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
– October to December 2023

February 2024

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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 – October to December 2023
Date of Report:	6 February 2024
Date prepared by ET:	6 February 2024
Date received by IA:	6 February 2024

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): Thomas Chan Date: 6 February 2024

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~~): Wen Xiong Wang Date: 6 February 2024

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Water Column Profiling, Routine Water Quality Monitoring, Pit Specific Sediment Chemistry, Cumulative Impact Sediment Chemistry and Sediment Chemistry after a Major Storm were carried out for the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) during the quarterly reporting period of October to December 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 – October to December 2023

Results indicated that levels of Salinity, pH, DO and SS complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream 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 – October to December 2023

Results of Routine Water Quality Monitoring conducted in October, November and December 2023 showed that the levels of DO, pH and SS complied with the WQOs at all stations. Levels of Salinity also complied with the WQOs 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 – October to December 2023

Monitoring results showed that the concentrations of most inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) and Upper Chemical Exceedance Levels (UCELs) 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 – December 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.

Sediment Chemistry after a Major Storm of ESC CMP V – October 2023

Sampling for Sediment Chemistry after a Major Storm Event as conducted for ESC CMPs on 11 October 2023 after the visit of tropical cyclone Koinu, which led to the issue of No. 8 Storm Signal on 9 October 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. Overall, there appeared to be no evidence showing the failure of CMPs in retaining disposed mud or causing contamination of sediments after the major storm event in October 2023.

行政摘要

在 2023 年 10 月至 12 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、沉積物化學累積性影響監察及強颱風後的沉積物質素監察。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 10 月至 12 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 10 月至 12 月

2023 年 10 月至 12 月的例行水質監察結果顯示，所有監測站的溶解氧濃度，酸鹼值及懸浮固體含量均符合海水水質指標。另外，大部分監測站的鹽度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 10 月至 12 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及化學物質高量值。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 12 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。

強颱風後的沉積物質素監察 – 2023 年 10 月

強烈熱帶風暴小犬於 2023 年 10 月 9 日吹襲香港，並在 2023 年 10 月 9 日發出 8 號烈風或暴風信號。在強颱風過後，環境小組在 2023 年 10 月 11 日在沙洲以東海泥卸置設施附近範圍採集沉積物樣本作分析。監察結果顯示大部分的無機污染物含量在所有監測站均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。總體而言，沒有證據顯示 2023 年 10 月強颱風導致污泥從泥坑擴散或引起沉積物污染。

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 October to December 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 – October to December 2023* is to provide information regarding the findings in the reporting period of October to December 2023 (from 1 October to 31 December 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 Oct 2023	17 Oct 2023
	8 Nov 2023	17 Nov 2023
	7 Dec 2023	15 Dec 2023
Routine Water Quality Monitoring of ESC CMPs	5 Oct 2023	19 Oct 2023
	9 Nov 2023	23 Nov 2023
	6 Dec 2023	20 Dec 2023
Pit Specific Sediment Chemistry of ESC CMP Vb	4 Oct 2023	9 Nov 2023
	7 Nov 2023	24 Nov 2023
	4 Dec 2023	22 Dec 2023
Cumulative Impact Sediment Chemistry of ESC CMPs	5 Dec 2023	22 Dec 2023
Sediment Chemistry After a Major Storm	11 Oct 2023	30 Oct 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 October to December 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 October, November and December 2023.

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 October to December 2023 as presented in **Table 3.1**. A total of sixteen (16) stations were sampled during ebb tide in November 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 October and December 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; while higher salinity levels were recorded at Ma Wan station in October 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 December 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 October to December 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 October to December 2023, except for Arsenic for all reporting months and Chromium, Copper, Nickel, Lead, Zinc, Mercury and Silver at Active-Pit stations in December 2023. In October 2023, 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. In November 2023, 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-NPCA. In December 2023, concentrations of Chromium were higher than the LCELs at Active-Pit station ESC-NPCA; concentrations of Copper were higher than the Upper Chemical Exceedance Levels (UCELs) at Active-Pit stations ESC-NPCA and ESC-NPCB; and the concentration of Nickel, Lead, Zinc, Mercury and Silver were higher than the UCELs at Active-Pit station ESC-NPCA; as well as the concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge stations ESC-NECA and ESC-NECB.

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 Chromium, Copper, Lead, Nickel and Zinc.

Consecutive potential project related trend was observed for Lead, detailed regression 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.

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. Potential project related spatial trend was detected during flood tide in October and December 2023 and ebb tide in December 2023, but no significant spatial trend was detected in consecutive month. 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 December 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 December 2023, except concentrations of Arsenic were higher than the LCEL at Near-field stations ESC-RNB1, Mid-field stations ESC-RMA, and Far-field stations ESC-RFA, ESC-RFB. as well as concentrations of Silver were higher than the LCEL at 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.

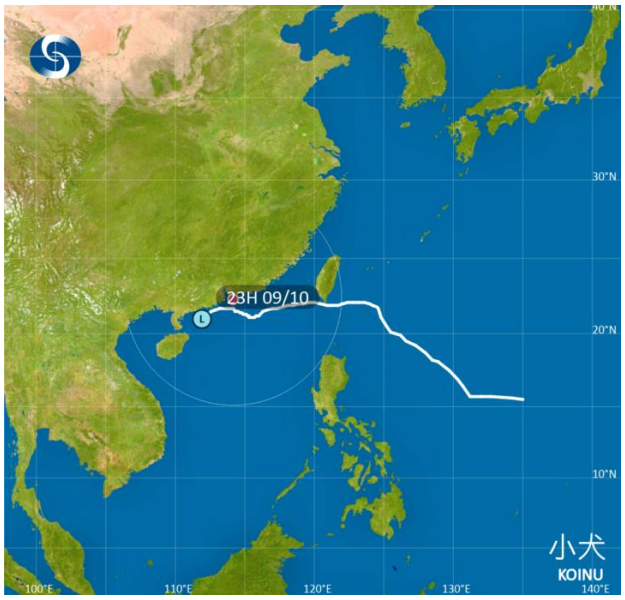
4.5 Sediment Chemistry after a Major Storm of ESC CMPs

4.5.1 Background

Sampling for Sediment Chemistry after a Major Storm of ESC CMPs was conducted at nine (9) monitoring stations (see **Figure 4.5** for the monitoring locations) on 11 October 2023 after the visit of tropical cyclone Koinu which led to the issue of No. 8 Storm Signal on 9 October 2023. The track of Koinu is shown in **Photo 4.1**.

