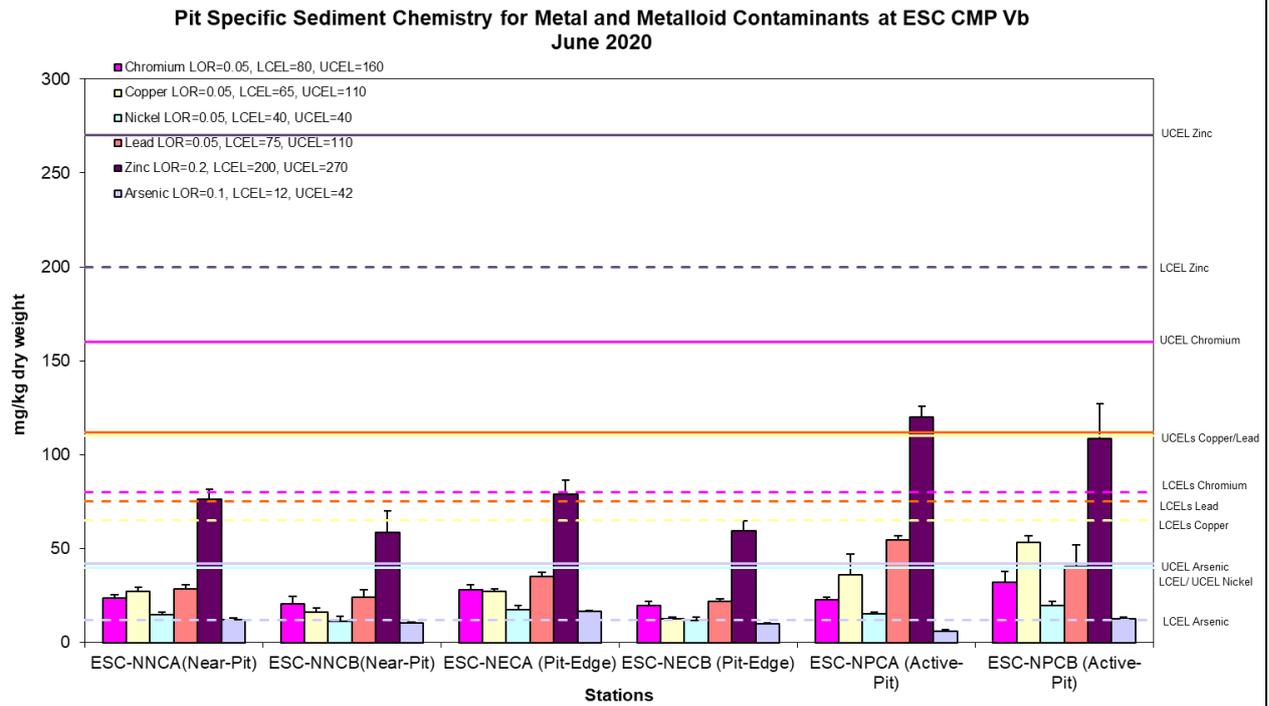


Figure 1: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in June 2020.

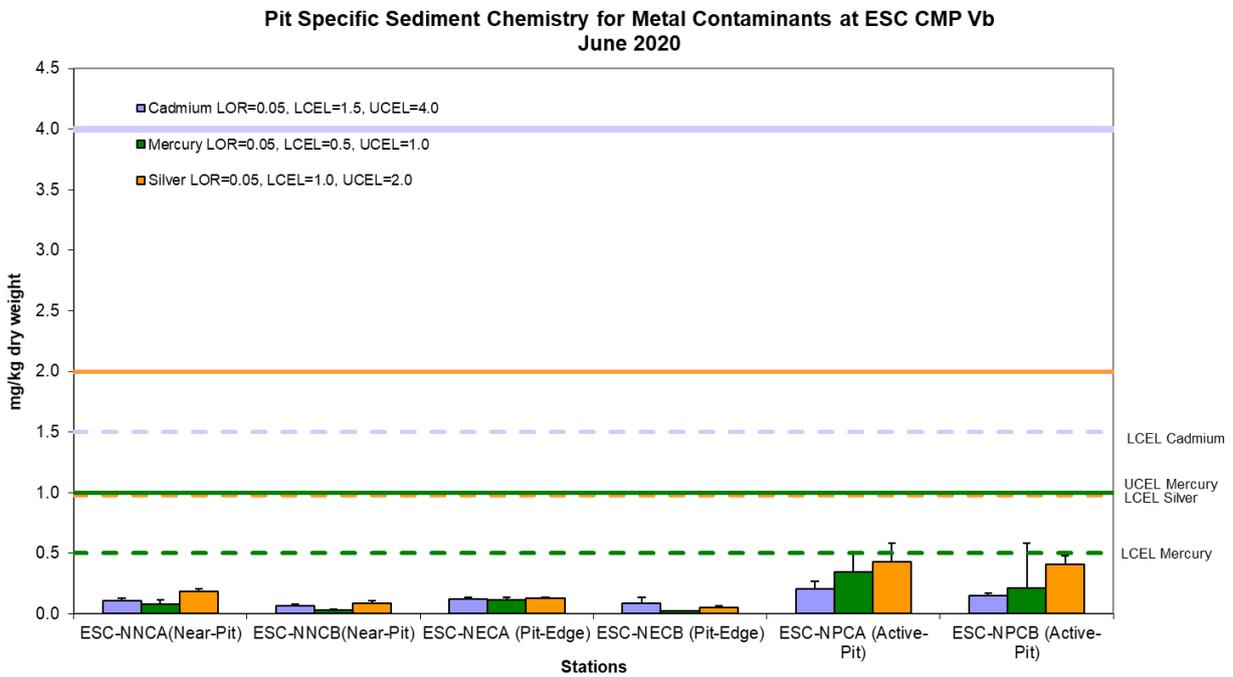


Figure 2: Concentration of Metals (Cd, Hg, Ag; mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in June 2020.

