MOTT MACDONALD

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

Quarterly EM&A Report for
Contaminated Mud Pits to the East of Sha Chau
– April to June 2023

July 2023

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Mott MacDonald Hong Kong Limited
registered in Hong Kong no. 236497

土木工程拓展署
Civil Engineering and Development Department

MOTT MACDONALD

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:	Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – April to June 2023
Date of Report:	26 July 2023
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Reference EP Condition

Environmental Permit Condition:

Condition 3.1 of EP-312/2008/A:
The EM&A programme shall be implemented in accordance with the procedures and requirements as set out in the EM&A Manual. Any changes to the programme shall be justified by the ET leader and verified by the Independent Auditor as conforming to the information and requirements contained in the EM&A Manual before submission to the Director for approval.

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: 26 July 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: 26 July 2023

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Executive summary

Water Column Profiling, Routine Water Quality Monitoring, Pit Specific Sediment Chemistry and Cumulative Impact Sediment Chemistry were carried out for the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) during the quarterly reporting period of April to June 2023. This report presents the results of these monitoring activities to identify whether the disposal and capping operations at ESC CMP V are causing any unacceptable impact(s) to the surrounding aquatic environment or to those marine organisms that utilize these habitats.

Water Quality Monitoring for ESC CMPs

Water Column Profiling of ESC CMP Vb – April to June 2023

Results indicated that levels of Salinity, pH and DO complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream stations. Levels of SS also complied with the WQOs at most stations. Levels of DO, Turbidity and SS also complied with the Action and Limit Levels at all stations.

Overall, the results indicated that the mud disposal operation at ESC CMP Vb did not appear to cause any unacceptable impact in water quality during this reporting period.

Routine Water Quality Monitoring of ESC CMPs – April to June 2023

Results of Routine Water Quality Monitoring conducted in April, May and June 2023 showed that the levels of DO, pH and Salinity complied with the WQOs at all stations. Levels of SS also complied with the WDOs at most stations. Levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations. From the monitoring results and statistical analysis, there were no trends indicating any increase in the concentrations of contaminants with proximity to the pit or with time. Thus, it appears that mud disposal operations at ESC CMPs have not caused any unacceptable impact in water quality during the reporting period.

Sediment Quality Monitoring for ESC CMPs

Pit Specific Sediment Chemistry of ESC CMP Vb – April to June 2023

Monitoring results showed that the concentrations of most inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at most monitoring stations. Statistical analysis indicated that there did not appear any trend of increasing sediment contaminants' concentrations with proximity to the pit or with time. Thus, it appears that mud disposal operation at ESC CMP Vb have not caused any unacceptable impact in sediment quality during the reporting period.

Cumulative Impact Sediment Chemistry of ESC CMPs – June 2023

Monitoring results showed that the concentrations of most inorganic contaminants were below the LCELs at most monitoring stations. Statistical analysis indicated that there did not appear to be any significant trend of increasing concentrations of contaminants with proximity to the pit or with time. Thus, it appears that mud disposal operation at ESC CMP Vb have not caused any unacceptable impact in sediment quality during the reporting period.

行政摘要

在 2023 年 4 月至 6 月的季度報告期內，環境小組在沙洲以東海泥卸置設施進行了水層質量監察、例行水質監察、指定污泥坑沉積物化學監察及沉積物化學累積性影響監察。本報告詳述以上的環境監察結果，從而分析在沙洲以東海泥卸置設施 CMP V 的卸置及覆蓋作業有否對鄰近水體環境及利用這水體為棲身地的海洋生物造成不可接受的環境影響。

沙洲以東海泥卸置設施 (ESC CMPs)之水質監察

水層質量監察 – 2023 年 4 月至 6 月

監察結果顯示上游及下游監測站的鹽度、酸鹼值及溶解氧均符合海水水質指標。另外，大部分監測站的懸浮固體含量均符合海水水質指標。上游及下游監測站的溶解氧含量、混濁度及懸浮固體含量也符合行動及極限水平。總體而言，水層質量監察結果表明報告期內沙洲以東海泥卸置設施 CMP Vb 的污泥卸置活動沒有引致任何不可接受的水質影響。

例行水質監察 – 2023 年 4 月至 6 月

2023 年 4 月至 6 月的例行水質監察結果顯示，所有監測站的溶解氧濃度，酸鹼值及鹽度均符合海水水質指標。另外，大部分監測站的懸浮固體含量均符合海水水質指標。所有監測站的溶解氧含量，混濁度及懸浮固體含量也符合行動及極限水平。從監察數據和統計結果顯示，海水的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對周邊水體環境產生任何不可接受的水質影響。

沙洲以東海泥卸置設施 (ESC CMPs)之沉積物監察

指定污泥坑沉積物化學監察 – 2023 年 4 月至 6 月

監察結果顯示，大部分監測站的無機污染物含量均大致低於化學物質低量值。從統計結果顯示，沉積物的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對沉積物質素造成任何不可接受的影響。

沉積物化學累積性影響監察 – 2023 年 6 月

監察結果顯示，大部分監測站的無機污染物含量均大致低於化學物質低量值。從統計結果顯示，沉積物的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對沉積物質素造成任何不可接受的影響。

1 Introduction

1.1 Project Description

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. 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 present EM&A programme under Agreement No. CE 59/2020 (EP) ("the Study") covers the dredging, disposal and capping operations of the ESC CMP V (see **Appendix A** for the EM&A programme.)

1.2 Activities Conducted during the Reporting Period

Detailed works schedule for ESC CMP V is shown in **Table 1.1**. During the reporting period of April to June 2023, the following works were undertaken at the CMPs:

- 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

The records for contaminated mud disposal at ESC CMP Vb and capping operation at ESC CMP Vd during the reporting period are presented in **Appendix B1** and **B2**, respectively.

1.3 Objectives of the Monitoring and Audit Programme

The objectives of the EM&A programme are as follows:

1. To monitor and report on the environmental impacts of the dredging operations associated with the construction of the disposal pits at CMP V;
2. To monitor and report on the environmental impacts due to capping operations of the exhausted pits at CMP V;
3. To monitor and report on the environmental impacts of the disposal of contaminated marine sediments in the active pits at CMP V and specifically to determine:
   a. changes/trends caused by disposal activities in the concentrations of contaminants in sediments adjacent to the pits;
   b. changes/trends caused by disposal activities in the concentrations of contaminants in tissues of demersal marine life adjacent to and remote from the pits;
   c. impacts on water quality and benthic ecology caused by the disposal activities; and
   d. the risks to human health and dolphin of eating seafood taken in the marine area around the active pits.
4. To monitor and report on the environmental impacts of the disposal operation at CMP V and specifically to determine whether the methods of disposal are effective in minimising the risks of unacceptable environmental impacts.
5. To monitor and report on the benthic recolonisation of the capped pits at CMP V and specifically to determine the difference in infauna between the capped pits and adjacent sites.
6. To assess the impact of a major storm (Typhoon Signal No. 8 or above) on the containment of any uncapped or partially capped pits at CMP V.
7. To design and continually review the operation and monitoring programme and:
   a. to make recommendations for changes to the operation that will rectify any unacceptable environmental impacts; and
   b. to make recommendations for changes to the monitoring programme that will improve the ability to cost effectively detect environmental changes caused by the disposal activities.
8. To establish numerical decision criteria for defining impacts for each monitoring component.
9. To provide supervision on the field works and laboratory works to be carried out by contractors/laboratories.

1.4 Purpose of this Report

The purpose of this *Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – April to June 2023* is to provide information regarding the findings in the reporting period of April to June 2023 (from 1 April to 30 June 2023) on the environmental impacts resulting from backfilling operation at ESC CMP Vb and capping operation at ESC CMP Vd. Although the EM&A programme has been conducted since 1997, this report presents the analytical and statistical results of the quarterly reporting period. Results from previous monitoring will be presented and discussed in the Annual Review Report. Readers are referred to the Monthly EM&A Reports for this Study for graphical and tabular presentations of the monitoring results.

The objectives of this report are to:

- Confirm that all activities, tests, analyses, assessments etc. have been carried out as stated in the Updated EM&A Manual[3]; and
- Report on any trend resulting from dredging, backfilling and capping operations at the CMPs.

[3] ERM (2017) Updated Environmental Monitoring and Audit (EM&A) Manual. Environmental Monitoring and Audit for Contaminated Mud Pit at Sha Chau (2017-2020) – Investigation. Agreement No. CE 63/2016(EP). Submitted to EPD in July 2017.

2 Summary of EM&A Programme

2.1 EM&A Tasks

Six key elements were designed for the EM&A Programme for assessing whether key environmental parameters are being affected by dredging, backfilling and capping operations at the CMPs. Key tasks are as follows:

- Sediment Quality Monitoring;
- Sediment Toxicity Testing;
- Trawling & Tissue/Whole Body Contaminant Testing;
- Water Quality Monitoring;
- Human Health and Ecological Risk Assessment; and
- Benthic Recolonisation.

