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
– July to September 2023

November 2023

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

土木工程拓展署
Civil Engineering and Development Department

MOTT MACDONALD

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

Environmental Certification Sheet

Environmental Permit No. EP-312/2008/A

Reference Document /Plan

Document/~~Plan~~ to be ~~Certified~~/ Verified:	Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – July to September 2023
Date of Report:	1 November 2023
Date prepared by ET:	1 November 2023
Date received by IA:	1 November 2023

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: 1 November 2023

IA Verification

I hereby verify that the above referenced document/~~plan~~ complies with the above referenced condition of EP-312/2008/A.

Dr Wang Wen Xiong,
Independent Auditor (IA): Wen Xiong Wang Date: 1 November 2023

Issue and Revision Record

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Executive summary

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

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

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

Routine Water Quality Monitoring of ESC CMPs – July to September 2023

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

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

Cumulative Impact Sediment Chemistry of ESC CMPs – August 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 – July and September 2023

Samplings for Sediment Chemistry after a Major Storm Event were conducted for ESC CMPs on 23 July 2023 after the visit of tropical cyclone Talim, which led to the issue of No. 8 Storm Signal

on 17 July 20223; and on 5 September 2023 after the visit of tropical cyclone Saola, which led to the issue of No. 8 Storm Signal on 1 September 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 events in July and September 2023.

Sediment Toxicity Tests of ESC CMPs – August 2023

Statistical analysis showed either no significant differences between Impact and Reference stations, or no project related trend in the toxicity tests of most tested marine benthos. There did not appear to be any evidence of unacceptable impacts to sediment toxicity due to the mud disposal operations at ESC CMPs.

Demersal Trawling for ESC CMPs – July and August 2023

During the sampling period in July and August 2023, the mean number of faunal species caught was generally lower at Impact stations. Biotic abundance, Biomass, Catch per Unit Effort (CPUE) and Yield per Unit Effort (YPUE) were also generally lower at Impact stations ESC-INA and ESC-INB. Fluctuations in mean number of faunal species caught, Biotic abundance, Biomass, CPUE and YPUE were also observed amongst Reference stations.

行政摘要

在 2023 年 7 月至 9 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、強颱風後的沉積物質素監察、沉積物毒性測試及底棲漁業資源監察。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 7 月至 9 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 7 月至 9 月

2023 年 7 月至 9 月的例行水質監察結果顯示，所有監測站的溶解氧濃度，酸鹼值及鹽度均符合海水水質指標。另外，大部分監測站的懸浮固體含量均符合海水水質指標。所有監測站的溶解氧含量，混濁度及懸浮固體含量也符合行動及極限水平。從監察數據和統計結果顯示，海水的污染物濃度沒有因越接近泥坑而趨向增加，亦沒有隨著時間而增加。總體而言，沒有證據顯示在報告期內沙洲以東海泥卸置運作對周邊水體環境產生任何不可接受的水質影響。

沙洲以東海泥卸置設施 (ESC CMPs)之沉積物監察

指定污泥坑沉積物化學監察 – 2023 年 7 月至 9 月

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

沉積物化學累積性影響監察 – 2023 年 8 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 7 月及 9 月

強烈熱帶風暴泰利於 2023 年 7 月 15 日吹襲香港，並在 2023 年 7 月 17 日發出 8 號烈風或暴風信號。超強颱風蘇拉於 2023 年 8 月 30 日吹襲香港，並在 2023 年 9 月 1 日發出 8 號烈風或暴風信號。在強颱風過後，環境小組分別在 2023 年 7 月 23 日及 2023 年 9 月 5 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 7 月及 9 月強颱風導致污泥從泥坑擴散或引起沉積物污染。

沙洲以東污泥坑之沉積物毒性測試 – 2023 年 8 月

統計結果顯示，大部份已測試的海洋底棲生物在受影響監測站及參考監測站的沉積物毒性測試沒有明顯分別，且在沉積物毒性測試中亦沒有偵測到與項目相關的趨勢。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毒性造成任何不可接受的影響。

沙洲以東污泥坑之底棲漁業資源監察 – 2023 年 7 月及 8 月

監察結果顯示，2023 年 7 月和 8 月的底棲漁業資源在受影響監測站普遍錄得較低的品種數量。而在 2023 年 7 月及 8 月受影響監測站 ESC-INA 及 ESC-INB 的生物量、生物重量、單位努力漁獲量及單位努力生產量錄得稍低的數值。而在參考監測站之中的監察結果也錄得波動。