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Date: July 2020

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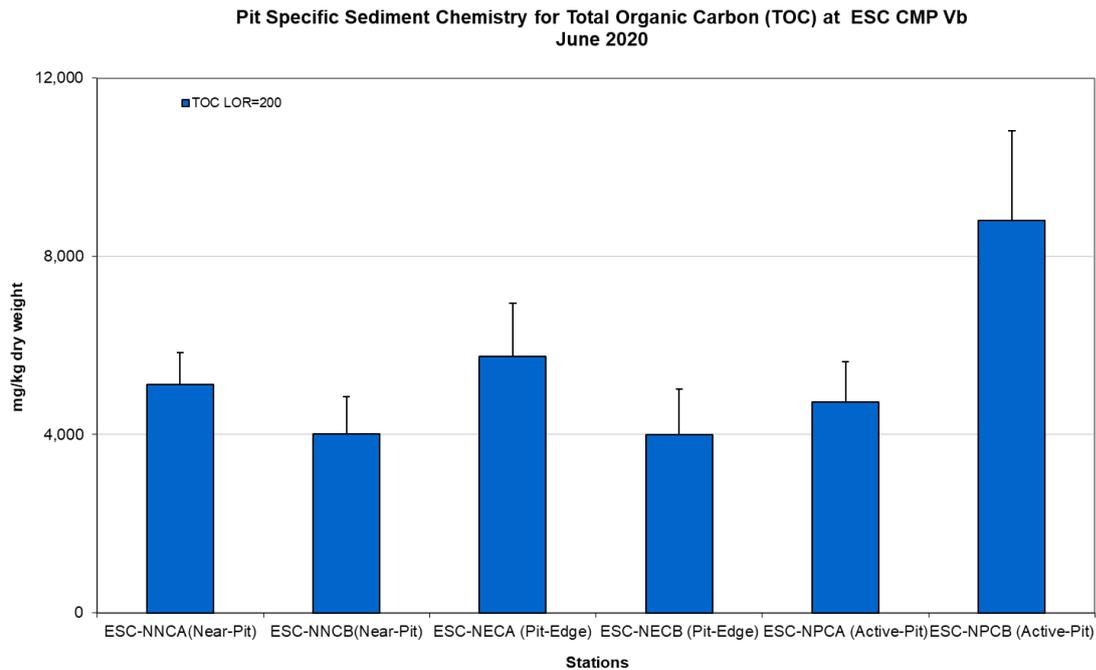


Figure 3: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in June 2020.

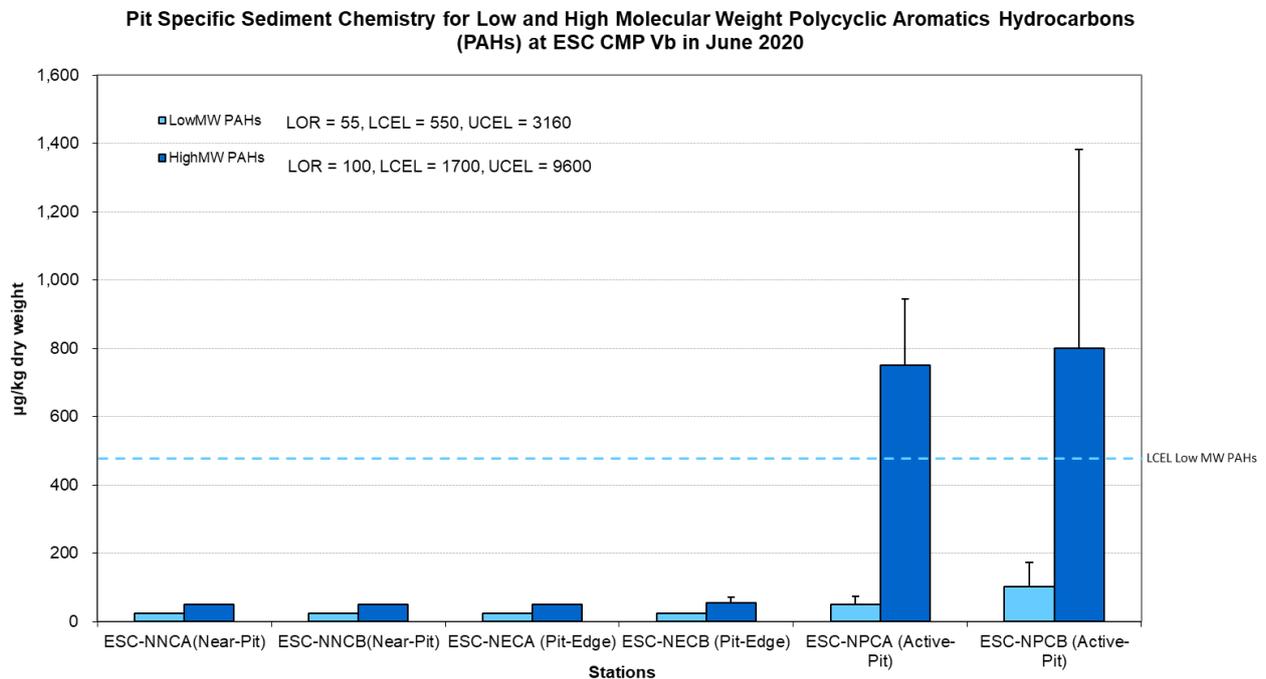


Figure 4: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in June 2020.

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Pit Specific Sediment Chemistry for Tributyltin (TBT) at ESC CMP Vb
June 2020