2.2 EM&A Sampling and Analysis

Details regarding the methodologies for the field sampling and laboratory analysis of the monitoring tasks listed in **Section 2.1** are presented in the Updated EM&A Manual as well as in the following sampling and laboratory analysis contracts:

- Contract No. CV/2022/05 Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Sampling (2022-2027); and
- Contract No. CV/2022/06 Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Sample Testing (2022-2027).

Lam Geotechnics Limited and ALS Technichem (HK) Pty Limited (hereinafter known as “Contractors”) were responsible for sampling under Contract No. CV/2022/05 and laboratory analysis under Contract No. CV/2022/06, respectively, during the reporting period.

3 Summary of Monitoring and Audit Activities

3.1 Sampling and Laboratory Analysis

Schedules of the EM&A programme are presented in **Appendix A**. The sampling, *in-situ* measurements and analysis of samples were conducted in accordance with the Updated EM&A Manual during this reporting period. The sampling conducted as well as the monitoring results received from the Contractors for this reporting period are shown in **Table 3.1**.

Table 3.1: Samplings Conducted and Monitoring Results Received from the Contractors for the Reporting Period

Key Task	Date of Sampling and *In-situ* Measurement	Date of Results Received from the Contractors
ESC CMPs		
Water Column Profiling of ESC CMP Vb	6 April 2023	18 April 2023
	5 May 2023	15 May 2023
	6 June 2023	16 June 2023
Routine Water Quality Monitoring of ESC CMPs	4 April 2023	21 April 2023
	4 May 2023	18 May 2023
	8 June 2023	23 June 2023
Pit Specific Sediment Chemistry of ESC CMP Vb	3 April 2023	8 May 2023
	3 May 2023	29 May 2023
	5 June 2023	20 June 2023
Cumulative Impact Sediment Chemistry of ESC CMPs	5 June 2023	20 June 2023

The monitoring results of the above environmental monitoring components for ESC CMPs have been presented in the respective Monthly EM&A Reports. The statistical analysis of these environmental monitoring components, where applicable, are presented in the following sections to report any trends caused by disposal activities at ESC CMPs during the reporting period. It should be noted that statistical analysis was not conducted for Water Column Profiling for ESC CMP Vb as the monitoring stations were mobile depending on the location of backfilling operation during the monitoring event.

4 Summary of Monitoring Results and Statistical Analysis for ESC CMPs

4.1 Water Column Profiling of ESC CMP Vb

Water Column Profiling for ESC CMP Vb was conducted once every month from April to June 2023 as presented in **Table 3.1**. A total of two (2) stations were sampled, one located 100 m Upstream and one located 100 m Downstream of the disposal area. The monitoring results indicated that levels of Salinity, pH, DO and SS complied with the WQOs at both Upstream and Downstream stations in April and May 2023. In June 2023, the SS level at the Downstream station was higher than the WQO while the SS level at the Upstream station complied with the WQO, but the levels of DO, Turbidity and SS also complied with the Action and Limit Levels at all stations during the reporting quarter.

Overall, the results indicated that the mud disposal operation at ESC CMP Vb did not appear to cause any unacceptable deterioration in water quality during this reporting period.

4.2 Routine Water Quality Monitoring of ESC CMPs

4.2.1 Background

Routine Water Quality Monitoring for ESC CMPs was conducted once every month from April to June 2023 as presented in **Table 3.1**. A total of sixteen (16) stations were sampled during ebb tide in April and May 2023 with locations of the monitoring stations presented in **Figure 4.1**; while a total of ten (10) stations were sampled during flood tide in June 2023 with locations of the monitoring stations presented in **Figure 4.2**. The disposal and capping volumes during the reporting period are detailed in **Appendix B1** and **B2**, respectively. The monitoring results showed that levels of DO, pH, Salinity and SS complied with the WQOs at most stations; the SS level was higher than the wet season WQO at Reference stations in May 2023. Nevertheless, the levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations during the reporting period.

4.2.2 Summary of Statistical Analysis

The aim of the statistical analysis is to reveal any trends of increasing concentration of contaminants with proximity to the pit or with time. Data obtained during this reporting period were statistically compared with data obtained since monitoring began at CMP V in February 2012 except for metals and metalloid of which data prior to July 2022 collected under a more conservative method were excluded, where those metals and metalloid data demonstrated no consistent project related spatial trends.

For most parameters, only low concentrations were measured throughout the study period and some parameters have majority of their recorded values below the limit of reporting. Statistical analysis was performed on parameters for which at least 60% of data were above the limit of reporting since monitoring of CMP V began in February 2012. For metals and metalloid, starting from July 2022, dissolved metal and metalloid concentrations for which at least 60% of data were detectable were taken into account in the statistical analysis to review if any trends of increasing concentration of contaminants with proximity to the pit or with time.

Improvements have been made to the statistical analysis whereby the spatio-temporal differences in in-situ parameters, dissolved metal, inorganic and organic contaminant contents were tested

by two-factor Analysis of Variance (ANOVA) separately for ebb tide and flood tide. Area and Period were treated as fixed factors under investigation.

Should spatial trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent SNK post-hoc tests, further evaluation would be conducted to evaluate if the mud disposal activities were causing consistent and adverse impact to the water body. If potential concern was detected by SNK results for consecutive reporting months, linear regression analyses would be performed to examine the temporal change of contaminant levels in each area over the concerned months in consideration of tidal effects. Further analysis may also include assessing the concentration variation between stations. Details regarding the statistical analysis results are presented in **Appendix C**.

4.2.3 In-situ Measurements

Dissolved Oxygen (DO)

DO levels varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of decreasing concentrations of DO with proximity to the pit. DO levels were generally the highest at Impact stations for ebb tide, and were similar at Reference and Intermediate stations for flood tide, thus there was no significant project related impact.

Turbidity

Turbidity levels varied significantly with sampling periods and areas during ebb tide and flood tide. During ebb tide, the relationship between turbidity levels and proximity to the pit (i.e. Area) indicated a significant overall spatial trend due to historic data from past reporting quarters. No potential project related spatial trend was detected within this reporting quarter. During flood tide, the turbidity levels were generally similar at Impact, Reference and Intermediate stations, thus there was no significant project related impact.

4.2.4 Metals and Metalloid

Statistical analysis was performed for both ebb and flood tides data of all dissolved metal and metalloid contaminants except Lead and Silver which had high percentage of their values not detected (i.e. > 60% of values were not detected from July 2022 to June 2023). The concentration of Copper, Nickel, and Zinc varied significantly over sampling periods and area. Other dissolved metal and metalloid varied significantly over either sampling periods or area as indicated by results of the ANOVA tests (**Appendix C**). There were no consistent project related spatial trends detected for all dissolved metals and metalloid, and the concentrations were generally the highest at Reference and Intermediate stations.

4.2.5 Inorganic Contaminants

Ammonia Nitrogen (NH_3-N)

NH_3-N concentrations varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of increasing concentrations of NH_3-N with proximity to the pit. Concentrations of NH_3-N were generally similar at all stations and slightly higher at Ma Wan station, thus there was no significant project related impact.

Total Inorganic Nitrogen (TIN)

TIN concentrations varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of increasing concentrations of TIN with proximity to the pit. Concentrations of TIN at Reference and Impact stations were generally similar, thus there was no significant project related impact.

5-Day Biochemical Oxygen Demand (BOD_5)

Levels of BOD_5 varied significantly with sampling periods and areas during ebb tide and flood tide. There was no consistent spatial trend of increasing concentrations of BOD_5 with proximity to the pit. Levels of BOD_5 were generally the highest at Reference and Ma Wan stations.

Suspended Solids (SS)

SS levels varied significantly with sampling periods and areas during ebb tide and flood tide. During ebb tide, the relationship between SS levels and proximity to the pit (i.e. Area) indicated a significant overall spatial trend, but no potential project related spatial trend was detected in this reporting period, thus there was no evidence showing consistent project related impact. During flood tide, there was no consistent spatial trend of increasing SS levels with proximity to the pit, where SS levels were generally the highest at Reference stations.

4.2.6 Conclusions

Overall, results of statistical analyses for the water quality data did not appear to provide any evidence of unacceptable water quality impacts caused by the mud disposal and capping operations at CMP V of the ESC area.

4.3 Pit Specific Sediment Chemistry of ESC CMP Vb

4.3.1 Background

Pit Specific Sediment Chemistry of ESC CMP Vb was conducted once every month from April to June 2023 as presented in **Table 3.1**. A total of six (6) monitoring stations for ESC CMP Vb were sampled in each monitoring event and the monitoring locations are shown in **Figure 4.3**. The monitoring results showed that the concentrations of most inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at most stations from April to June 2023, except for Arsenic, Copper and Silver. In April 2023, 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 were higher than LCEL at Active-Pit station ESC-NPCB. In May 2023, 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. In June 2023, 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.