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 July to September 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 – July to September 2023* is to provide information regarding the findings in the reporting period of July to September 2023 (from 1 July to 30 September 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	5 Jul 2023	13 Jul 2023
	4 Aug 2023	14 Aug 2023
	5 Sep 2023	15 Sep 2023
Routine Water Quality Monitoring of ESC CMPs	4 Jul 2023	19 Jul 2023
	7 Aug 2023	21 Aug 2023
	6 Sep 2023	20 Sep 2023
Pit Specific Sediment Chemistry of ESC CMP Vb	3 Jul 2023	24 Jul 2023
	2 Aug 2023	29 Aug 2023
	4 Sep 2023	28 Sep 2023
Cumulative Impact Sediment Chemistry of ESC CMPs	3 Aug 2023	29 Aug 2023
Sediment Chemistry After a Major Storm	21 Jul 2023	4 Aug 2023
	5 Sep 2023	19 Sep 2023
Sediment Toxicity Test of ESC CMPs	3 Aug 2023	19 Oct 2023
Demersal Trawling of ESC CMPs	6 & 7 Jul 2023	7 Sep 2023
	10 & 11 Aug 2023	7 Sep 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 July to September 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 August and September 2023. In July 2023, the SS level at the Upstream station was higher than the WQO while the SS level at the Downstream station complied with the WQO, but the levels of DO, Turbidity and SS also complied with the Action and Limit Levels at all stations during the reporting quarter.

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

4.2 Routine Water Quality Monitoring of ESC CMPs

4.2.1 Background

Routine Water Quality Monitoring for ESC CMPs was conducted once every month from July to September 2023 as presented in **Table 3.1**. A total of sixteen (16) stations were sampled during ebb tide in July 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 August and September 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 the SS levels were higher than the wet season WQO at Impact and Intermediate stations in July 2023 and higher salinity levels were recorded at Ma Wan station in September 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 September 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 July to September 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 July to September 2023, except for Arsenic, Copper and Silver. In July 2023, the concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA and Pit-Edge station ESC-NECA; the concentrations of Copper were higher than LCEL at Active-Pit station ESC-NPCB; the concentration of Silver was higher than LCEL at Active-Pit station ESC-NPCB. In August 2023, the concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA, Pit-Edge station ESC-NECA, Active-Pit stations ESC-NPCA and ESC-NPCB. In September 2023, concentrations of Arsenic were higher than the LCEL at Near-Pit station ESC-NNCA and Pit-Edge station ESC-NECA.

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, Lead and Nickel during flood tide in August 2023. Detailed analysis was conducted to further confirm the result, and there appears no evidence of consistent spatial trend of increasing contaminant concentrations with proximity to the pit over time.

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 ebb tide in August 2023, but no significant spatial trend was detected in subsequent 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 August 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 August 2023, except the concentrations of Arsenic which were higher than the LCEL at Near-field stations ESC-RNB1, Mid-field stations ESC-RMA, and Far-field stations ESC-RFA, ESC-RFB .

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 23 July 2023 after the visit of tropical cyclone Talim which led to the issue of No. 8 Storm Signal on 17 July 2023. The track of Talim is shown in **Photo 4.1**. Another sampling for Sediment Chemistry after a Major Storm Event was conducted at nine (9) monitoring stations (see **Figure 4.5** for the locations of the monitoring stations) on 5 September 2023 after the visit of tropical cyclone Saola, which led to the issue of No. 8 Storm Signal on 1 September 2023. The track of Saola is shown in **Photo 4.2**.

For July 2023, the monitoring results showed that the concentrations of most inorganic contaminants were below the LCEL at most monitoring stations, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Near-field station ESC-RNB1, Mid-field stations ESC-RMA, ESC-RMB and Far-field stations ESC-RFA, ESC-RFB.

For September 2023, the monitoring results showed that the concentrations of most inorganic contaminants were below the LCEL at most monitoring stations, except for Arsenic. The concentrations of Arsenic were higher than the LCEL at Near-field station ESC-RNB1, Mid-field stations ESC-RMA and Far-field station ESC-RFB.

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

Photo 4.2: Track of Tropical Cyclone Ma-on (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 July and September 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 events in July and September 2023.

4.6 Sediment Toxicity Tests – August 2023

Sediment Toxicity Tests were undertaken for sediments collected from the Impact (Near-Field), Reference and Ma Wan stations (see **Figure 4.6** for the sampling locations) in August 2023.

Appropriate statistical test, i.e. ANOVA, was applied for comparing and determining the level of significance in the results of August 2023 between Impact and Reference Stations. When significant difference was detected then multiple comparison procedures would be used (e.g. Tukey's Test) to isolate where the differences is occurring.