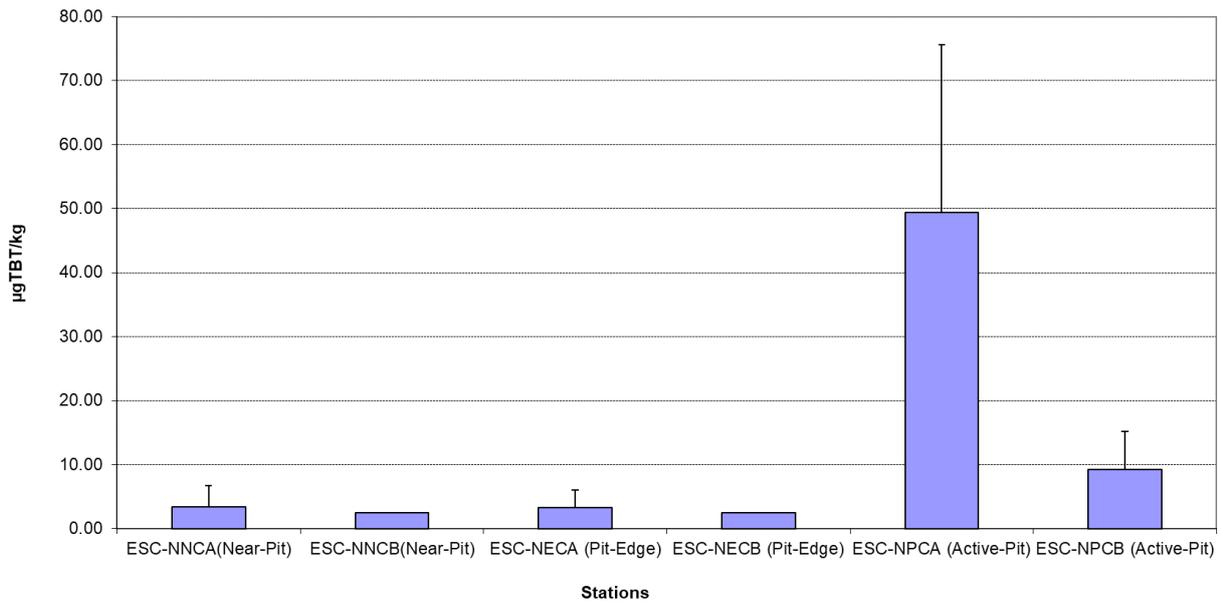


Figure 5: Concentration of Tributyltin (TBT) (µg/kg dry weight; mean +SD) in sediment samples collected from Pit Specific Sediment Chemistry Monitoring for ESC CMP Vb in June 2020.

Cumulative Impact Sediment Chemistry for Metal and Metalloid Contaminants at ESC CMPs
June 2020

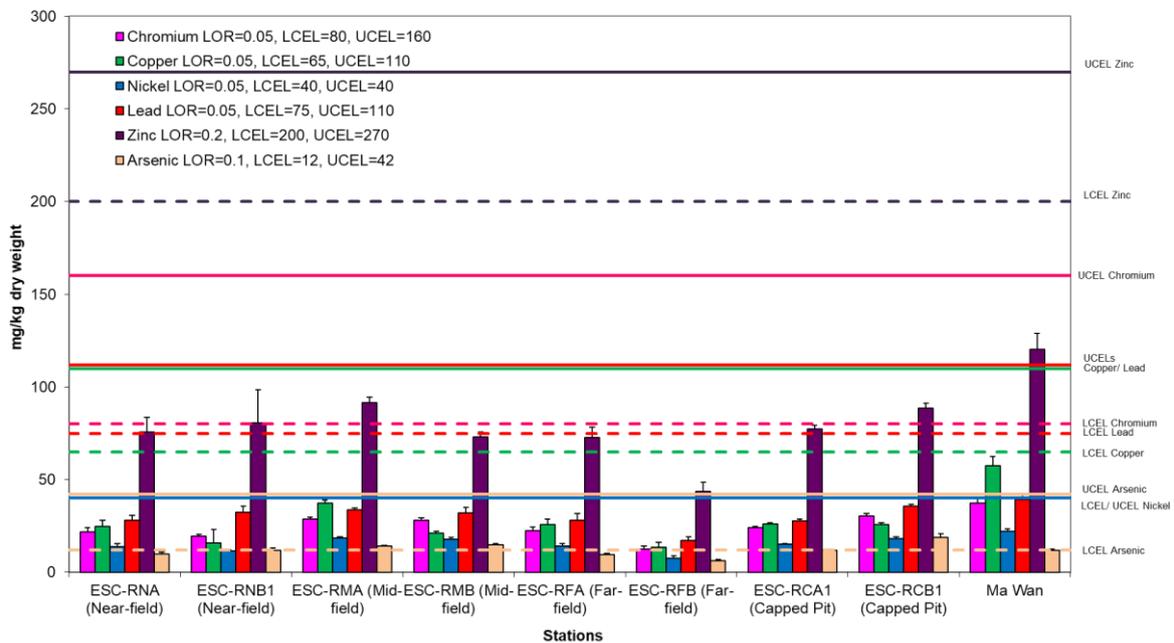


Figure 6: Concentration of Metals and Metalloid (Cr, Cu, Ni, Pb, Zn, As; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2020.

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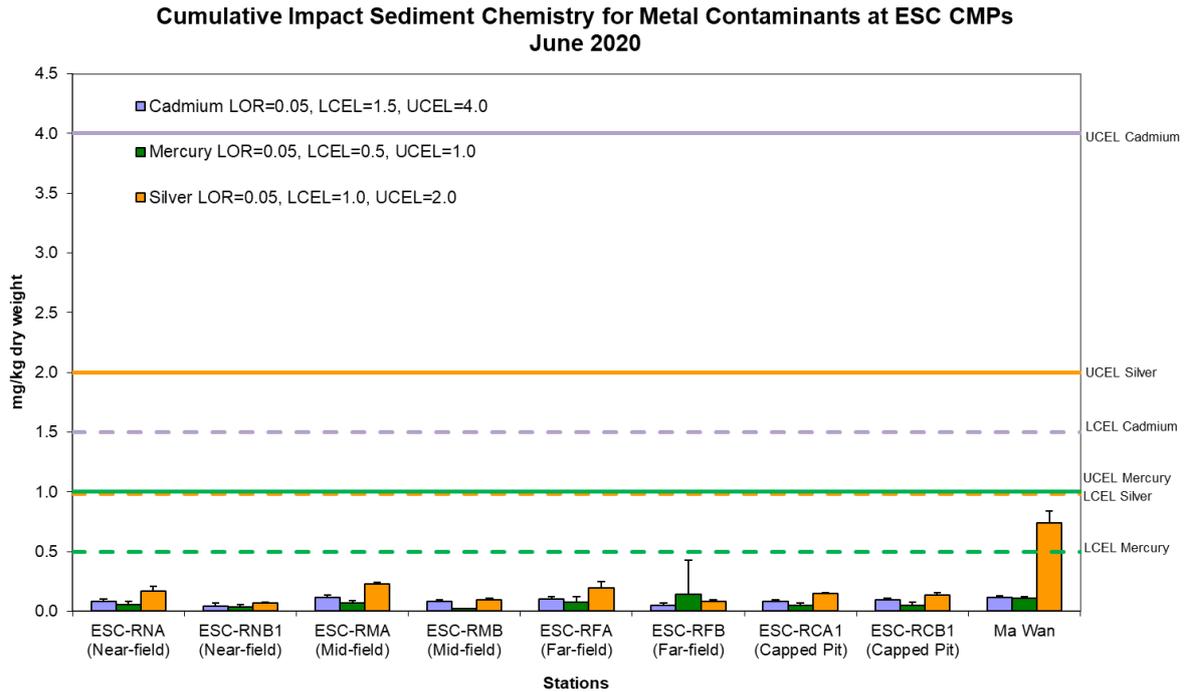


Figure 7: Concentration of Metals (Cd, Hg, Ag; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2020.