4.3.2 Summary of Statistical Analysis

Statistical analysis was performed for data obtained from Pit Specific Sediment Chemistry of ESC CMP Vb since February 2020. Improved statistical tests were run to examine the difference in contaminant concentrations between Active-Pit, Pit-Edge and Near-Pit stations and between sampling periods. ANOVA was employed as the statistical test, with Period, Area, and Direction as fixed factors.

Should temporal trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent SNK post-hoc tests for consecutive reporting months, further evaluation would be conducted to evaluate if the mud disposal activities were causing consistent and adverse impact to the sediment quality. Linear regression analyses would be performed to examine the temporal change of contaminant levels in each area over the concerned months. Detailed results of statistical analysis are presented in **Appendix C**.

Metals and Metalloids

There were significant spatial and temporal variations in the concentrations of all metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver and Zinc). No potential project related spatial trend was detected for the reporting months for all metal and metalloid contaminants, except for Nickel during ebb tide in April 2023. Detailed analysis was conducted to further confirm the result, and there appears no evidence of consistent spatial trend of increasing contaminant concentrations with proximity to the pit over time.

For Nickel during ebb tide in April 2023, regression analysis was performed for ebb tide data and it is observed that the concentration of Nickel in May 2023 returned to a lower level, and it is considered that the contaminant was well dispersed. Therefore, there is no evidence indicating consistent or increasing project related impact over time.

Organic Contaminants

Concentrations of majority of organic contaminants were below their limits of reporting. Statistical analyses were only performed for contaminants for which 60% of data were over their limits of reporting.

In this reporting period, only Total Organic Carbon (TOC) concentrations were statistically analysed. Levels of TOC varied significantly with sampling periods and areas. No potential project related spatial trend was detected for the reporting months. Therefore, there is no evidence indicating consistent or increasing project related impact over time.

4.3.3 Conclusions

From the results of the above statistical analyses, there did not appear to be any significant trend of increasing sediment contaminants' concentrations with proximity to the pit or with time. Therefore, 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.

4.4 Cumulative Impact Sediment Chemistry of ESC CMPs

4.4.1 Background

Cumulative Impact Sediment Chemistry of ESC CMPs was conducted in June 2023 as presented in **Table 3.1**. A total of nine (9) monitoring stations were sampled and the monitoring locations are shown in **Figure 4.4**. The monitoring results showed that the concentrations of most inorganic contaminants were below the LCELs at most monitoring stations in June 2023, except the concentrations of Arsenic which 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.

4.4.2 Summary of Statistical Analysis

Data obtained during this reporting period were statistically compared with previous data obtained since monitoring began for ESC CMPs in June 2016. Improved statistical tests were run to examine the difference in contaminant concentrations amongst Near-Field, Mid-Field, Far-Field stations. ANOVA was employed as the statistical test, with Area and Station as fixed factors.

Should spatial trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent SNK post-hoc tests for a considerable period over the whole sampling period, further evaluation would be conducted to evaluate if the mud disposal activities were causing consistent and adverse cumulative impact to the sediment quality. Regression analysis would be performed to examine the potential increase on the sediment contaminant concentration over time. Detailed results of statistical analysis are presented in **Appendix C**.

Metals and Metalloid

There were significant spatial variations in the concentrations of all metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver and Zinc), but no consistent spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) was observed. In most cases, metal concentrations were the highest at Ma Wan or Mid-Field stations, thus there was no significant project related impact.

Organic Contaminants

Concentrations of the majority of organic contaminants were below their limits of reporting. Statistical analyses were only performed for contaminants for which 60% of data were over their limits of reporting.

In this reporting period, only TOC concentrations were statistically analysed. Levels of TOC varied significantly with sampling area and time, with generally higher concentrations recorded at Ma Wan station. There was no consistent spatial trend of increasing concentrations of TOC with proximity to the pit.

4.4.3 Conclusions

From the results of the above statistical analysis, there did not appear to be any significant trend of increasing sediment contaminants' concentrations with proximity to the pit or over time. Therefore, 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.

5 Findings of the Field Events and Laboratory Tests and Analyses by the Independent Auditor

The next inspection of Independent Auditor (IA) is tentatively scheduled on 7 July 2023 for the Demersal Trawling exercise, the inspection results and comments will be presented in the next Quarterly EM&A Report.

6 Future Key Issues

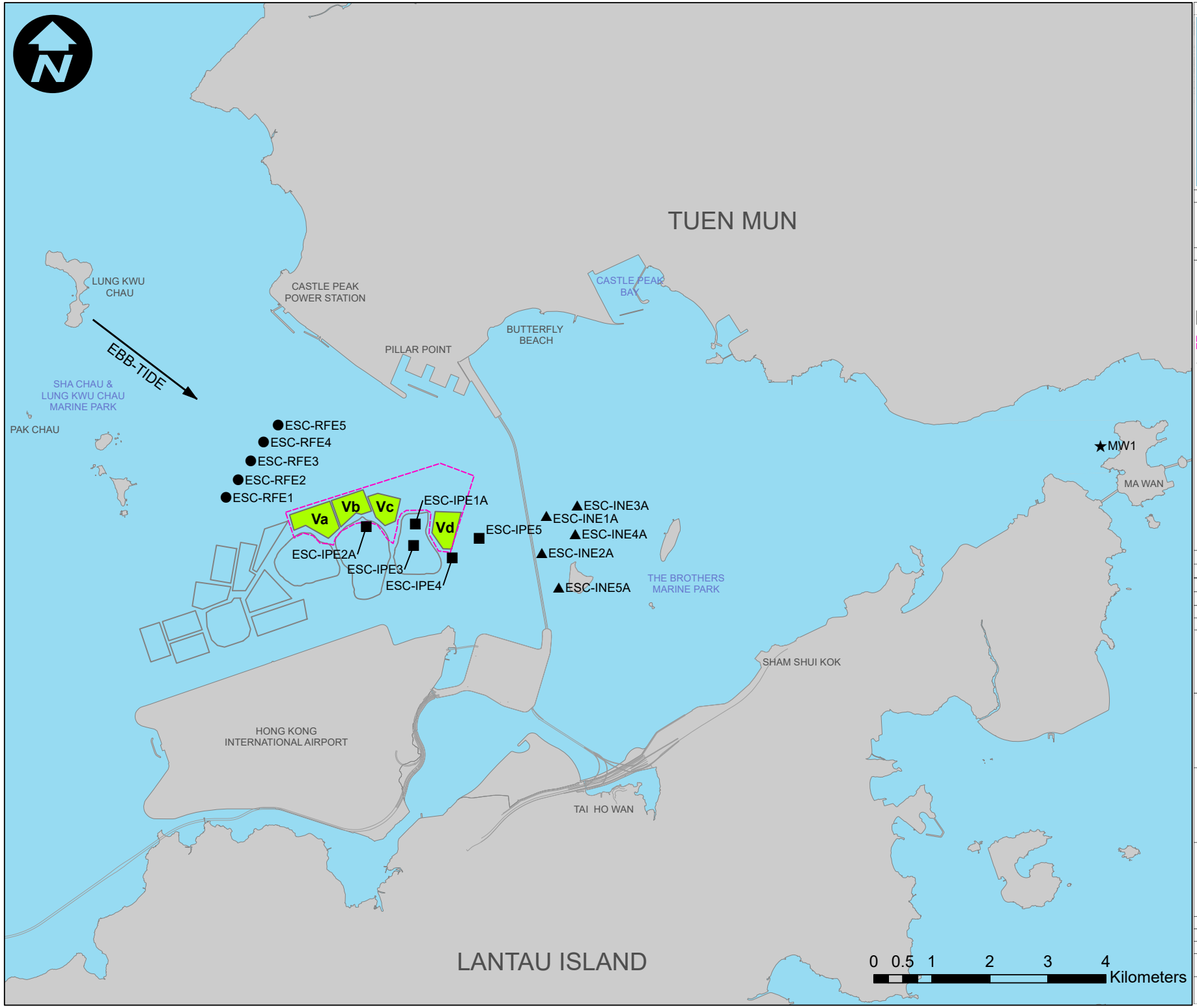
6.1 Activities Scheduled for the Next Reporting Period

The following monitoring activities will be conducted in the next quarterly reporting period of July to September 2023 for ESC CMPs including:

- Water Column Profiling of ESC CMP Vb in July, August and September 2023;
- Routine Water Quality Monitoring of ESC CMPs in July, August and September 2023;
- Pit Specific Sediment Chemistry of ESC CMP Vb in July, August and September 2023;
- Cumulative Impact Sediment Chemistry of ESC CMPs in August 2023;
- Demersal Trawling for ESC CMPs in July and August 2023; and
- Sediment Toxicity Test of ESC CMPs in August 2023.