Results of the Sediment Toxicity Tests in August 2023 showed that there were no significant differences between Impact and Reference stations in the toxicity tests for all tested marine benthos except the survival rate for marine bivalve as well as mortality rates for barnacles and shrimp. In detailed analysis, the potential project related spatial trend was not detected in the survival rate for marine bivalve. Potential project related trend was detected for mortality rates for barnacles and shrimp in August 2023; however, during our further investigation on the analysis results of the Cumulative Impact Monitoring of Sediment Quality, no unacceptable project related impacts to sediment quality was observed. It is also noted that the mortality rate of barnacles and shrimp at the Impact station closer to the disposal operation (i.e. ESC-TDA) was similar as Reference and Ma Wan Stations, implying that there may be external factors contributing to the potential project related trend.

Therefore, in overall, there did not appear to be any evidence of unacceptable impacts to sediment toxicity due to the mud disposal operations at ESC CMP Vb. Detailed results of statistical analyses are presented in **Appendix C.**

4.7 Demersal Trawling – July and August 2023

Fishery resources monitoring by demersal trawling was carried out at two (2) impact and four (4) reference stations (see **Figure 4.7** for locations) in July and August 2023. Monitoring results are presented in the following sections.

Abundance and Biomass

The average number of species collected in the period of July and August 2023 is presented in **Table 4.1**. Mean number of faunal species caught at Impact stations was generally lower than at Reference stations in July and August 2023. Fluctuations in mean number of faunal species caught were also observed amongst Reference stations.

Biotic abundance, Biomass, Catch per Unit Effort (CPUE) and Yield per Unit Effort (YPUE) were generally lower at Impact stations ESC-INA and ESC-INB in July and August 2023 (**Table 4.2**). Fluctuations in Biotic abundance, Biomass, CPUE and YPUE were also observed amongst Reference stations.

Annual trend and statistical analyses will be conducted in the Annual EM&A Review Report to determine whether there is any significant difference that shows a considerable impact to fishery resources caused by the mud disposal operations at ESC CMP Vb.

Table 4.1: Summary of the Mean Number of Faunal Species Caught during Monitoring in July and August 2023

Mean Number of Faunal Species	Impact Stations		Reference Stations			
	ESC-INA	ESC-INB	TNA	TNB	TSA	TSB
Jul 2023	28.0	26.8	44.4	40.0	36.8	34.6
Aug 2023	16.8	13.0	34.2	32.8	36.2	40.8

Table 4.2: Summary of CPUE and YPUE during Monitoring in July and August 2023

Date	Station	Type of Station	No. of Individuals per Station	Total Biomass per Station (g)	Mean CPUE(1) per Tow (no./hr/net)	Mean YPUE(2) per Tow (g/hr/net)
Jul 2023	ESC-INA	Impact	645	11197.5	129	2239.5
Jul 2023	ESC-INB	Impact	1124	17019.9	224.8	3403.98
Jul 2023	TNA	Reference	5983	60546.4	1196.6	12109.28
Jul 2023	TNB	Reference	5970	68647.2	1194	13729.44
Jul 2023	TSA	Reference	22631	98658.3	4526.2	19731.66
Jul 2023	TSB	Reference	12961	58614.5	2592.2	11722.9
Aug 2023	ESC-INA	Impact	434	8246.1	86.8	1649.22
Aug 2023	ESC-INB	Impact	137	3207.8	27.4	641.56
Aug 2023	TNA	Reference	3535	27566.1	707	5513.22
Aug 2023	TNB	Reference	5564	69918.3	1112.8	13983.66
Aug 2023	TSA	Reference	11211	37634.1	2242.2	7526.82
Aug 2023	TSB	Reference	4563	47471.5	912.6	9494.3

Notes:
(1) CPUE is calculated by dividing the number of individuals with the trawling time and number of nets (in hour and number of nets).
(2) YPUE is calculated by dividing the weight (g) of fish with trawling effort (in hour and number of nets).

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 Demersal Trawling on 7 July 2023. A total of 3 stations (ESC-INA, TNA and TNB) were sampled on that day. The IA was generally satisfied with the sample collection and confirmed that the requirements as stated in the EM&A Manual were implemented accordingly.