The monitoring results showed that the concentrations of all inorganic contaminants were below the LCEL in October 2023, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Mid-field stations ESC-RMA and Far-field stations ESC-RFB.

Photo 4.1: Track of Tropical Cyclone Koinu (Source: Hong Kong Observatory)



4.5.2 Summary of Statistical Analyses

The data obtained were examined using statistical analyses. Statistical tests were run on inorganic contaminants, including Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Mercury, Silver and Zinc to examine differences in their sediment concentrations between Near-Field, Mid-Field, Far-Field, Capped-Pit and Ma Wan stations. A single-factor Analyses of Variance was employed as the statistical test, with Area as fixed factor.

Should spatial trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit) be detected by ANOVA and subsequent post-hoc tests, further evaluation such as linear regression would be performed to examine the significance of the trend. Detailed results of statistical analyses are presented in **Appendix C**.

4.5.3 Conclusions

In October 2023, results of the statistical analyses indicated that concentrations of all contaminants show significant differences amongst sampling areas. However, there did not appear to be any trend of increasing contaminant's concentrations with proximity to the pit (i.e. Capped-pit > Near-field > Mid-field > Far-field). Therefore, results of statistical analyses do not provide any evidence of the failure of ESC CMP Vd in retaining disposed mud or causing contamination of sediments after the major storm event in October 2023.

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

During the reporting period, the Independent Auditor (IA) conducted an inspection for laboratory testing and analysis on 16 November 2023. The visit included the inspection of sampling treatments and equipment, especially regarding the QA/QC. The IA was generally satisfied with the laboratory analysis and confirmed that the requirements as stated in the EM&A Manual were implemented accordingly.

6 Future Key Issues

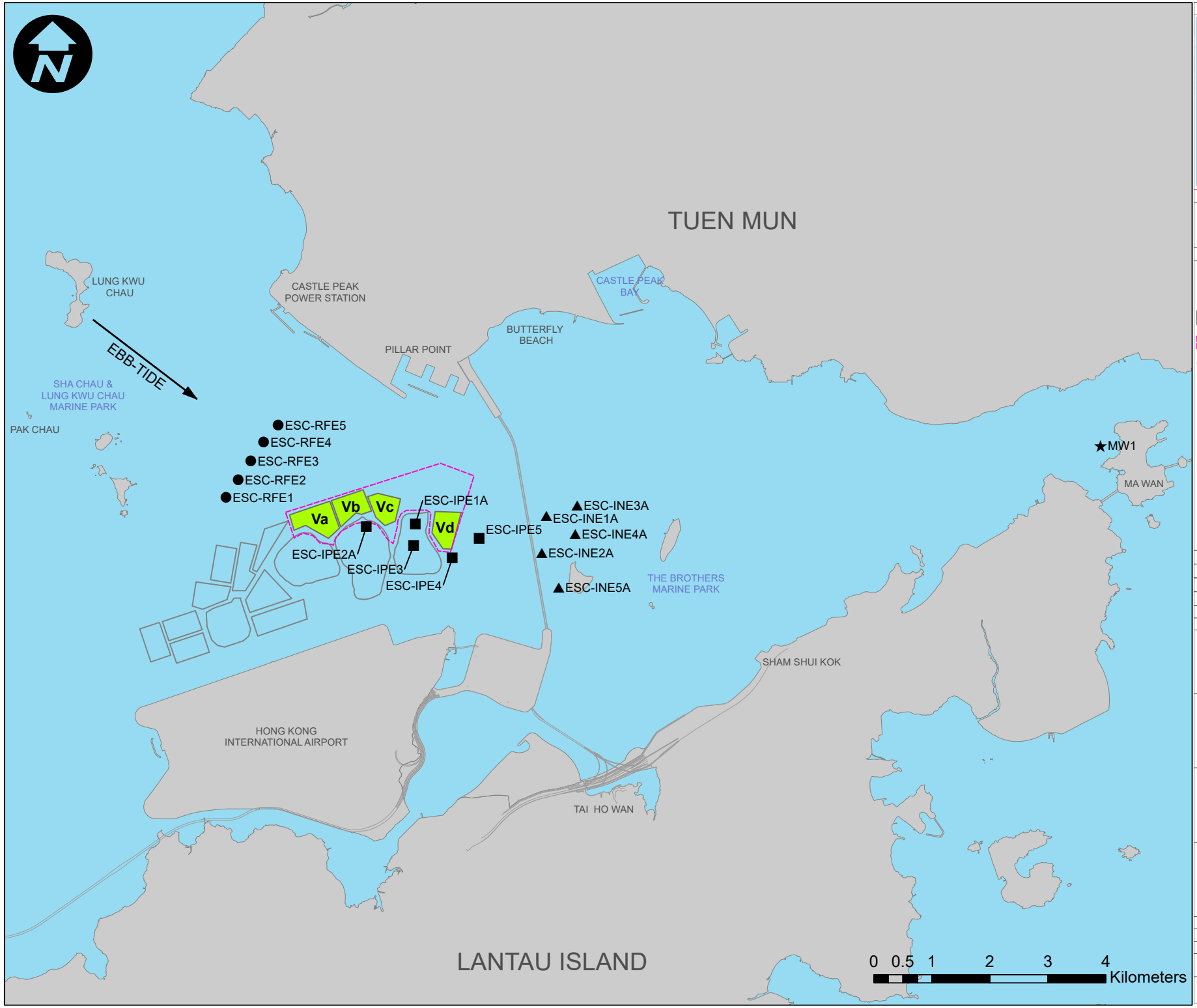
6.1 Activities Scheduled for the Next Reporting Period

The following monitoring activities will be conducted in the next quarterly reporting period of January to March 2024 for ESC CMPs including:

- Water Column Profiling of ESC CMP Vb in January, February and March 2024;
- Routine Water Quality Monitoring of ESC CMPs in January, February and March 2024;
- Pit Specific Sediment Chemistry of ESC CMP Vb in January, February and March 2024;
- Cumulative Impact Sediment Chemistry of ESC CMPs in February 2024;
- Sediment Toxicity Test of ESC CMPs in February 2024; and
- Demersal Trawling for ESC CMPs in January and February 2024.