The sampling schedule for ESC CMPs is presented in **Appendix A**.

Figures



Key Plan:

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'k'd	App'd
P1	APR 2021	KN			

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

Project

AGREEMENT NO. CE 59/2020 (EP) ENVIRONMENTAL MONITORING AND AUDIT FOR DISPOSAL FACILITY TO THE EAST OF SHA CHAU (2021-2026) – INVESTIGATION

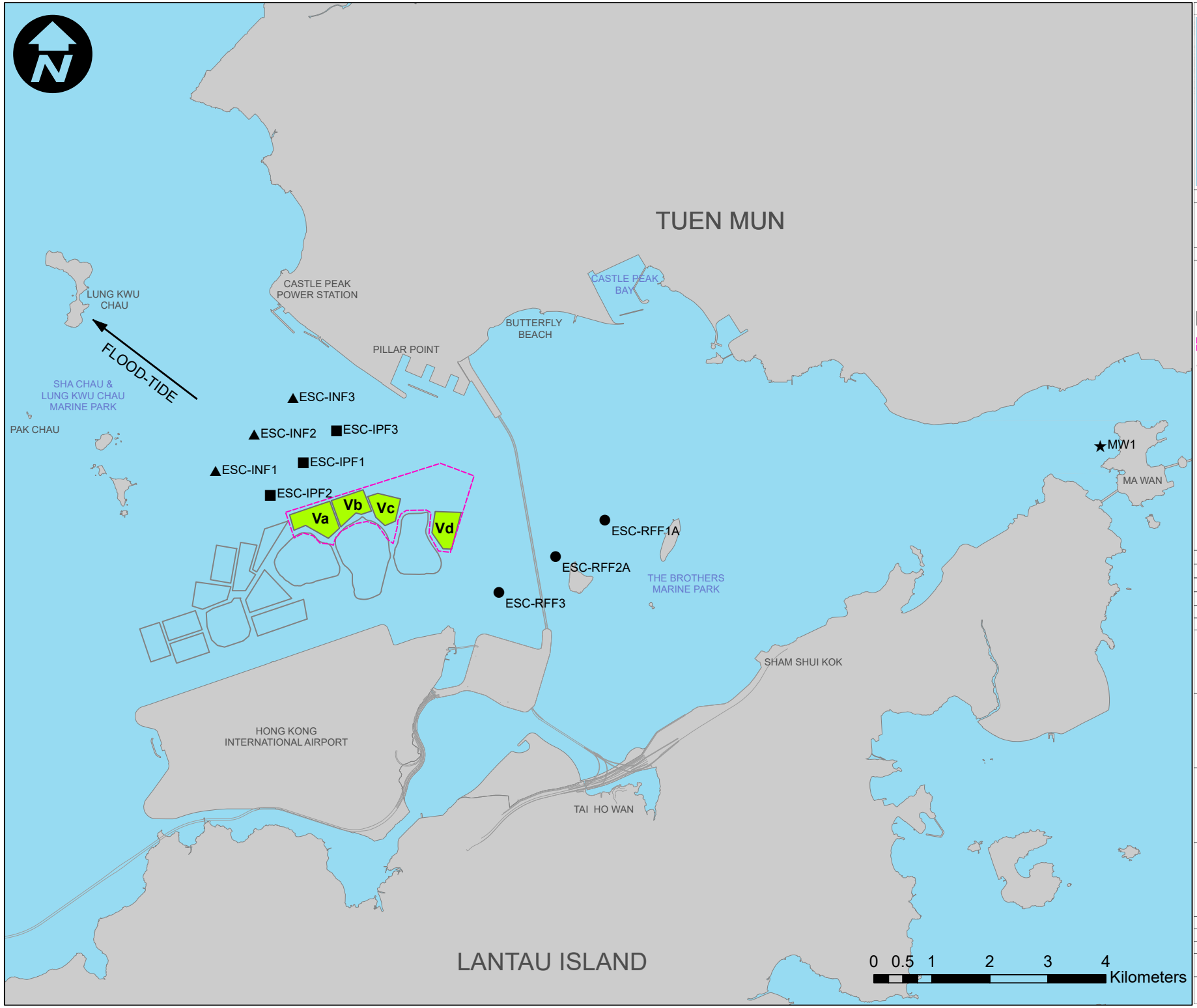
Title

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

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 4.1



Key Plan:

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

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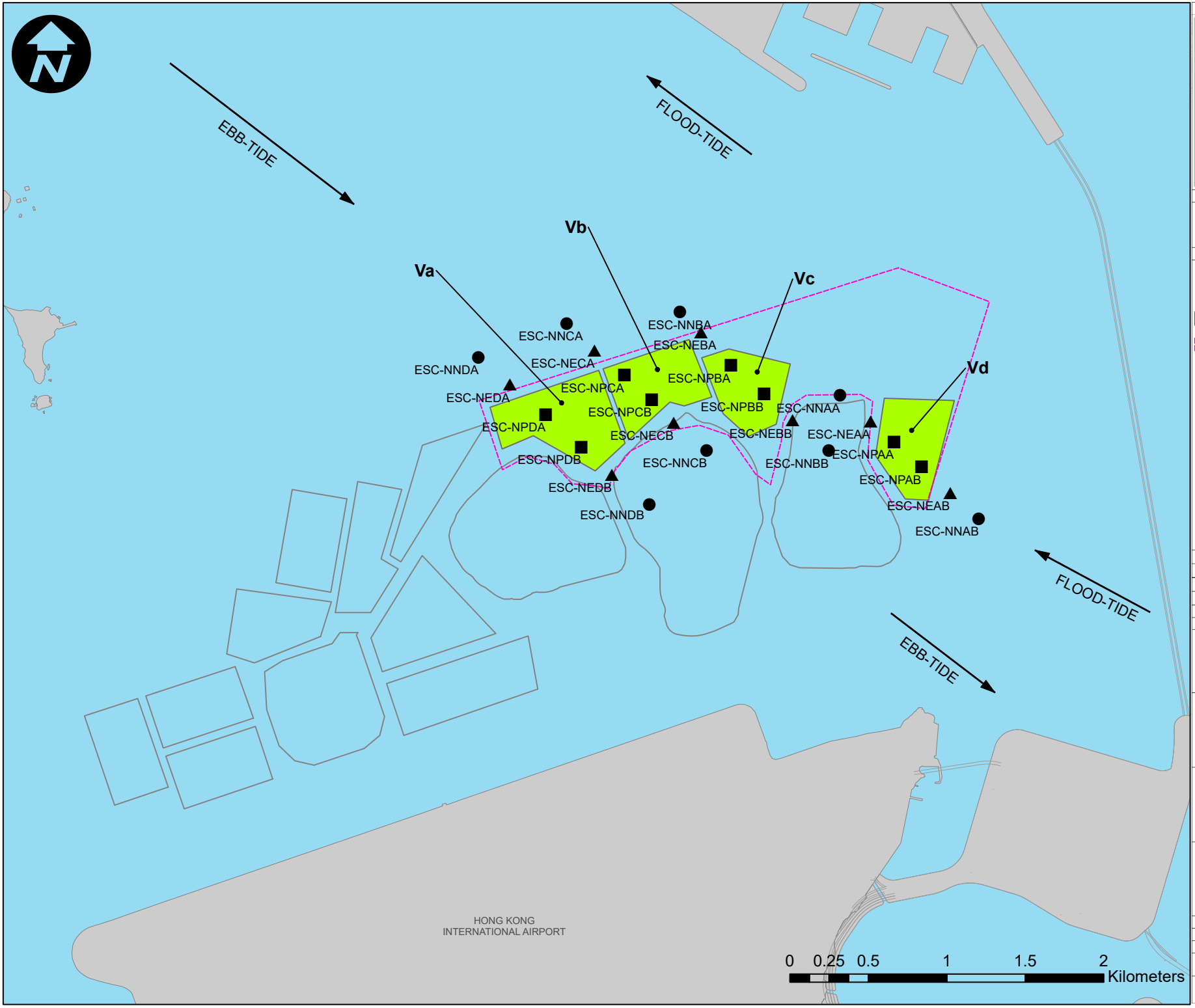
Title

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

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 4.2



Key Plan:

Notes:

Key to symbols:

LEGEND

ESC CMP V

ESC USABLE AREA 1

PIT SPECIFIC SEDIMENT MONITORING STATIONS

ACTIVE-PIT STATION

PIT-EDGE STATION

NEAR-PIT STATION

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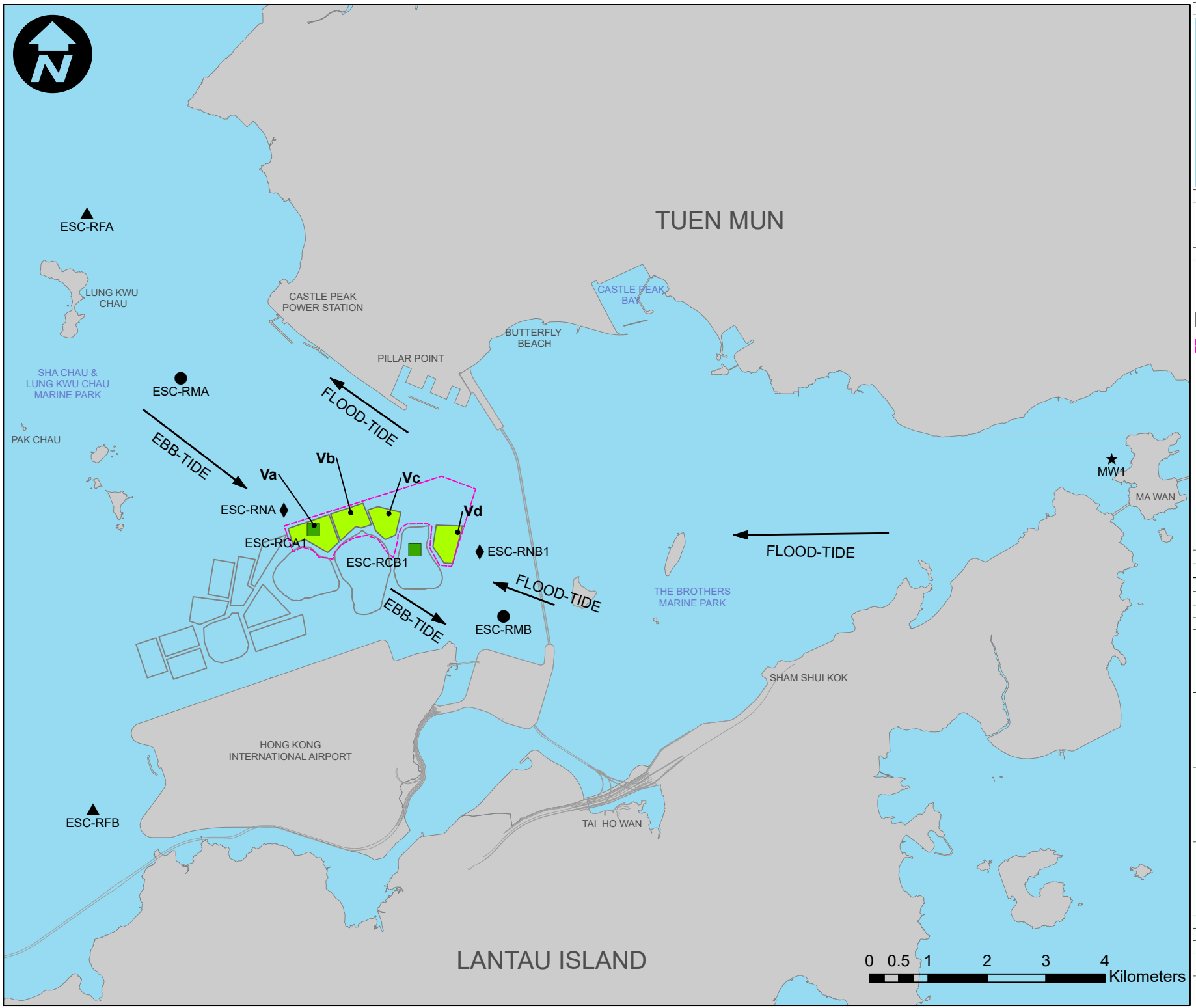
Title

PIT SPECIFIC SEDIMENT QUALITY MONITORING STATIONS FOR CMP V

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 4.3



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

CUMULATIVE IMPACT SEDIMENT MONITORING STATIONS

- CAPPED PIT STATION
- NEAR-FIELD STATION
- MID-FIELD STATION
- FAR-FIELD STATION
- MA WAN STATION

Rev	Date	Drawn	Description	Ch'k'd	App'd
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Title

CUMULATIVE IMPACTS SEDIMENT QUALITY MONITORING STATIONS FOR ESC CMPS

Designed			Eng check		
Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 4.4

Appendices

Appendix A Sampling Schedule

Appendix B Disposal and Capping Records

Appendix C Statistical Analysis

Appendix A. Sampling Schedule

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

Parameter / Station Type	Station ID	Frequency	2021 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2022 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2023 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2024 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2025 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2026 Jan	Feb	Mar
Pit Specific Sediment Chemistry *																																																																
Active-Pit																																																																
	ESC-NPAA	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	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-NPAB	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Pit-Edge																																																																
	ESC-NEAA	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	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-NEAB	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Near-Pit																																																																
	ESC-NNAA	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	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-NNAB	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cumulative Impact Sediment Chemistry *																																																																
Near-field Stations																																																																
	ESC-RNA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RNB1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Mid-field Stations																																																																
	ESC-RMA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RMB	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Capped Pit Stations																																																																
	ESC-RCA1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RCB1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Far-field Stations																																																																
	ESC-RFA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RFB	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Ma Wan Station																																																																
	MW1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Sediment Toxicity Tests																																																																
Near-pit Stations																																																																
	ESC-TDA	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
	ESC-TDB1	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
Reference Stations																																																																
	ESC-TRA	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
	ESC-TRB	2 times per year		5						5							5#					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 Sampling																																																																
Near-pit Stations																																																																
	ESC-INA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	ESC-INB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Reference North																																																																
	TNA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	TNB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Reference South																																																																
	TSA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	TSB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Demersal Trawling																																																																
Near-pit Stations																																																																
	ESC-INA	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	
	ESC-INB	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	
Reference North																																																																
	TNA	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	
	TNB	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	
Reference South																																																																
	TSA	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	
	TSB	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	
Capping *																																																																
Ebb Tide																																																																
Impact Station Downcurrent																																																																
	ESC-IPE1A	4 times per year *																																																															
	ESC-IPE2A	4 times per year *																																																															
	ESC-IPE3	4 times per year *																																																															
	ESC-IPE4	4 times per year *																																																															
	ESC-IPE5	4 times per year *																																																															
Intermediate Station Downcurrent																																																																
	ESC-INE1A	4 times per year *																																																															
	ESC-INE2A	4 times per year *																																																															
	ESC-INE3A	4 times per year *																																																															
	ESC-INE4A	4 times per year *																																																															
	ESC-INE5A	4 times per year *																																																															
Reference Station Upcurrent																																																																
	ESC-RFE1	4 times per year *																																																															
	ESC-RFE2	4 times per year *																																																															
	ESC-RFE3	4 times per year *																																																															
	ESC-RFE4	4 times per year *																																																															
	ESC-RFE5	4 times per year *																																																															
Ma Wan Station																																																																
	MW1	4 times per year *																																																															
Flood Tide																																																																
Impact Station Downcurrent																																																																
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	ESC-IPF2	4 times per year *																																																															
	ESC-IPF3	4 times per year *																																																															
Intermediate Station Downcurrent																																																																
	ESC-INF1	4 times per year *																																																															
	ESC-INF2	4 times per year *																																																															
	ESC-INF3	4 times per year *																																																															
Reference Station Upcurrent																																																																
	ESC-RFF1A	4 times per year *																																																															
	ESC-RFF2A	4 times per year *																																																															
	ESC-RFF3	4 times per year *																																																															
Ma Wan Station																																																																
	MW1	4 times per year *																																																															
Routine Water Quality Monitoring *																																																																
Ebb Tide																																																																
Impact Station Downcurrent																																																																
	ESC-IPE1A	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
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	ESC-IPE3	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
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	ESC-IPE5	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
Intermediate Station Downcurrent																																																																
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	ESC-INE2A	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
	ESC-INE3A	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
	ESC-INE4A	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
	ESC-INE5A	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
Reference Station Upcurrent																																																																
	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
	ESC-RFE2	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
	ESC-RFE3	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
	ESC-RFE4	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
	ESC-RFE5	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
Ma Wan Station																																																																
	MW1	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
Flood Tide																																																																
Impact Station Downcurrent																																																																
	ESC-IPF1	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
	ESC-IPF2	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
	ESC-IPF3	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
Intermediate Station Downcurrent																																																																
	ESC-INF1	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
	ESC-INF2	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
	ESC-INF3	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
Reference Station Upcurrent																																																																
	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
	ESC-RFF2A	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
	ESC-RFF3	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
Ma Wan Station																																																																
	MW1	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
Water Column Profiling *																																																																
Plume Stations																																																																
	WCP1	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
	WCP2	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
Benthic Recoloinisation Studies																																																																
Capped Stations at CMP V																																																																
	ESCV-CPA	2 times per year																																																															
	ESCV-CPB	2 times per year																																																															
	ESCV-CPC	2 times per year																																																															
	ESCV-CPD	2 times per year																																																															
Reference Stations																																																																
	RBA	2 times per year																																																															
	RBB	2 times per year																																																															
	RBC1	2 times per year																																																															
Impact Monitoring for Dredging																																																																
Upstream Stations																																																																
	US1	3 times per week														2	2	2	2	2																																													
	US2	3 times per week														2	2	2	2	2																																													
Downstream Stations																																																																
	DS1	3 times per week														2	2	2	2	2																																													
	DS2	3 times per week														2	2	2	2	2																																													
	DS3	3 times per week														2	2	2	2	2																																													
	DS4	3 times per week														2	2	2	2	2																																													
	DS5	3 times per week														2	2	2	2	2																																													
Ma Wan Station																																																																
	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 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 and 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 are combined such that 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 has been effective for the EM&A activities since July 2022.