6 Future Key Issues

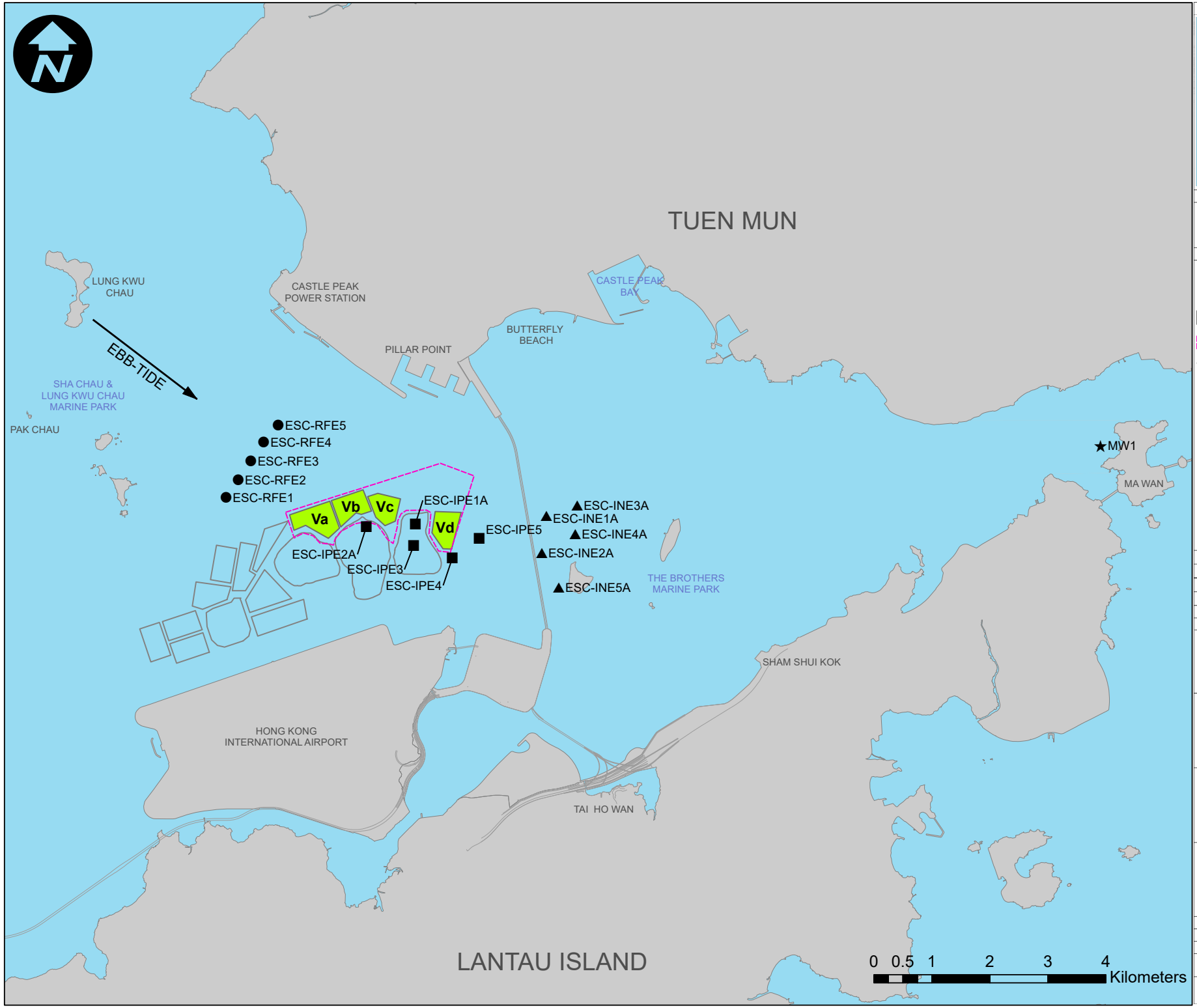
6.1 Activities Scheduled for the Next Reporting Period

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

- Water Column Profiling of ESC CMP Vb in October, November and December 2023;
- Routine Water Quality Monitoring of ESC CMPs in October, November and December 2023;
- Pit Specific Sediment Chemistry of ESC CMP Vb in October, November and December 2023; and
- Cumulative Impact Sediment Chemistry of ESC CMPs in December 2023.

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

Figures



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

WATER QUALITY SAMPLING STATIONS

- ■ IMPACT STATION
- ▲ INTERMEDIATE STATION
- ● REFERENCE STATION
- ★ MA WAN STATION

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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