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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Project

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

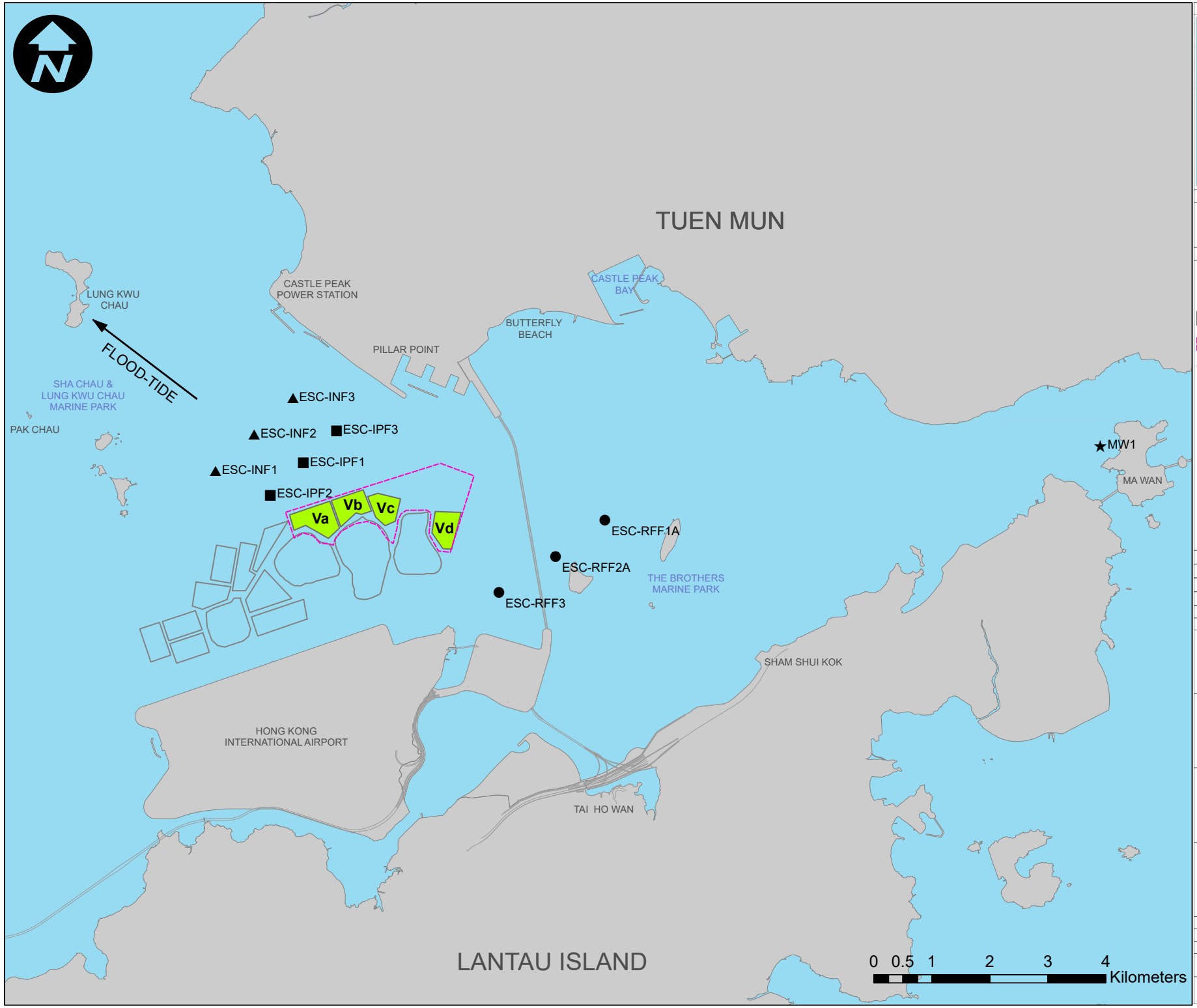
Title

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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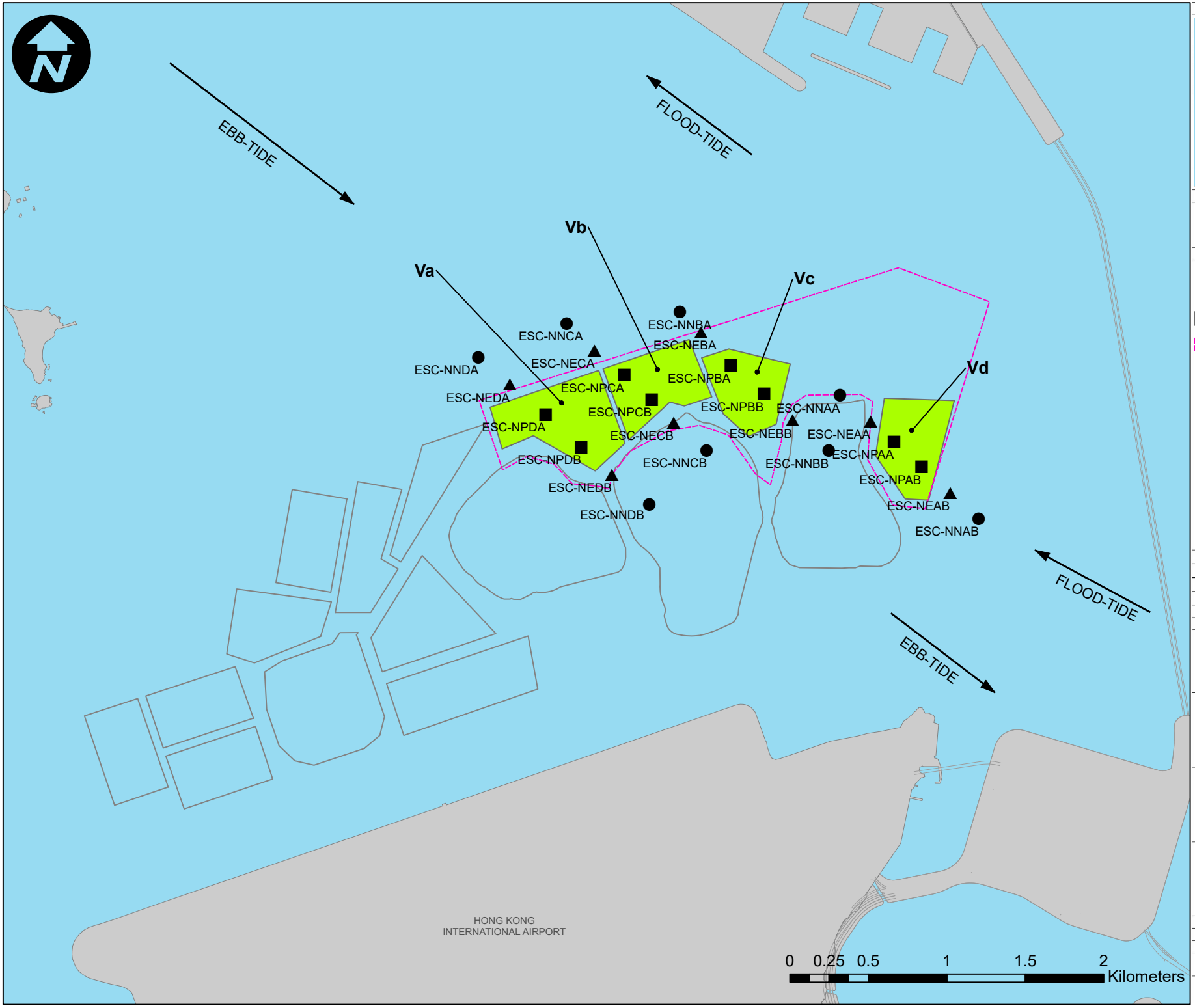
Title