Due to the logistic problem induced by the pandemic which adversely affecting the supply of international species adopted in testing programme of Sediment Toxicity Tests, as such, Sediment Toxicity Tests of ESC CMPs originally scheduled in February 2022 were postponed to March 2022.

^ To enable the required Research Fishing Permit could be granted by the time undertaking the Demersal Trawling, trawling originally scheduled in July and August 2022 was postponed to August and September 2022.

Appendix B. Disposal and Capping Records

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Apr 2023	650	930,533
2 Apr 2023	0	930,533
3 Apr 2023	0	930,533
4 Apr 2023	0	930,533
5 Apr 2023	0	930,533
6 Apr 2023	650	931,183
7 Apr 2023	0	931,183
8 Apr 2023	0	931,183
9 Apr 2023	0	931,183
10 Apr 2023	0	931,183
11 Apr 2023	0	931,183
12 Apr 2023	650	931,833
13 Apr 2023	650	932,483
14 Apr 2023	650	933,133
15 Apr 2023	650	933,783
16 Apr 2023	0	933,783
17 Apr 2023	650	934,433
18 Apr 2023	650	935,083
19 Apr 2023	650	935,733
20 Apr 2023	650	936,383
21 Apr 2023	650	937,033
22 Apr 2023	660	937,693
23 Apr 2023	0	937,693
24 Apr 2023	647	938,340
25 Apr 2023	650	938,990
26 Apr 2023	650	939,640
27 Apr 2023	1,319	940,959
28 Apr 2023	1,562	942,521
29 Apr 2023	502	943,023
30 Apr 2023	0	943,023

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 May 2023	0	943,023
2 May 2023	708	943,731
3 May 2023	1,160	944,891
4 May 2023	650	945,541
5 May 2023	2,113	947,654
6 May 2023	0	947,654
7 May 2023	0	947,654
8 May 2023	607	948,261
9 May 2023	650	948,911
10 May 2023	1,138	950,049
11 May 2023	650	950,699
12 May 2023	650	951,349
13 May 2023	1,321	952,670
14 May 2023	0	952,670
15 May 2023	650	953,320
16 May 2023	1,313	954,633
17 May 2023	650	955,283
18 May 2023	1,378	956,661
19 May 2023	652	957,313
20 May 2023	0	957,313
21 May 2023	0	957,313
22 May 2023	0	957,313
23 May 2023	640	957,953
24 May 2023	0	957,953
25 May 2023	0	957,953
26 May 2023	0	957,953
27 May 2023	363	958,316
28 May 2023	0	958,316
29 May 2023	0	958,316
30 May 2023	0	958,316
31 May 2023	0	958,316

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Jun 2023	639	958,955
2 Jun 2023	0	958,955
3 Jun 2023	575	959,530
4 Jun 2023	0	959,530
5 Jun 2023	0	959,530
6 Jun 2023	0	959,530
7 Jun 2023	24	959,554
8 Jun 2023	552	960,106
9 Jun 2023	0	960,106
10 Jun 2023	0	960,106
11 Jun 2023	0	960,106
12 Jun 2023	49	960,155
13 Jun 2023	0	960,155
14 Jun 2023	0	960,155
15 Jun 2023	0	960,155
16 Jun 2023	492	960,647
17 Jun 2023	525	961,172
18 Jun 2023	0	961,172
19 Jun 2023	0	961,172
20 Jun 2023	532	961,704
21 Jun 2023	0	961,704
22 Jun 2023	0	961,704
23 Jun 2023	0	961,704
24 Jun 2023	549	962,253
25 Jun 2023	0	962,253
26 Jun 2023	0	962,253
27 Jun 2023	0	962,253
28 Jun 2023	0	962,253
29 Jun 2023	388	962,641
30 Jun 2023	483	963,124

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Apr 2023	3,195	485,547
2 Apr 2023	2,452	487,999
3 Apr 2023	4,695	492,694
4 Apr 2023	5,356	498,050
5 Apr 2023	2,786	500,836
6 Apr 2023	1,810	502,646
7 Apr 2023	1,703	504,349
8 Apr 2023	969	505,318
9 Apr 2023	2,850	508,168
10 Apr 2023	2,326	510,494
11 Apr 2023	2,305	512,799
12 Apr 2023	2,607	515,406
13 Apr 2023	2,110	517,516
14 Apr 2023	2,638	520,154
15 Apr 2023	1,758	521,912
16 Apr 2023	868	522,780
17 Apr 2023	1,559	524,339
18 Apr 2023	0	524,339
19 Apr 2023	2,211	526,550
20 Apr 2023	2,844	529,394
21 Apr 2023	2,590	531,984
22 Apr 2023	973	532,957
23 Apr 2023	2,563	535,520
24 Apr 2023	506	536,026
25 Apr 2023	3,187	539,213
26 Apr 2023	641	539,854
27 Apr 2023	0	539,854
28 Apr 2023	1,079	540,933
29 Apr 2023	0	540,933
30 Apr 2023	0	540,933

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 May 2023	0	540,933
2 May 2023	0	540,933
3 May 2023	2,536	543,469
4 May 2023	0	543,469
5 May 2023	984	544,453
6 May 2023	0	544,453
7 May 2023	999	545,452
8 May 2023	648	546,100
9 May 2023	636	546,736
10 May 2023	1,081	547,817
11 May 2023	647	548,464
12 May 2023	647	549,111
13 May 2023	621	549,732
14 May 2023	2,453	552,185
15 May 2023	0	552,185
16 May 2023	2,260	554,445
17 May 2023	1,288	555,733
18 May 2023	1,294	557,027
19 May 2023	648	557,675
20 May 2023	2,121	559,796
21 May 2023	1,290	561,086
22 May 2023	1,295	562,381
23 May 2023	1,287	563,668
24 May 2023	3,035	566,703
25 May 2023	1,262	567,965
26 May 2023	1,903	569,868
27 May 2023	1,265	571,133
28 May 2023	1,277	572,410
29 May 2023	0	572,410
30 May 2023	2,318	574,728
31 May 2023	648	575,376

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Jun 2023	648	576,024
2 Jun 2023	1,603	577,627
3 Jun 2023	638	578,265
4 Jun 2023	643	578,908
5 Jun 2023	1,288	580,196
6 Jun 2023	641	580,837
7 Jun 2023	646	581,483
8 Jun 2023	1,928	583,411
9 Jun 2023	1,434	584,845
10 Jun 2023	1,287	586,132
11 Jun 2023	1,734	587,866
12 Jun 2023	641	588,507
13 Jun 2023	649	589,156
14 Jun 2023	1,293	590,449
15 Jun 2023	645	591,094
16 Jun 2023	648	591,742
17 Jun 2023	648	592,390
18 Jun 2023	635	593,025
19 Jun 2023	635	593,660
20 Jun 2023	647	594,307
21 Jun 2023	648	594,955
22 Jun 2023	647	595,602
23 Jun 2023	2,396	597,998
24 Jun 2023	1,883	599,881
25 Jun 2023	1,295	601,176
26 Jun 2023	1,669	602,845
27 Jun 2023	0	602,845
28 Jun 2023	1,292	604,137
29 Jun 2023	646	604,783
30 Jun 2023	1,297	606,080

Appendix C. Statistical Analysis

Routine Water Quality Monitoring for ESC CMPs – Statistical Analysis up to June 2023

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	144.99	40	353.85	**
Area	0.80	3	25.95	**
Period:Area	7.78	120	6.33	**
Residuals	49.67	4849		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result[1]:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan}\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact < Intermediate < Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	6015.94	40	1173.92	**
Area	63.45	3	165.07	**
Period:Area	61.55	120	4.00	**
Residuals	407.41	3180		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\left.\begin{matrix}\text{Reference} = \text{Intermediate} \\ \text{Reference, Intermediate} > \text{Impact} > \text{Ma Wan}\end{matrix}\right\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact < Intermediate < Reference) were detected for all months over the study period.