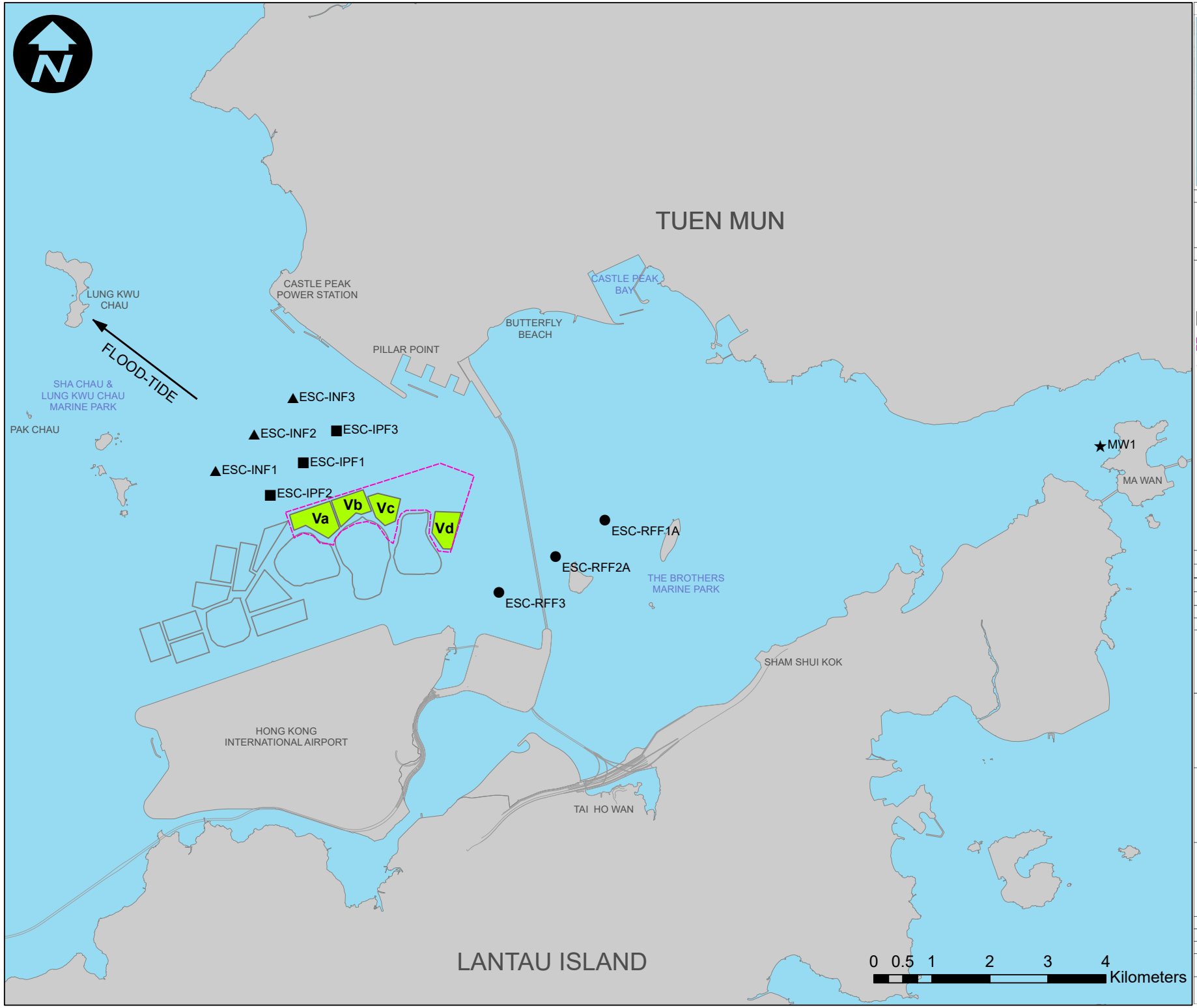
Title

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
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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