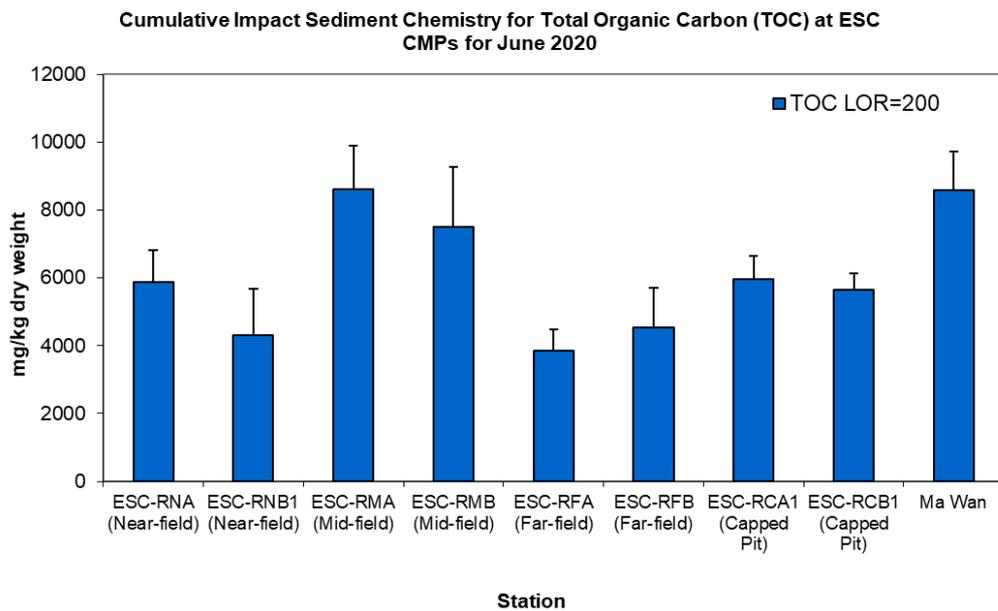


Figure 8: Concentration of Total Organic Carbon (TOC) (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2020.

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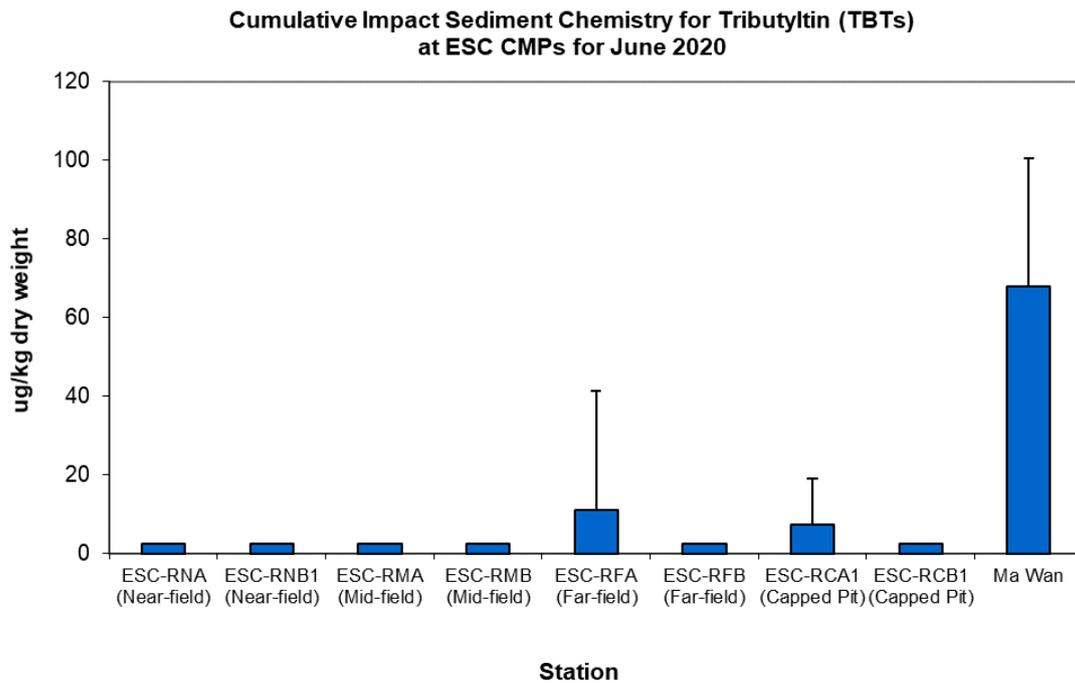


Figure 9: Concentration of Tributyltin (TBT) ($\mu\text{g}/\text{kg}$ dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2020.

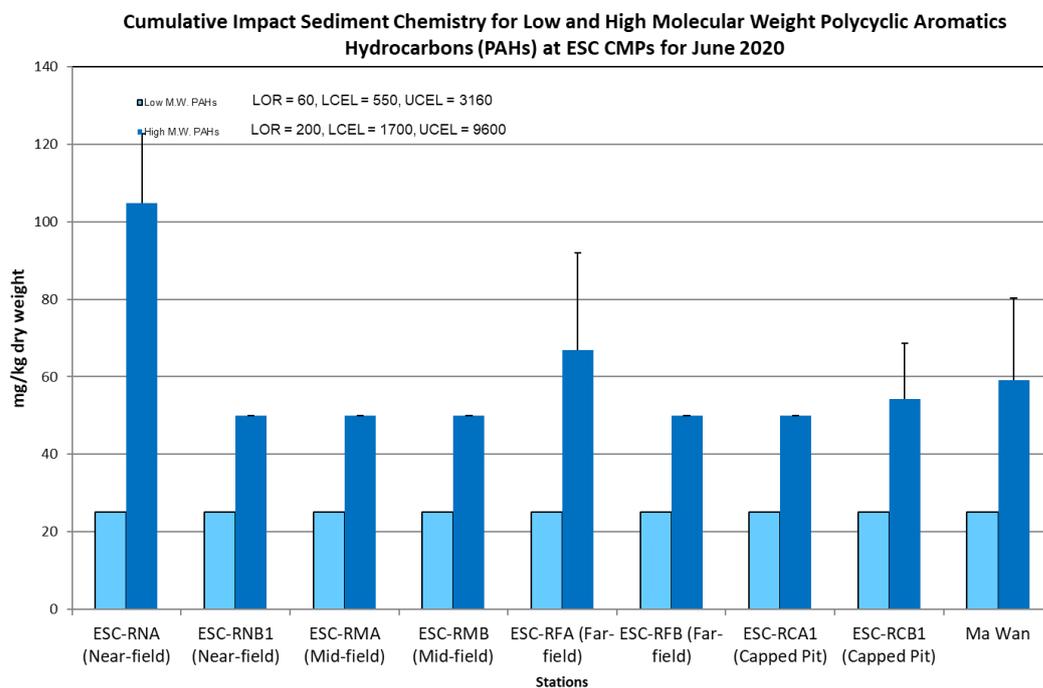


Figure 10: Concentration of Low and High Molecular Weight Polycyclic Aromatics (mg/kg dry weight; mean +SD) in sediment samples collected from Cumulative Impact Sediment Chemistry Monitoring for ESC CMPs in June 2020.