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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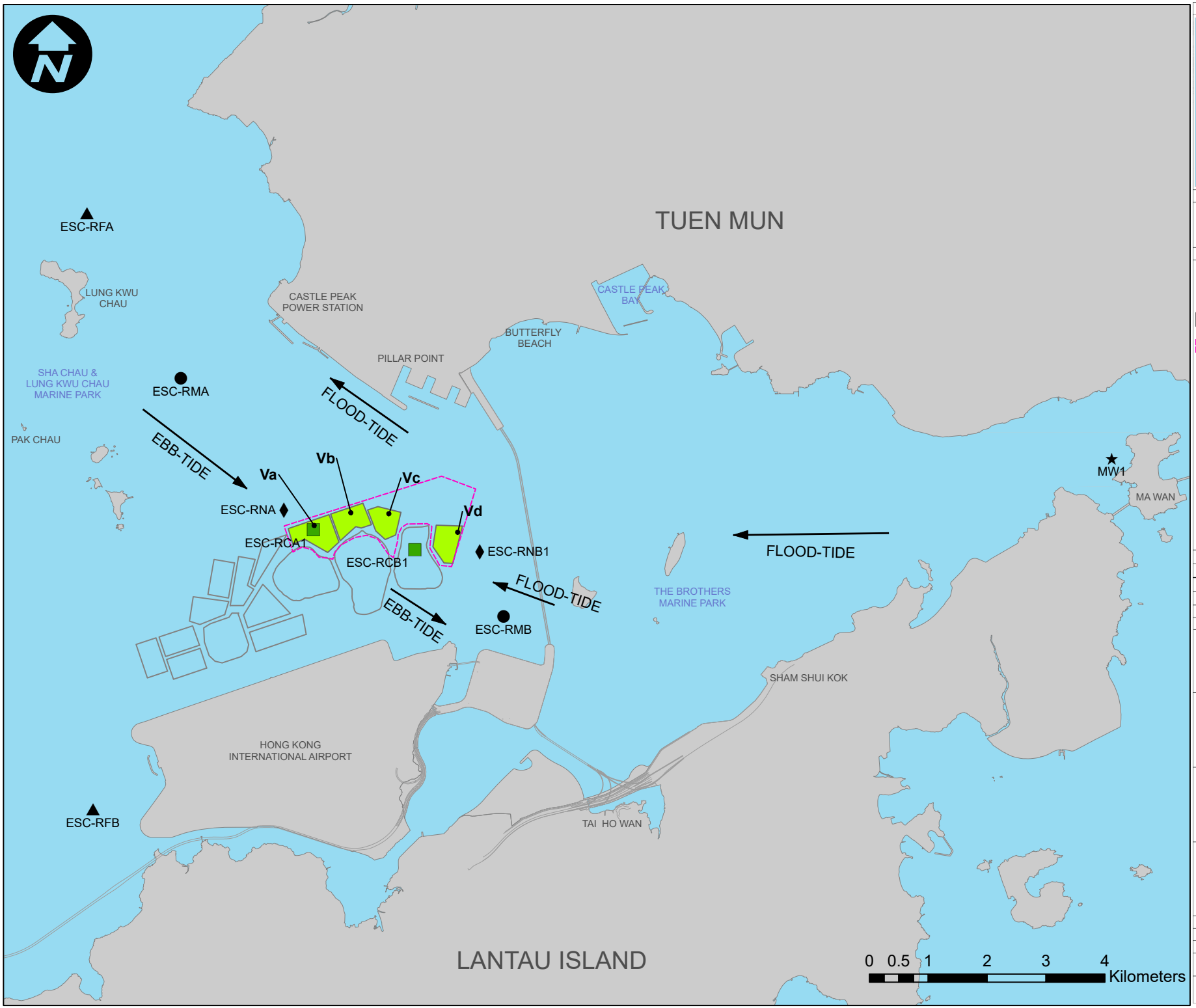
Title