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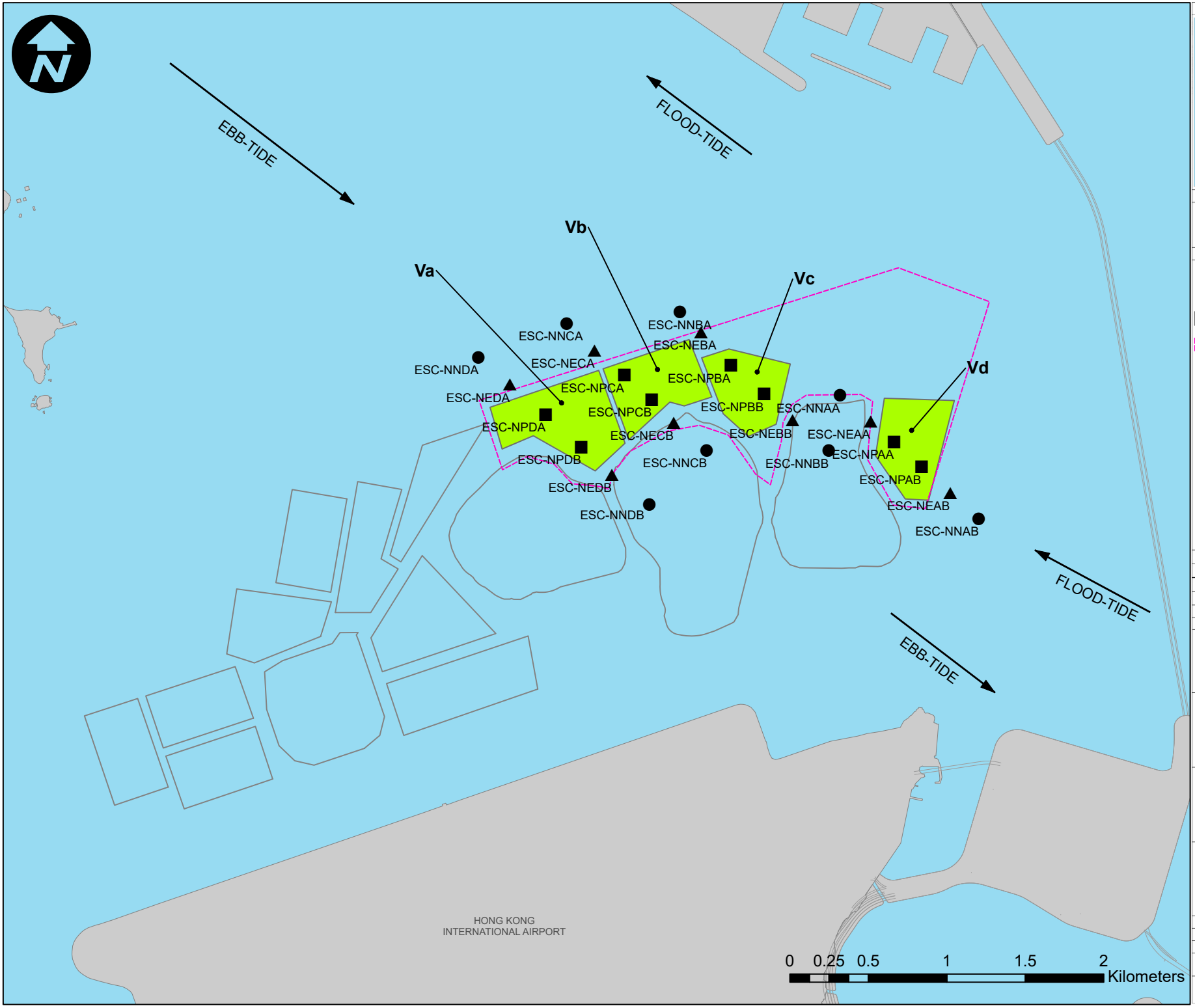
FIGURE 4.2



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

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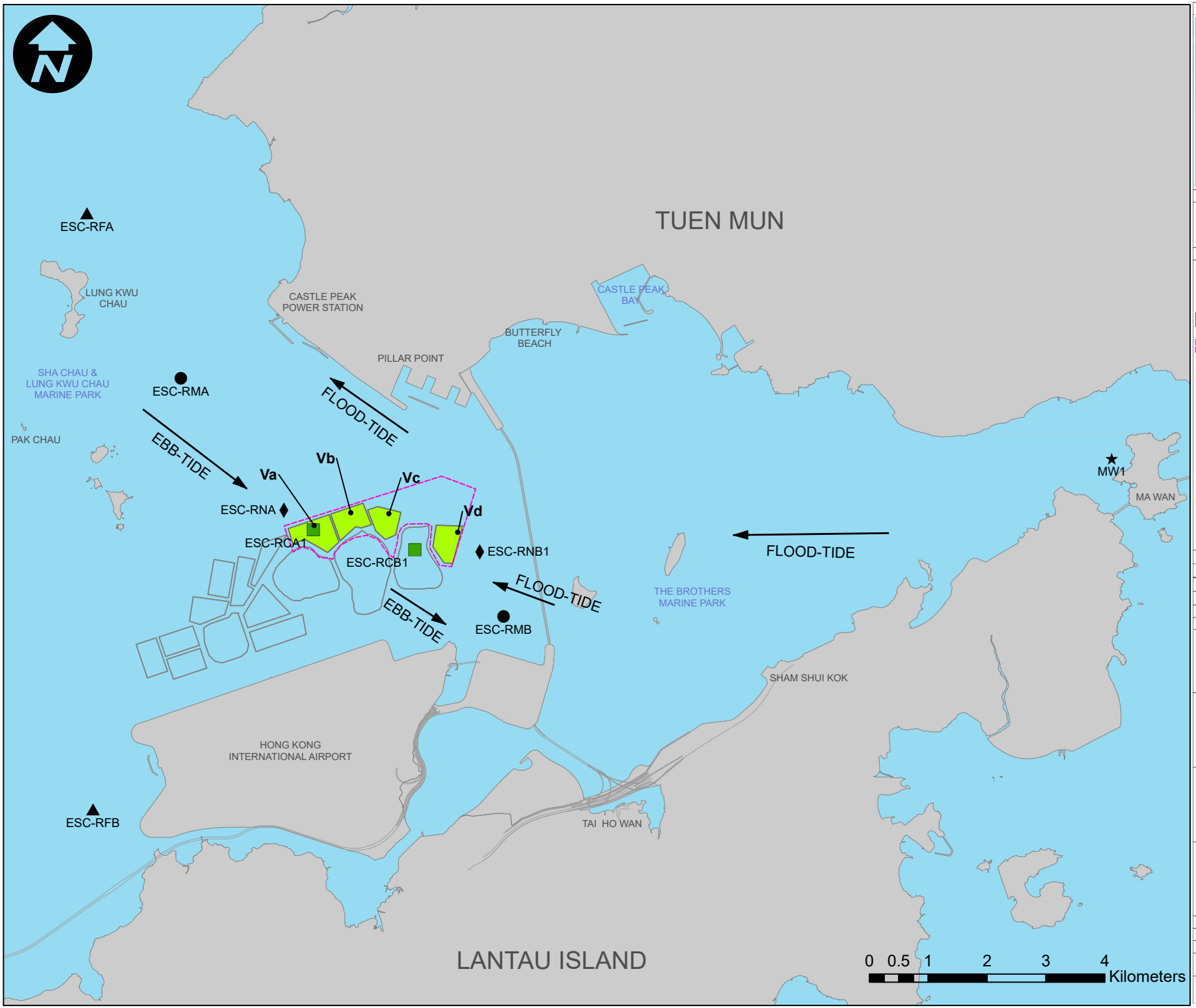
Scale at A3		Status		Rev	