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Water Quality Monitoring During Capping at ESC CMP
June 2020

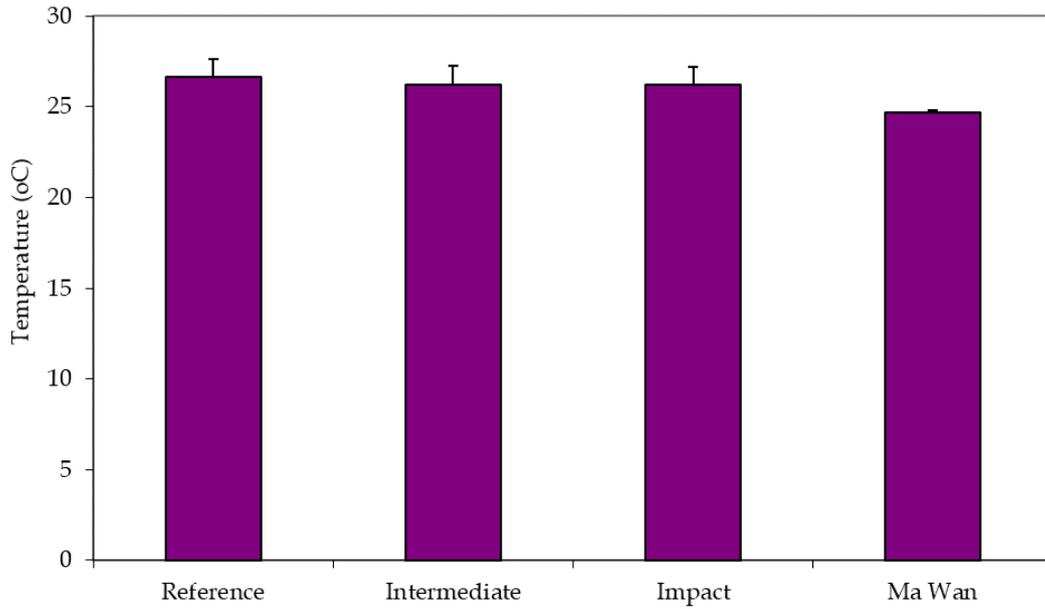


Figure 11: Levels of Temperature (°C; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

Water Quality Monitoring During Capping at ESC CMP
June 2020

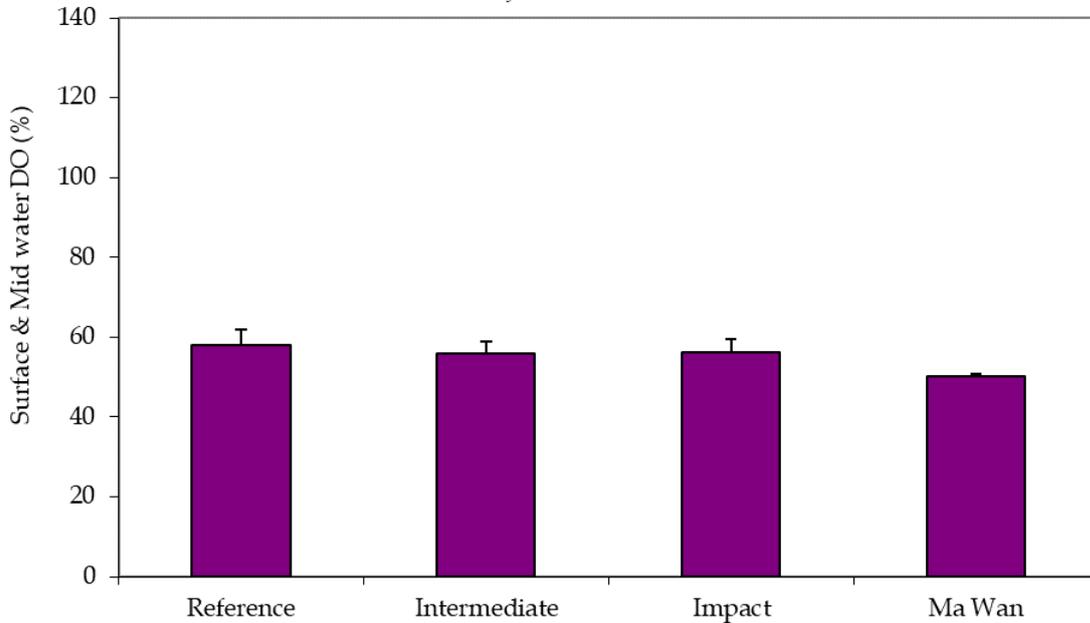


Figure 12: Levels of Dissolved Oxygen (% saturation; mean +SD) of Surface and Mid Water recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020