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

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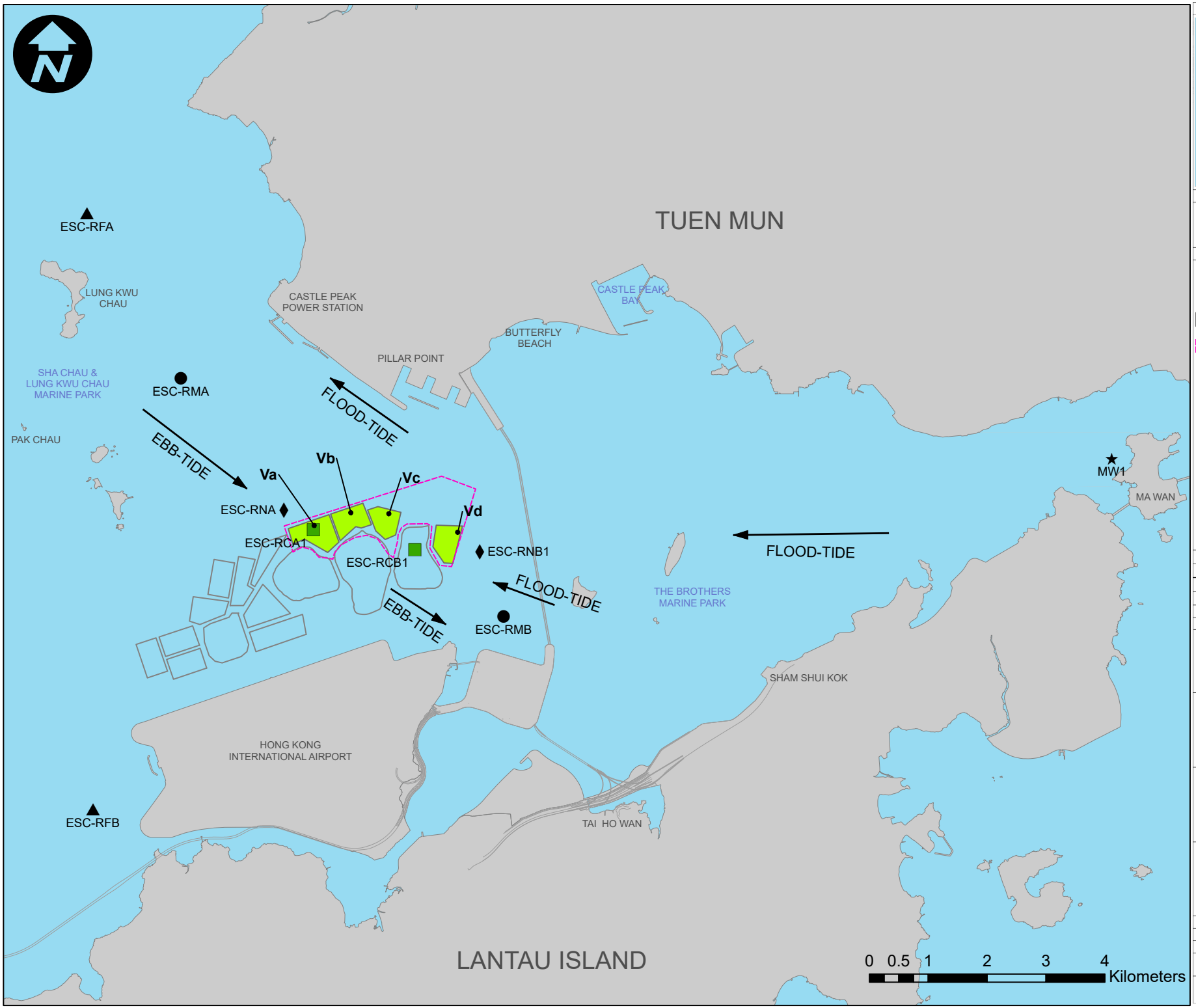
Title

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



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

MONITORING STATIONS

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

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

Title

SEDIMENT CHEMISTRY AFTER A MAJOR STORM MONITORING STATIONS FOR ESC CMPS

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

Drawing Number

FIGURE 4.5

Appendices

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												2022												2023												2024												2025												2026		
Pit Specific Sediment Chemistry *			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 *			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 *			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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																																																																	
	ESC-IPF1	4 times per year *																																																														
	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 *			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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
	ESC-IPE2A	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
	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
	ESC-IPE4	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
	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
Intermediate Station Downcurrent																																																																	
	ESC-INE1A	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
	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
	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
	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
	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
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
	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
	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
	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
	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
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
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
	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
	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
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
	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
	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
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
	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
	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
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
Water Column Profiling *			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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 Oct 2023	0	970,842
2 Oct 2023	0	970,842
3 Oct 2023	200	971,042
4 Oct 2023	200	971,242
5 Oct 2023	300	971,542
6 Oct 2023	0	971,542
7 Oct 2023	0	971,542
8 Oct 2023	0	971,542
9 Oct 2023	0	971,542
10 Oct 2023	300	971,842
11 Oct 2023	300	972,142
12 Oct 2023	300	972,442
13 Oct 2023	300	972,742
14 Oct 2023	200	972,942
15 Oct 2023	0	972,942
16 Oct 2023	300	973,242
17 Oct 2023	300	973,542
18 Oct 2023	300	973,842
19 Oct 2023	300	974,142
20 Oct 2023	200	974,342
21 Oct 2023	200	974,542
22 Oct 2023	0	974,542
23 Oct 2023	0	974,542
24 Oct 2023	300	974,842
25 Oct 2023	100	974,942
26 Oct 2023	200	975,142
27 Oct 2023	200	975,342
28 Oct 2023	200	975,542
29 Oct 2023	0	975,542
30 Oct 2023	200	975,742
31 Oct 2023	300	976,042

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Nov 2023	318	976,360
2 Nov 2023	200	976,560
3 Nov 2023	318	976,878
4 Nov 2023	200	977,078
5 Nov 2023	0	977,078
6 Nov 2023	200	977,278
7 Nov 2023	300	977,578
8 Nov 2023	200	977,778
9 Nov 2023	200	977,978
10 Nov 2023	800	978,778
11 Nov 2023	800	979,578
12 Nov 2023	0	979,578
13 Nov 2023	0	979,578
14 Nov 2023	0	979,578
15 Nov 2023	550	980,128
16 Nov 2023	550	980,678
17 Nov 2023	1,400	982,078
18 Nov 2023	550	982,628
19 Nov 2023	550	983,178
20 Nov 2023	550	983,728
21 Nov 2023	1,200	984,928
22 Nov 2023	900	985,828
23 Nov 2023	0	985,828
24 Nov 2023	1,500	987,328
25 Nov 2023	950	988,278
26 Nov 2023	550	988,828
27 Nov 2023	2,050	990,878
28 Nov 2023	400	991,278
29 Nov 2023	2,000	993,278
30 Nov 2023	1,500	994,778