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

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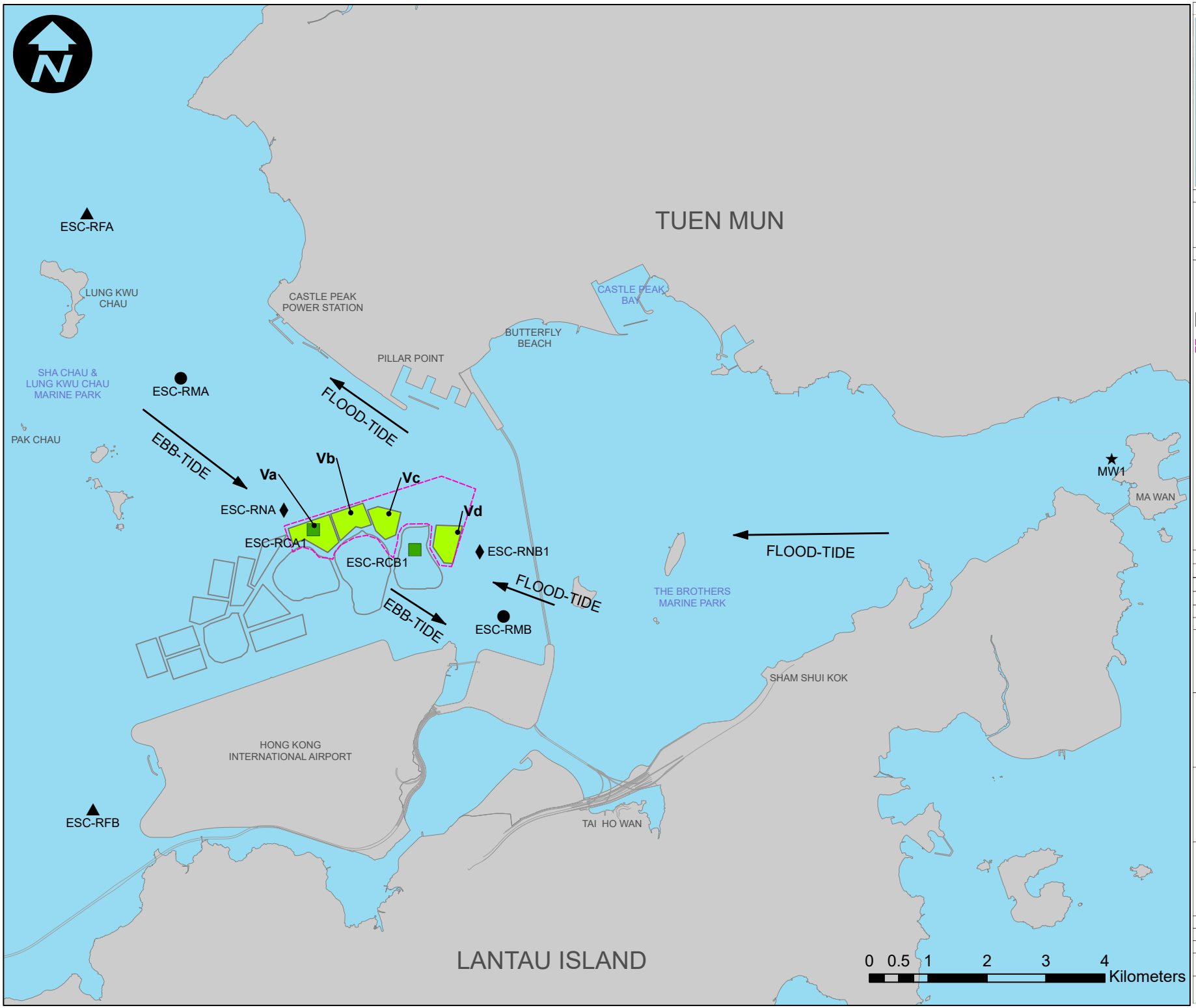
FIGURE 4.4