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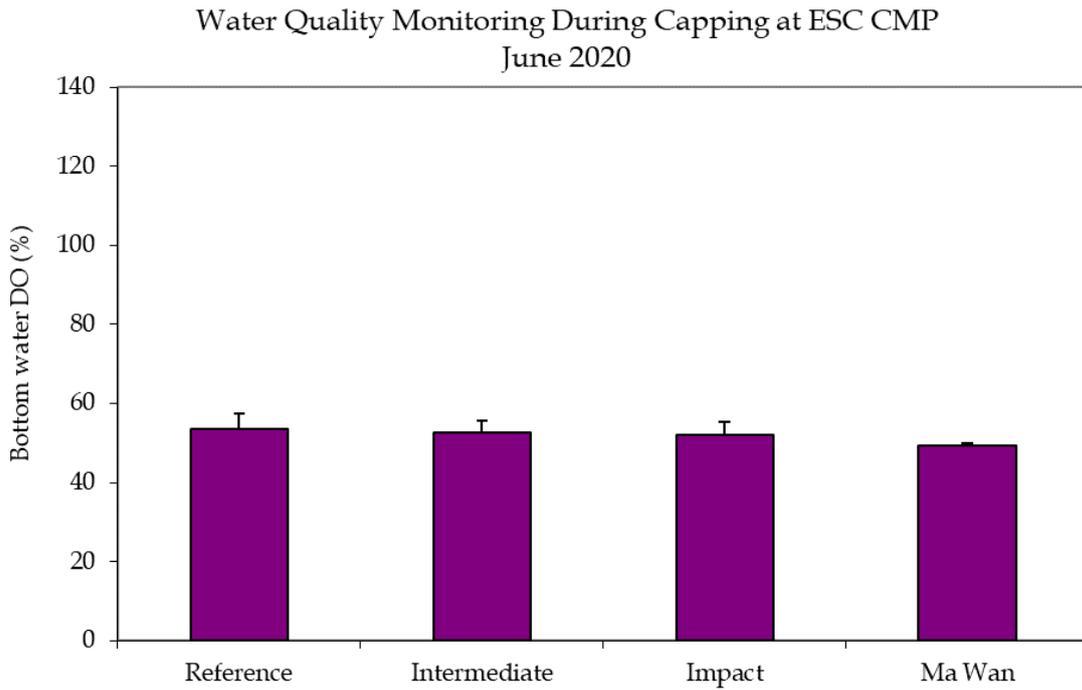


Figure 13: Levels of Dissolved Oxygen (% saturation; mean +SD) of Bottom Water recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020

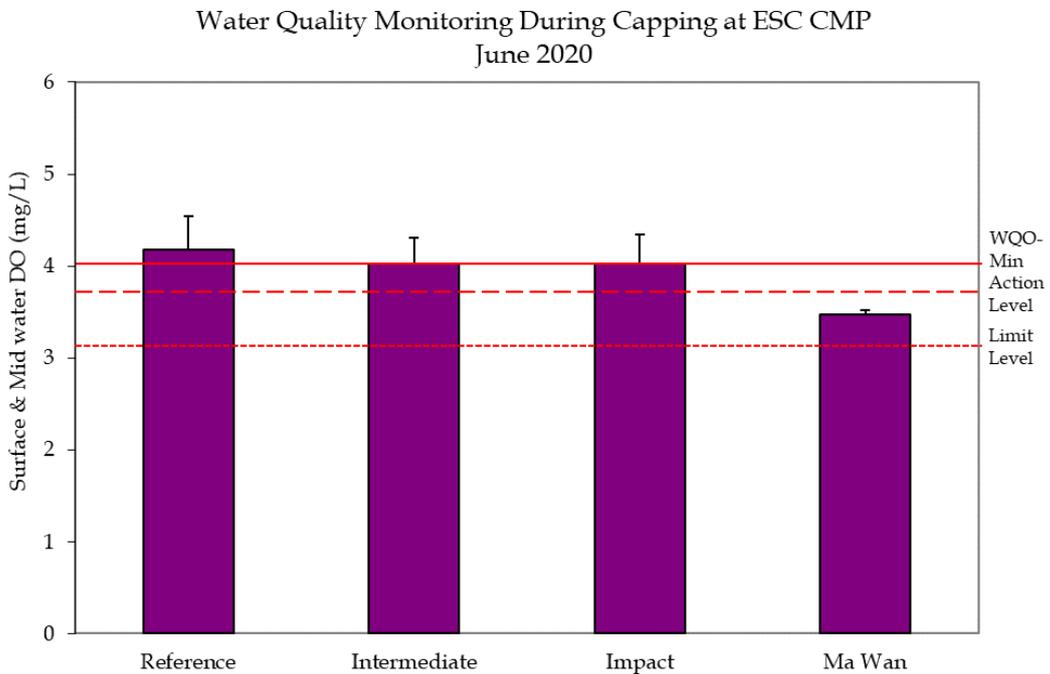


Figure 14: Levels of Dissolved Oxygen (mg/L; mean +SD) of Surface and Mid-depth Water recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\39 Monthly June 2020

Date: July 2020

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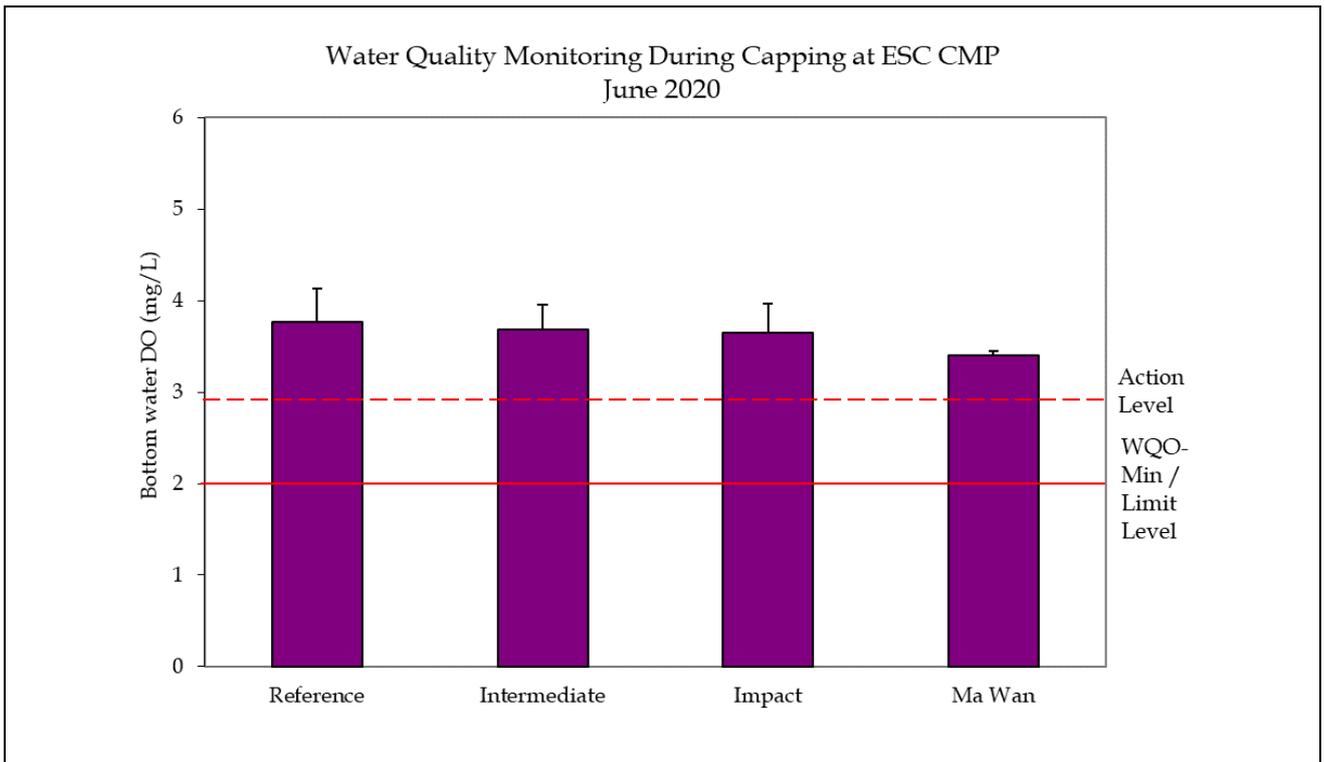