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Dec 2023	1,100	995,878
2 Dec 2023	0	995,878
3 Dec 2023	400	996,278
4 Dec 2023	1,650	997,928
5 Dec 2023	1,100	999,028
6 Dec 2023	550	999,578
7 Dec 2023	0	999,578
8 Dec 2023	2,200	1,001,778
9 Dec 2023	1,100	1,002,878
10 Dec 2023	550	1,003,428
11 Dec 2023	550	1,003,978
12 Dec 2023	610	1,004,588
13 Dec 2023	0	1,004,588
14 Dec 2023	2,200	1,006,788
15 Dec 2023	1,100	1,007,888
16 Dec 2023	550	1,008,438
17 Dec 2023	550	1,008,988
18 Dec 2023	550	1,009,538
19 Dec 2023	400	1,009,938
20 Dec 2023	1,100	1,011,038
21 Dec 2023	1,100	1,012,138
22 Dec 2023	550	1,012,688
23 Dec 2023	1,100	1,013,788
24 Dec 2023	0	1,013,788
25 Dec 2023	2,000	1,015,788
26 Dec 2023	1,550	1,017,338
27 Dec 2023	2,700	1,020,038
28 Dec 2023	2,050	1,022,088
29 Dec 2023	540	1,022,628
30 Dec 2023	2,000	1,024,628
31 Dec 2023	2,950	1,027,578

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Oct 2023	0	691,184
2 Oct 2023	997	692,181
3 Oct 2023	1,001	693,182
4 Oct 2023	1,007	694,189
5 Oct 2023	499	694,688
6 Oct 2023	0	694,688
7 Oct 2023	0	694,688
8 Oct 2023	0	694,688
9 Oct 2023	0	694,688
10 Oct 2023	501	695,189
11 Oct 2023	497	695,686
12 Oct 2023	507	696,193
13 Oct 2023	505	696,698
14 Oct 2023	496	697,194
15 Oct 2023	504	697,698
16 Oct 2023	499	698,197
17 Oct 2023	0	698,197
18 Oct 2023	0	698,197
19 Oct 2023	0	698,197
20 Oct 2023	5	698,202
21 Oct 2023	0	698,202
22 Oct 2023	0	698,202
23 Oct 2023	0	698,202
24 Oct 2023	0	698,202
25 Oct 2023	0	698,202
26 Oct 2023	0	698,202
27 Oct 2023	0	698,202
28 Oct 2023	0	698,202
29 Oct 2023	0	698,202
30 Oct 2023	0	698,202
31 Oct 2023	0	698,202

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Nov 2023	0	698,202
2 Nov 2023	0	698,202
3 Nov 2023	0	698,202
4 Nov 2023	0	698,202
5 Nov 2023	0	698,202
6 Nov 2023	0	698,202
7 Nov 2023	0	698,202
8 Nov 2023	0	698,202
9 Nov 2023	0	698,202
10 Nov 2023	0	698,202
11 Nov 2023	0	698,202
12 Nov 2023	0	698,202
13 Nov 2023	0	698,202
14 Nov 2023	0	698,202
15 Nov 2023	0	698,202
16 Nov 2023	994	699,196
17 Nov 2023	0	699,196
18 Nov 2023	0	699,196
19 Nov 2023	0	699,196
20 Nov 2023	0	699,196
21 Nov 2023	0	699,196
22 Nov 2023	0	699,196
23 Nov 2023	0	699,196
24 Nov 2023	0	699,196
25 Nov 2023	0	699,196
26 Nov 2023	0	699,196
27 Nov 2023	0	699,196
28 Nov 2023	0	699,196
29 Nov 2023	843	700,039
30 Nov 2023	0	700,039

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Dec 2023	0	700,039
2 Dec 2023	0	700,039
3 Dec 2023	0	700,039
4 Dec 2023	0	700,039
5 Dec 2023	0	700,039
6 Dec 2023	0	700,039
7 Dec 2023	0	700,039
8 Dec 2023	0	700,039
9 Dec 2023	0	700,039
10 Dec 2023	0	700,039
11 Dec 2023	0	700,039
12 Dec 2023	0	700,039
13 Dec 2023	0	700,039
14 Dec 2023	0	700,039
15 Dec 2023	0	700,039
16 Dec 2023	0	700,039
17 Dec 2023	0	700,039
18 Dec 2023	0	700,039
19 Dec 2023	0	700,039
20 Dec 2023	0	700,039
21 Dec 2023	0	700,039
22 Dec 2023	0	700,039
23 Dec 2023	0	700,039
24 Dec 2023	0	700,039
25 Dec 2023	0	700,039
26 Dec 2023	0	700,039
27 Dec 2023	0	700,039
28 Dec 2023	0	700,039
29 Dec 2023	0	700,039
30 Dec 2023	0	700,039
31 Dec 2023	0	700,039

Appendix C. Statistical Analysis

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

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	159.74	42	380.04	**
Area	0.78	3	26.06	**
Period:Area	7.90	126	6.27	**
Residuals	51.30	5126		

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	6512.20	44	1156.04	**
Area	66.69	3	173.64	**
Period:Area	66.10	132	3.91	**
Residuals	462.82	3615		

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	2359.24	42	278.12	**
Area	153.87	3	253.95	**
Period:Area	292.64	126	11.50	**
Residuals	1035.30	5126		

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	96565.96	44	121.03	**
Area	3307.07	3	60.79	**
Period:Area	13682.85	132	5.72	**
Residuals	65549.52	3615		

Note:

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

SNK Results:

- Overall result:
  $\left.\begin{matrix}\text{Impact} = \text{Reference} = \text{Intermediate} \\ \text{Impact, Reference, Intermediate} > \text{Ma Wan}\end{matrix}\right\}$ ∴ 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.

Arsenic

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	9.89	7	46.11	**
Area	0.08	3	0.89	N.S.
Period:Area	1.14	21	1.78	**
Residuals	6.90	225		

Note:

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

SNK Results:

- Overall result:
  $\text{Impact} = \text{Ma Wan} = \text{Intermediate} = \text{Reference}\}$ ∴ 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.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	2.22	9	32.72	**
Area	0.06	3	2.87	**
Period:Area	0.49	27	2.38	**
Residuals	1.21	160		

Note:

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

SNK Results:

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

Cadmium

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	0.0088	7	7.5027	**
Area	0.0006	3	1.2896	N.S.
Period:Area	0.0048	21	1.3627	N.S.
Residuals	0.0377	225		

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	0.0088	9	5.5861	**
Area	0.0003	3	0.5364	N.S.
Period:Area	0.0042	27	0.8947	N.S.
Residuals	0.0279	160		

Note:

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

SNK Results:

- Overall result:
  Intermediate = Impact = 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.