[1] The overall result represents the SNK tests on fixed factor Area.

Turbidity

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2172.28	40	275.59	**
Area	151.48	3	256.24	**
Period:Area	286.75	120	12.13	**
Residuals	955.52	4849		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan}\ \}$ ∴ potential overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Apr 2012, Aug 2012, Apr 2013, May 2016, Apr 2017, Apr 2020, Nov 2021
- No potential project related spatial trend detected for the reporting months.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	90018.81	40	117.17	**
Area	3487.69	3	60.53	**
Period:Area	13284.63	120	5.76	**
Residuals	61077.72	3180		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Impact} = \text{Reference} = \text{Intermediate} \\ \text{Impact, Reference, Intermediate} > \text{Ma Wan}\end{array}\right\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Arsenic

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2.22	5	39.86	**
Area	0.04	3	1.20	N.S.
Period:Area	0.28	15	1.70	N.S.
Residuals	1.88	169		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Impact} = \text{Intermediate} = \text{Reference} \\ \text{Ma Wan} > \text{Impact, Intermediate, Reference}\end{array}\right\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	4.59	5	32.62	**
Area	0.05	3	0.59	N.S.
Period:Area	1.41	15	3.34	**
Residuals	2.70	96		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\text{Reference} = \text{Impact} = \text{Intermediate} = \text{Ma Wan}\}$ ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Cadmium

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0086	5	8.8179	**
Area	0.0010	3	1.6511	N.S.
Period:Area	0.0042	15	1.4323	N.S.
Residuals	0.0331	169		

Note:

1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  Reference = Intermediate = Impact = Ma Wan} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0047	5	4.1807	**
Area	0.0002	3	0.3538	N.S.
Period:Area	0.0031	15	0.9296	N.S.
Residuals	0.0216	96		

Note:

1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  Intermediate = Ma Wan = Impact = Reference} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Chromium

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	10.32	5	18.07	**
Area	0.08	3	0.24	N.S.
Period:Area	2.40	15	1.40	N.S.
Residuals	19.30	169		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  Impact = Intermediate = Reference = Ma Wan} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1.25	5	4.28	**
Area	0.28	3	1.60	N.S.
Period:Area	0.94	15	1.08	N.S.
Residuals	5.60	96		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  Ma Wan = Intermediate = Reference = Impact} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Copper

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	10.66	5	53.70	**
Area	0.54	3	4.55	**
Period:Area	1.36	15	2.28	**
Residuals	6.71	169		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{r}\text{Impact} = \text{Intermediate} = \text{Reference} \\ \text{Impact, Intermediate, Reference} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1.83	5	10.35	**
Area	1.23	3	11.59	**
Period:Area	1.03	15	1.95	**
Residuals	3.39	96		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{r}\text{Impact} = \text{Reference} = \text{Ma Wan} \\ \text{Intermediate} > \text{Impact, Reference, Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Mercury

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1.34×10^{-04}	5	5.01	**
Area	2.92×10^{-06}	3	0.18	N.S.
Period:Area	7.14×10^{-05}	15	0.89	N.S.
Residuals	9.04×10^{-04}	169		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Impact = Reference = Intermediate = Ma Wan} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0029	5	308.59	**
Area	1.09×10^{-05}	3	1.94	N.S.
Period:Area	1.14×10^{-04}	15	4.04	**
Residuals	1.80×10^{-04}	96		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Reference = Intermediate = Ma Wan = Impact} ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Nickel

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	8.93	5	127.80	**
Area	0.47	3	11.27	**
Period:Area	0.53	15	2.55	**
Residuals	2.36	169		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Reference} = \text{Impact} = \text{Intermediate} \\ \text{Reference, Impact, Intermediate} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	3.93	5	43.25	**
Area	1.01	3	18.45	**
Period:Area	0.39	15	1.43	N.S.
Residuals	1.75	96		

Note:

3. Assume Gamma distribution
4. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Intermediate} = \text{Impact} = \text{Reference} \\ \text{Intermediate, Impact, Reference} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Zinc

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	21.55	5	8.46	**
Area	14.74	3	9.65	**
Period:Area	26.97	15	3.53	**
Residuals	86.03	169		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Intermediate} = \text{Impact} = \text{Reference} \\ \text{Intermediate, Impact, Reference} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	5.15	5	5.15	**
Area	8.59	3	14.34	**
Period:Area	9.36	15	3.12	**
Residuals	19.18	96		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Reference} = \text{Impact} = \text{Intermediate} \\ \text{Ma Wan} > \text{Reference, Impact, Intermediate}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months since July 2022.

Ammonia Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1076.62	40	332.77	**
Area	16.61	3	68.43	**
Period:Area	101.79	120	10.49	**
Residuals	312.94	3869		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Ma Wan = Reference = Impact = Intermediate } ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	849.74	40	115.51	**
Area	7.12	3	12.91	**
Period:Area	62.46	120	2.83	**
Residuals	454.99	2474		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Ma Wan = Reference = Intermediate = Impact } ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Total Inorganic Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	560.72	40	471.80	**
Area	21.98	3	246.58	**
Period:Area	40.08	120	11.24	**
Residuals	114.95	3869		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{c}\text{Impact} = \text{Reference} \\ \text{Impact, Reference} > \text{Intermediate} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	651.80	40	316.97	**
Area	12.33	3	79.94	**
Period:Area	41.34	120	6.70	**
Residuals	127.18	2474		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{c}\text{Reference} = \text{Intermediate} = \text{Impact} \\ \text{Reference, Intermediate, Impact} > \text{Ma Wan}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

BOD_5

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	570.52	40	109.88	**
Area	14.35	3	36.85	**
Period:Area	191.08	120	12.27	**
Residuals	502.22	3869		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{c}\text{Reference} = \text{Ma Wan} \\ \text{Impact} = \text{Intermediate} \\ \text{Reference, Ma Wan} > \text{Impact, Imtermediate}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	652.71	40	169.82	**
Area	21.78	3	75.54	**
Period:Area	153.33	120	13.30	**
Residuals	237.72	2474		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\text{Ma Wan} > \text{Reference} > \text{Intermediate} > \text{Impact}\ \} \ \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Impact > Intermediate > Reference) were detected for all months over the study period.

Suspended Solids

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	887.60	40	245.70	**
Area	41.68	3	153.84	**
Period:Area	147.32	120	13.59	**
Residuals	349.42	3869		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\text{Impact} > \text{Intermediate} > \text{Reference} > \text{Ma Wan}\ \}$ ∴ potential overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Apr 2012, Aug 2012, May 2016, Jul 2017, Jul 2018, Apr 2020, May 2021
- No potential project related spatial trend were detected for the reporting months.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	642.82	40	162.84	**
Area	15.84	3	53.51	**
Period:Area	124.03	120	10.47	**
Residuals	244.16	2474		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  $\left.\begin{matrix}\text{Intermediate} = \text{Impact} \\ \text{Reference} > \text{Intermediate}, \text{Impact} > \text{Ma Wan}\end{matrix}\right\}$ ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Impact > Intermediate > Reference):
  - Nov 2012, Jul 2013, Nov 2017, Aug 2018, Dec 2020, Sep 2021
- No potential project related spatial trend were detected for the reporting months.

Pit Specific Sediment Chemistry for ESC CMPs – Statistical Analysis up to June 2023

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	80.70	40	121.09	**
Area	8.09	2	242.88	**
Direction	8.62	1	517.21	**
Period:Area	18.12	80	13.59	**
Period:Direction	6.42	40	9.63	**
Area:Direction	8.31	2	249.47	**
Period:Area:Direction	16.96	80	12.73	**
Residuals	21.69	1302		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Pit Edge} > \text{Active Pit} \\ \text{Pit Edge} > \text{Near Pit} \\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction[2]
  - Flood Tide: Jun 2021, Aug 2021
  - Ebb Tide: Feb 2020, Nov 2020, Jul 2021, Mar 2022, Apr 2022[3], Jun 2022, Jul 2022, Aug 2022
- No potential project related spatial trend were detected for the reporting months.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	79.40	40	18.66	**
Area	116.01	2	545.30	**
Direction	1.62	1	15.19	**
Period:Area	59.31	80	6.97	**
Period:Direction	29.09	40	6.84	**
Area:Direction	36.07	2	169.53	**
Period:Area:Direction	43.93	80	5.16	**
Residuals	138.50	1302		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

$$\left.\begin{array}{l}\text{Pit Edge} = \text{Near Pit} \\ \text{Active Pit} > \text{Pit Edge} \\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for all months over the study period.