Figure 15: Levels of Dissolved Oxygen (mg/L; mean +SD) of Bottom Water recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

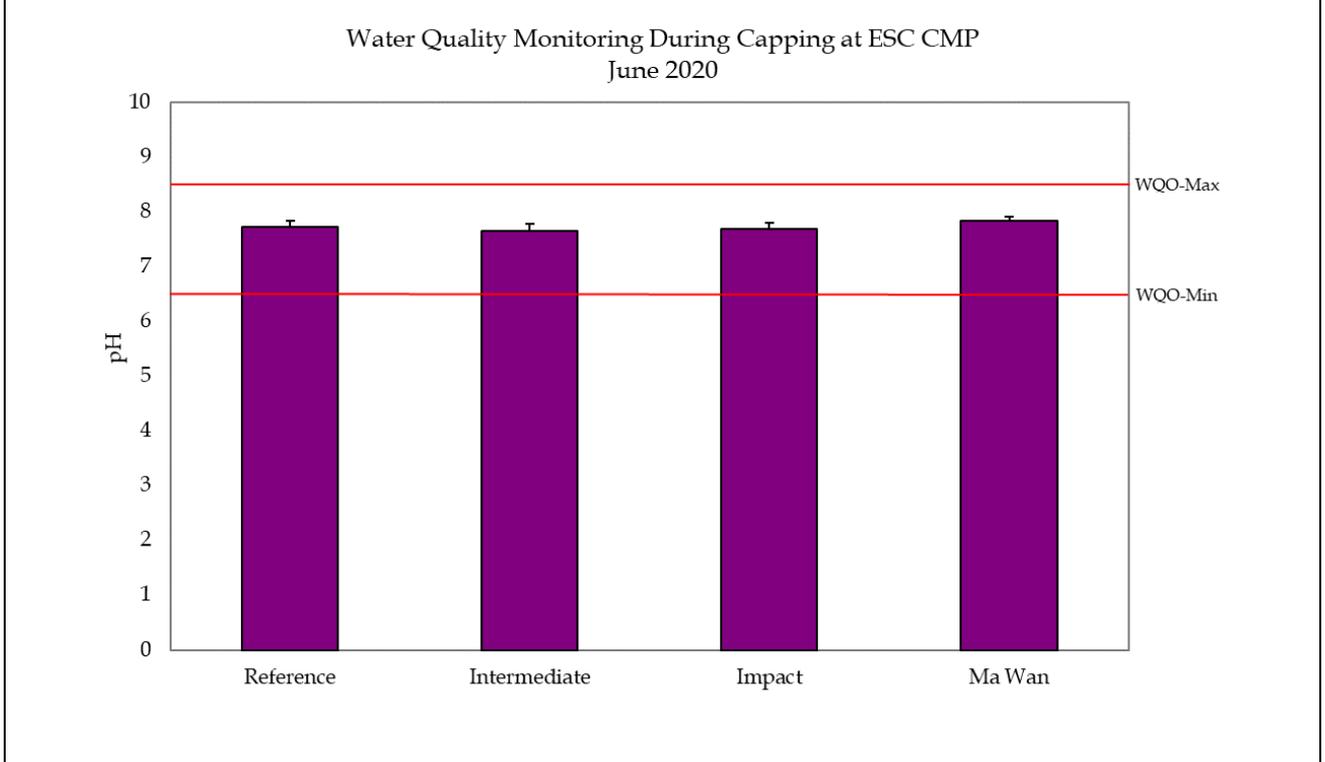


Figure 16: Levels of pH (mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\39 Monthly June 2020
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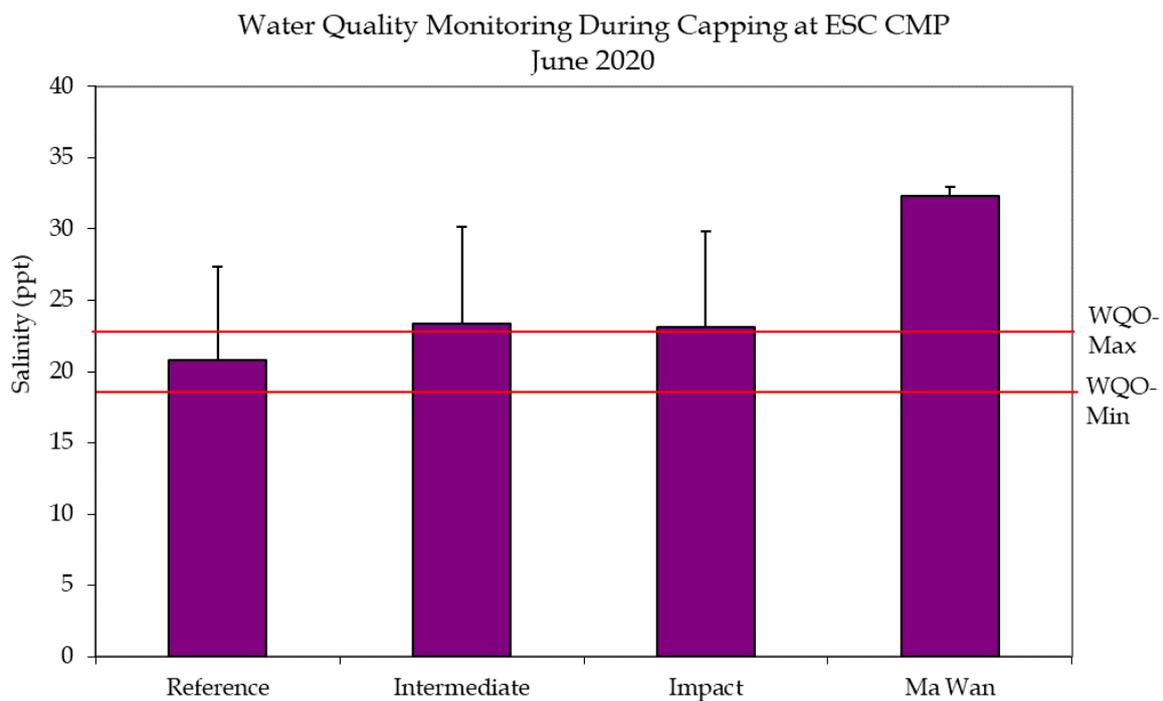