Chromium

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	10.42	7	8.46	**
Area	0.52	3	1.00	N.S.
Period:Area	6.50	21	1.76	**
Residuals	39.56	225		

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

SNK Results:
- Overall result:
  Intermediate = Impact = 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	2.87	9	5.12	**
Area	0.09	3	0.47	N.S.
Period:Area	1.47	27	0.87	N.S.
Residuals	9.96	160		

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 since July 2022.

Copper

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	12.57	7	54.20	**
Area	0.62	3	6.22	**
Period:Area	1.48	21	2.13	**
Residuals	7.45	225		

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

SNK Results:
- Overall result:

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

- 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	2.65	9	10.46	**
Area	1.68	3	19.87	**
Period:Area	2.07	27	2.72	**
Residuals	4.50	160		

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

SNK Results:
- Overall result:

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

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

Mercury

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1.64×10^{-04}	7	5.090814	**
Area	3.27×10^{-06}	3	0.237106	N.S.
Period:Area	7.57×10^{-05}	21	0.783421	N.S.
Residuals	0.0010351	225		

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	0.00433	9	7.81014	**
Area	0.00018	3	0.97209	N.S.
Period:Area	0.00105	27	0.62916	N.S.
Residuals	0.00986	160		

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

SNK Results:
- Overall result:
  Reference = Impact = Ma Wan = Intermediate} ∴ 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	12.84	7	135.30	**
Area	0.43	3	10.50	**
Period:Area	0.64	21	2.25	**
Residuals	3.05	225		

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	5.38	9	34.08	**
Area	2.03	3	38.54	**
Period:Area	0.70	27	1.47	N.S.
Residuals	2.81	160		

Note:

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

SNK Results:

- Overall result:

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

- 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	170.40	7	18.44	**
Area	15.44	3	3.90	**
Period:Area	48.89	21	1.76	**
Residuals	297.04	225		

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

SNK Results:
- Overall result:

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

- 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	56.87	9	11.82	**
Area	61.85	3	38.57	**
Period:Area	237.96	27	16.49	**
Residuals	85.52	160		

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

SNK Results:
- Overall result:

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

- 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	1199.06	42	341.65	**
Area	16.77	3	66.91	**
Period:Area	102.58	126	9.74	**
Residuals	327.98	3925		

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	898.34	44	109.35	**
Area	7.91	3	14.13	**
Period:Area	64.75	132	2.63	**
Residuals	473.85	2538		

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	581.77	42	472.05	**
Area	21.95	3	249.33	**
Period:Area	40.21	126	10.87	**
Residuals	115.17	3925		

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	660.74	44	297.47	**
Area	13.19	3	87.10	**
Period:Area	42.23	132	6.34	**
Residuals	128.12	2538		

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	593.82	42	110.11	**
Area	13.81	3	35.86	**
Period:Area	191.99	126	11.87	**
Residuals	503.99	3925		

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	759.99	44	181.88	**
Area	19.97	3	70.08	**
Period:Area	157.65	132	12.58	**
Residuals	241.02	2538		

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	918.46	42	243.66	**
Area	42.67	3	158.49	**
Period:Area	150.99	126	13.35	**
Residuals	352.26	3925		

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
- 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	663.27	44	153.55	**
Area	15.65	3	53.14	**
Period:Area	127.48	132	9.84	**
Residuals	249.15	2538		

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

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Impact} = \text{Intermediate} \\ \text{Reference} > \text{Impact}, \text{Intermediate} > \text{Ma Wan}\end{array}\right\}$ ∴ 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 December 2023

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	80.99	46	107.87	**
Area	7.97	2	244.13	**
Direction	9.51	1	582.90	**
Period:Area	18.95	92	12.62	**
Period:Direction	6.70	46	8.93	**
Area:Direction	8.93	2	273.52	**
Period:Area:Direction	17.35	92	11.55	**
Residuals	21.84	1338		

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	85.49	46	17.77	**
Area	121.16	2	579.23	**
Direction	2.33	1	22.32	**
Period:Area	65.49	92	6.81	**
Period:Direction	30.50	46	6.34	**
Area:Direction	36.44	2	174.22	**
Period:Area:Direction	49.56	92	5.15	**
Residuals	139.93	1338		

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	35.98	46	53.90	**
Area	23.11	2	796.08	**
Direction	6.92	1	476.61	**
Period:Area	10.39	92	7.78	**
Period:Direction	4.41	46	6.61	**
Area:Direction	17.54	2	604.20	**
Period:Area:Direction	9.25	92	6.93	**
Residuals	19.42	1338		

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

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit}\\ \text{Near Pit} > \text{Pit Edge}\\ \text{Active Pit} > \text{Pit Edge}\end{array}\right\}$ ∴ 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, 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, Jul 2022, Aug 2023, Dec 2023
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023, Dec 2023
- Potential project related spatial trend was detected in one month for both flood tide and ebb tide direction over the reporting period.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	81.42	46	52.00	**
Area	206.30	2	3030.22	**
Direction	19.24	1	565.24	**
Period:Area	41.78	92	13.34	**
Period:Direction	17.42	46	11.13	**
Area:Direction	52.82	2	775.80	**
Period:Area:Direction	43.07	92	13.75	**
Residuals	45.55	1338		

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

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Active Pit} > \text{Near Pit}\\ \text{Near Pit} > \text{Pit Edge}\\ \text{Active Pit} > \text{Pit Edge}\end{array}\right\}$ ∴ 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, Dec 2023
- Potential project related spatial trend was detected in one month for ebb tide direction over the reporting period.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	22.45	46	15.02	**
Area	30.06	2	462.55	**
Direction	8.93	1	274.84	**
Period:Area	14.72	92	4.92	**
Period:Direction	5.08	46	3.40	**
Area:Direction	8.84	2	136.06	**
Period:Area:Direction	7.73	92	2.59	**
Residuals	43.47	1338		

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, Aug 2023, Nov 2023, Dec 2023
  - 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, Dec 2023
- Potential project related spatial trend was detected in two months for flood tide and one month for ebb tide direction over the reporting period.