[2] Direction: Stations located at downstream of the active pit during corresponding tide.

[3] Circled months represents consecutive months with significant spatial trend.

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	33.63	40	57.48	**
Area	21.45	2	733.27	**
Direction	6.29	1	429.95	**
Period:Area	9.22	80	7.88	**
Period:Direction	4.21	40	7.19	**
Area:Direction	16.92	2	578.31	**
Period:Area:Direction	7.72	80	6.60	**
Residuals	19.04	1302		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Pit Edge}\\ \text{Pit Edge} > \text{Near Pit}\\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{potential overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Mar 2020, Oct 2020, Nov 2020, Dec 2020, Apr 2021, May 2021, Jun 2021, July 2021, Aug 2021, Oct 2021, Nov 2021, Dec 2021, Apr 2022, May 2022, July 2022
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023
- No potential project related spatial trend were detected for the reporting months.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	34.10	40	24.70	**
Area	189.26	2	2742.14	**
Direction	17.44	1	505.24	**
Period:Area	29.99	80	10.86	**
Period:Direction	16.55	40	11.99	**
Area:Direction	52.08	2	754.56	**
Period:Area:Direction	37.13	80	13.45	**
Residuals	44.93	1302		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit}\\ \text{Near Pit} > \text{Pit Edge}\\ \text{Active Pit} > \text{Pit Edge}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jul 2020, Oct 2020, May 2021, Jan 2023
  - Ebb Tide: Jul 2020, Oct 2020, Sep 2021, Jan 2022, Feb 2022
- No potential project related spatial trend were detected for the reporting months.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	18.05	40	13.60	**
Area	28.45	2	428.54	**
Direction	8.14	1	245.33	**
Period:Area	13.11	80	4.94	**
Period:Direction	4.75	40	3.58	**
Area:Direction	8.60	2	129.50	**
Period:Area:Direction	6.63	80	2.50	**
Residuals	43.21	1302		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Active Pit} > \text{Pit Edge}\\ \text{Pit Edge} > \text{Near Pit}\\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{Potential overall significant project related impact.}$$

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jun 2020, Jul 2020, Aug 2020, Sep 2020, Oct 2020, Nov 2020, Dec 2020, Apr 2021, May 2021, Jun 2021, Aug 2021, Oct 2021, Nov 2021, Dec 2021, Jan 2022, Feb 2022, Mar 2022, Jul 2022
  - Ebb Tide: May 2020, Jul 2020, Mar 2021, May 2021, Jun 2021, Sep 2021, Oct 2021, Jan 2022, Feb 2022, Jun 2022, Jul 2022, Sep 2022, Mar 2023
- No potential project related spatial trend were detected for the reporting months.

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	137.06	40	15.89	**
Area	111.75	2	259.08	**
Direction	75.04	1	347.97	**
Period:Area	75.13	80	4.35	**
Period:Direction	37.54	40	4.35	**
Area:Direction	104.09	2	241.34	**
Period:Area:Direction	38.81	80	2.25	**
Residuals	280.78	1302		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:

$$\left.\begin{array}{l}\text{Pit Edge} = \text{Near Pit}\\ \text{Active Pit} > \text{Pit Edge}\\ \text{Active Pit} > \text{Near Pit}\end{array}\right\} \therefore \text{no overall significant project related impact.}$$

- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for all months over the study period.

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Period	26.75	40	68.51	**
Area	21.72	2	1112.52	**
Direction	13.10	1	1341.91	**
Period:Area	10.52	80	13.48	**
Period:Direction	5.75	40	14.72	**
Area:Direction	20.81	2	1066.29	**
Period:Area:Direction	8.57	80	10.98	**
Residuals	12.71	1302		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

  Active Pit > Pit Edge
  Active Pit > Near Pit
  Pit Edge > Near Pit
  } ∴ Potential overall significant project related impact.

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Mar 2020, Oct 2020, Nov 2020, Dec 2020, Apr 2021, May 2021, Jun 2021, Jul 2021, Aug 2021, Oct 2021, Nov 2021, Dec 2021, Apr 2022, May 2022, Jul 2022
  - Ebb Tide: Jun 2020, Jul 2020, Oct 2020, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023, Apr 2023
- Potential project related spatial trend was detected in one month for ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Mar-23	0.87	0.83	28.50	-2.36	**
Apr-23	0.74	0.68	28.08	-1.76	**

Note: Linear regression analysis on spatial changes of contaminant concentrations in ebb tide direction for the two consecutive months with significant spatial trend.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	189.66	40	54.66	**
Area	338.67	2	1952.10	**
Direction	3.47	1	40.06	**
Period:Area	75.80	80	10.92	**
Period:Direction	36.41	40	10.49	**
Area:Direction	40.37	2	232.70	**
Period:Area:Direction	61.47	80	8.86	**
Residuals	112.94	1302		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit) were detected for all months over the study period.

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Period	19.64	40	42.48	**
Area	54.10	2	2339.60	**
Direction	3.52	1	304.89	**
Period:Area	15.44	80	16.69	**
Period:Direction	7.17	40	15.51	**
Area:Direction	9.07	2	392.46	**
Period:Area:Direction	10.91	80	11.79	**
Residuals	15.05	1302		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Jun 2020, Jul 2020, Oct 2020, Nov 2020, Apr 2021, May 2021, Feb 2022, Nov 2022, Jan 2023
  - Ebb Tide: Apr 2020, Jun 2020, Jul 2020, Oct 2020, Mar 2021, May 2021, Jun 2021, Sep 2021, Feb 2022, Jun 2022, Jul 2022, Mar 2023
- No potential project related spatial trend were detected for the reporting months.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	113.76	40	145.05	**
Area	69.25	2	1765.95	**
Direction	8.38	1	427.24	**
Period:Area	43.67	80	27.84	**
Period:Direction	14.36	40	18.31	**
Area:Direction	11.44	2	291.85	**
Period:Area:Direction	30.08	80	19.18	**
Residuals	25.53	1302		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:

  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  } ∴ no overall significant project related impact.

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Apr 2020, May 2020, Aug 2020, Oct 2020, May 2021, Jun 2021, Jul 2021, Sep 2021, Nov 2021, Feb 2022, Mar 2022, Jul 2022, Aug 2022, Jan 2023
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021, Oct 2021, Jul 2022, Feb 2023, Mar 2023
- No potential project related spatial trend were detected for the reporting months.

Cumulative Sediment Chemistry for ESC CMPs – Statistical Analysis up to June 2023

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	70.51	28	128.11	**
Area	102.53	4	1304.09	**
Period:Area	67.47	112	30.65	**
Residuals	44.21	2249		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  - Mid-Field > Far-Field > Ma Wan > Near-Field > Capped-pit, ∴no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	72.49	28	21.89	**
Area	68.16	4	144.07	**
Period:Area	57.44	112	4.34	**
Residuals	266.02	2249		

Note:

1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:

- Overall result:
  - Mid-Field = Far-Field = Ma Wan = Near-Field = Capped-pit, ∴no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	11142.38	28	41.85	**
Area	79403.93	4	2087.48	**
Period:Area	18696.68	112	17.55	**
Residuals	21386.92	2249		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	13091.53	28	15.50	**
Area	263867.07	4	2187.29	**
Period:Area	27977.36	112	8.28	**
Residuals	67827.81	2249		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	33459.25	28	85.16	**
Area	77167.75	4	1374.85	**
Period:Area	20673.04	112	13.15	**
Residuals	31558.08	2249		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	417.52	28	33.56	**
Area	51.85	4	29.18	**
Period:Area	229.19	112	4.61	**
Residuals	999.13	2249		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan = Capped-pit = Far-Field = Mid-Field = Near-Field, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Period	3408.88	28	27.62	**
Area	29109.01	4	1651.21	**
Period:Area	9486.08	112	19.22	**
Residuals	9911.86	2249		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	176.08	28	38.49	**
Area	812.27	4	1243.03	**
Period:Area	87.61	112	4.79	**
Residuals	367.41	2249		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field = Far-Field = Near-Field = Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Period	17.53	28	26.50	**
Area	146.41	4	1549.26	**
Period:Area	49.20	112	18.59	**
Residuals	53.14	2249		

Note:
1. Assume Gamma distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Far-Field > Mid-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2114511902	28	49.77	**
Area	3661674339	4	603.26	**
Period:Area	3988436808	112	23.47	**
Residuals	3412748796	2249		

Note:
1. Assume Gaussian distribution
2. N.S.: No significant difference; **: Significant difference (P-value < 0.05)

SNK Results:
- Overall result:
  - Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-pit, ∴ no overall significant project related impact.
- No potential project related spatial trend (i.e. Capped-pit > Near-Field > Mid-Field > Far-Field) were detected for all months over the study period.