Figure 17: Levels of Salinity (ppt; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

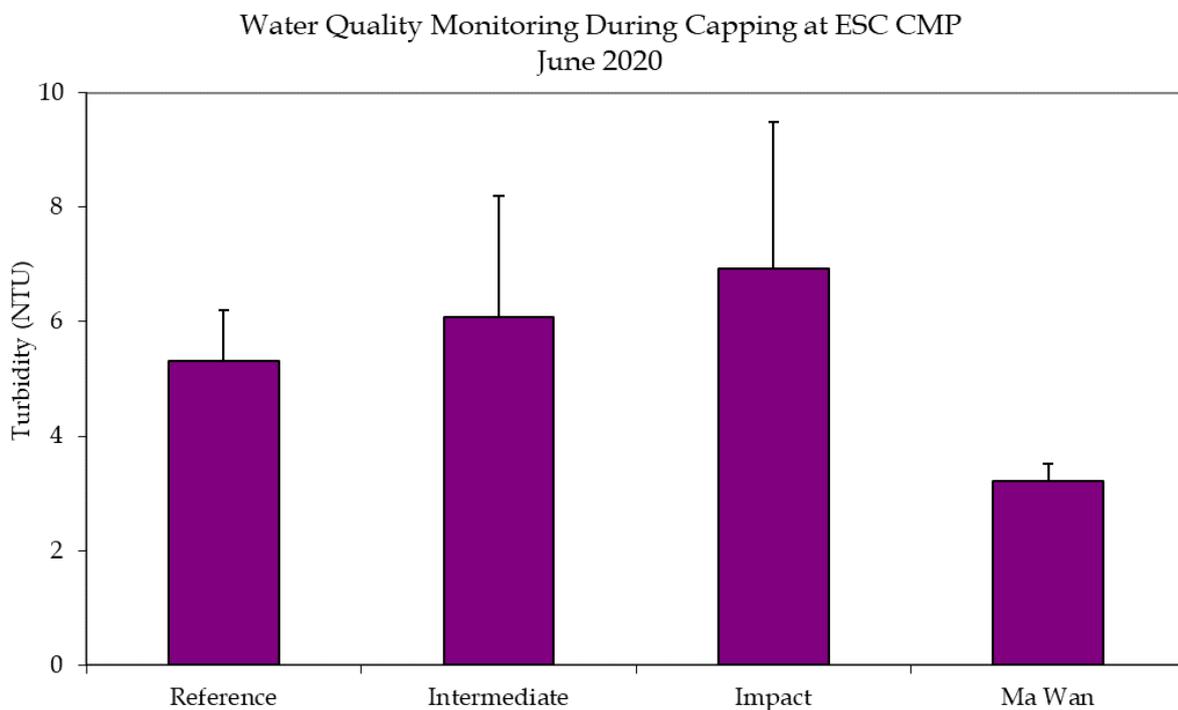


Figure 18: Levels of Turbidity (NTU; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\39 Monthly June 2020

Date: July 2020

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Water Quality Monitoring During Capping at ESC CMP
June 2020

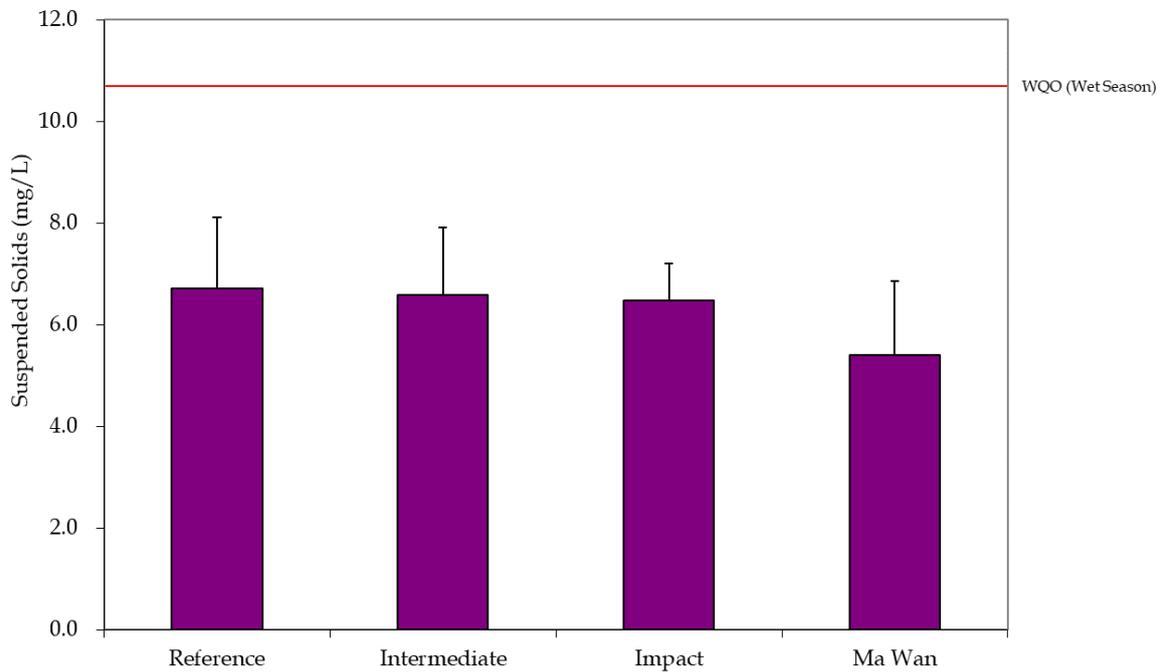


Figure 19: Levels of Suspended Solids (mg/L; mean +SD) recorded from Water Quality Monitoring during Capping of ESC CMPs in June 2020.

Source: P:\Projects\0400720 CEDD CMP EM&A 2017-2020\02 Deliverable\05 CMP Monthly Report\39 Monthly June 2020

Date: July 2020

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Annex D

Study Programme