Regression Analysis Results:

Period	R Square	Adjusted R Square	Y-intercept	Slope	Significance Level
Oct-23	0.58	0.48	39.52	-1.24	N.S.
Nov-23	0.59	0.49	42.05	-0.90	N.S.

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

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	155.33	46	16.05	**
Area	117.37	2	278.87	**
Direction	80.17	1	380.94	**
Period:Area	83.12	92	4.29	**
Period:Direction	38.55	46	3.98	**
Area:Direction	108.21	2	257.11	**
Period:Area:Direction	43.93	92	2.27	**
Residuals	281.57	1338		

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	29.64	46	66.15	**
Area	23.90	2	1226.99	**
Direction	14.48	1	1486.11	**
Period:Area	12.51	92	13.96	**
Period:Direction	6.06	46	13.53	**
Area:Direction	21.95	2	1126.90	**
Period:Area:Direction	10.86	92	12.12	**
Residuals	13.03	1338		

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
  Near Pit > Pit Edge
  Active 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, 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, Aug 2023, Dec 2023
  - Ebb Tide: Jun 2020, Jul 2020, Oct 2020, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023, Apr 2023, Dec 2023
- Potential project related spatial trend was detected in one month for both flood tide and ebb tide direction over the reporting period.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	201.18	46	51.45	**
Area	362.31	2	2131.10	**
Direction	3.61	1	42.47	**
Period:Area	83.83	92	10.72	**
Period:Direction	38.50	46	9.85	**
Area:Direction	40.85	2	240.26	**
Period:Area:Direction	65.92	92	8.43	**
Residuals	113.74	1338		

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	21.72	46	41.21	**
Area	58.42	2	2549.38	**
Direction	3.92	1	342.07	**
Period:Area	17.83	92	16.91	**
Period:Direction	7.48	46	14.18	**
Area:Direction	9.58	2	418.09	**
Period:Area:Direction	13.31	92	12.63	**
Residuals	15.33	1338		

Note:

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

SNK Results:

- Overall result:

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

- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: 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, Dec 2023
- Potential project related spatial trend was detected in one month for ebb tide direction over the reporting period.

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	115.49	46	130.35	**
Area	74.43	2	1932.29	**
Direction	8.98	1	466.42	**
Period:Area	45.92	92	25.92	**
Period:Direction	14.63	46	16.52	**
Area:Direction	12.38	2	321.46	**
Period:Area:Direction	32.95	92	18.60	**
Residuals	25.77	1338		

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, Oct 2023, Dec 2023
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021, Oct 2021, Jul 2022, Feb 2023, Mar 2023, Aug 2023, Dec 2023
- Potential project related spatial trend was detected in two months for flood tide and one month for ebb tide direction over the reporting period.

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

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	70.74	30	119.56	**
Area	104.93	4	1330.08	**
Period:Area	67.92	120	28.70	**
Residuals	44.87	2275		

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	74.67	30	21.09	**
Area	71.24	4	150.89	**
Period:Area	60.24	120	4.25	**
Residuals	268.51	2275		

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	11168.26	30	38.87	**
Area	81303.04	4	2122.44	**
Period:Area	19113.13	120	16.63	**
Residuals	21786.78	2275		

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	13588.75	30	14.99	**
Area	266895.97	4	2207.89	**
Period:Area	28444.77	120	7.84	**
Residuals	68752.18	2275		

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	33866.27	30	79.91	**
Area	78910.91	4	1396.43	**
Period:Area	21023.43	120	12.40	**
Residuals	32139.57	2275		

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	417.37	30	31.57	**
Area	50.48	4	28.64	**
Period:Area	237.45	120	4.49	**
Residuals	1002.44	2275		

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	3409.55	30	25.55	**
Area	29832.06	4	1676.65	**
Period:Area	9651.28	120	18.08	**
Residuals	10119.59	2275		

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	178.28	30	36.37	**
Area	832.02	4	1273.05	**
Period:Area	89.48	120	4.56	**
Residuals	371.72	2275		

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

SNK Results:
- Overall result:
  - $\text{Mid-Field} = \text{Far-Field} = \text{Near-Field} = \text{Capped-pit}$ $\text{Ma Wan} > \text{Mid-Field, Far-Field, Near-Field, Capped-pit}$ ∴ 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	18.03	30	25.46	**
Area	149.22	4	1580.69	**
Period:Area	49.69	120	17.55	**
Residuals	53.69	2275		

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	2155288112	30	47.27	**
Area	3651757872	4	600.71	**
Period:Area	4158141887	120	22.80	**
Residuals	3457496296	2275		

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.

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 11 October 2023)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3.12	4	49.02	**
Residuals	0.49	31		

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

SNK Results:

- Far-Field > Mid-Field > Ma Wan > Near-Field > Capped-pit

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.024	4	15.37	**
Residuals	0.012	31		

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

SNK Results:

- Ma Wan > Mid-Field = Far-Field > Near-Field > Capped-pit

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2213.08	4	45.27	**
Residuals	378.87	31		

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

SNK Results:
- Ma Wan > Far-Field = Mid-Field > Near-Field > Capped-pit

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3491.17	4	38.99	**
Residuals	694.00	31		

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

SNK Results:
- Ma Wan > Far-Field = Mid-Field > Near-Field > Capped-pit

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.87	4	42.04	**
Residuals	0.53	31		

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

SNK Results:
- Ma Wan > Far-Field > Mid-Field > Near-Field = Capped-pit

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	6.51	4	18.67	**
Residuals	2.70	31		

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

SNK Results:
- Ma Wan = Far-Field = Mid-Field = Near-Field = Capped-pit

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	781.15	4	32.14	**
Residuals	188.36	31		

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

SNK Results:
- Ma Wan > Far-Field = Mid-Field > Near-Field > Capped-pit

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Area	14.80	4	17.26	**
Residuals	6.65	31		

Note:

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

SNK Results:

- Ma Wan = Mid-Field = Far-Field = Near-Field = Capped-pit

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	14326.07	4	43.57	**
Residuals	2548.11	31		

Note:

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

SNK Results:

- Ma Wan > Far-Field = Near-Field = Mid-Field > Capped-pit