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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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

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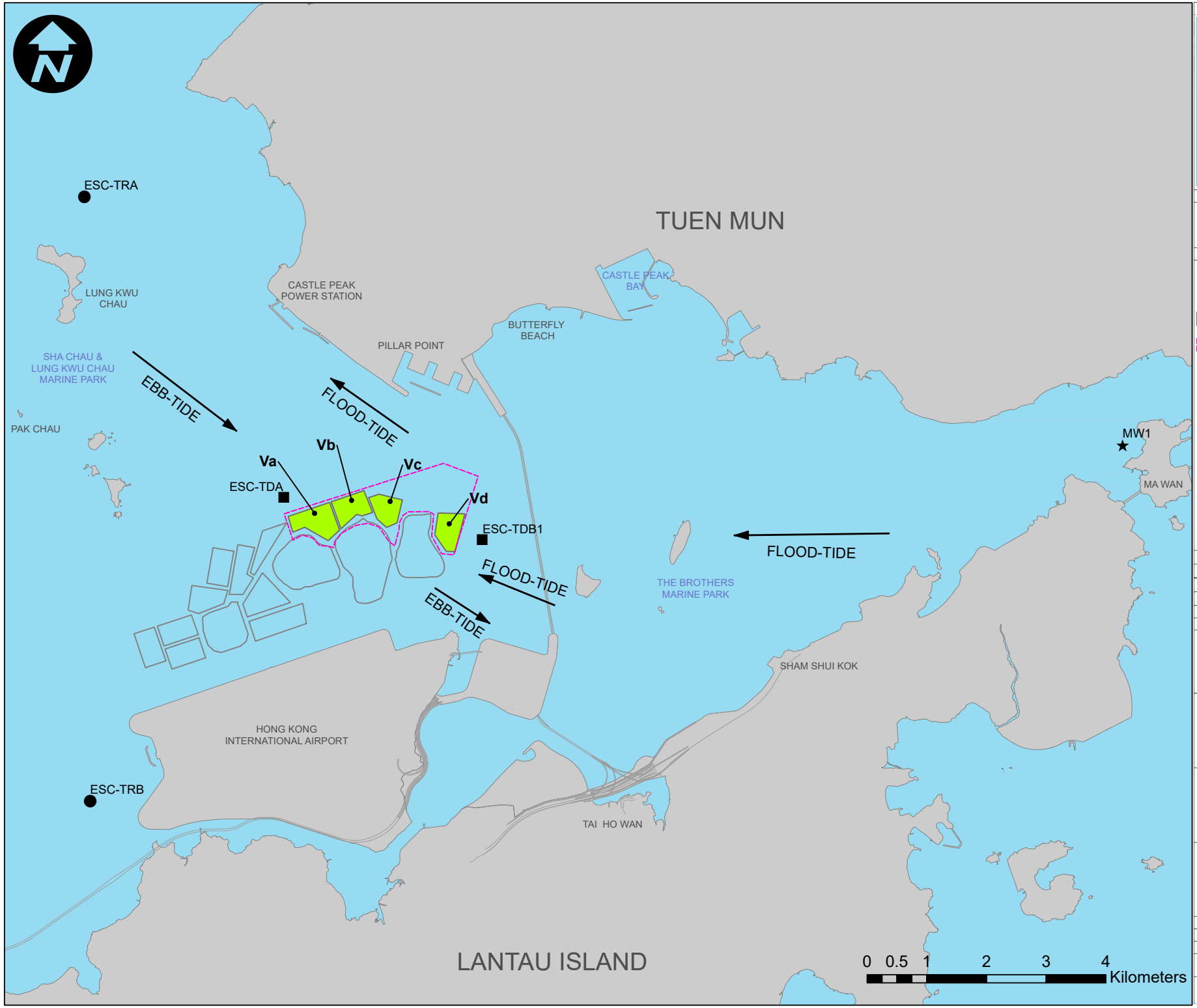
FIGURE 4.5



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

SEDIMENT TOXICITY MONITORING STATIONS

- NEAR-FIELD STATION
- REFERENCE STATION
- MA WAN STATION

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Title

SEDIMENT TOXICITY MONITORING STATIONS FOR ESC CMPS

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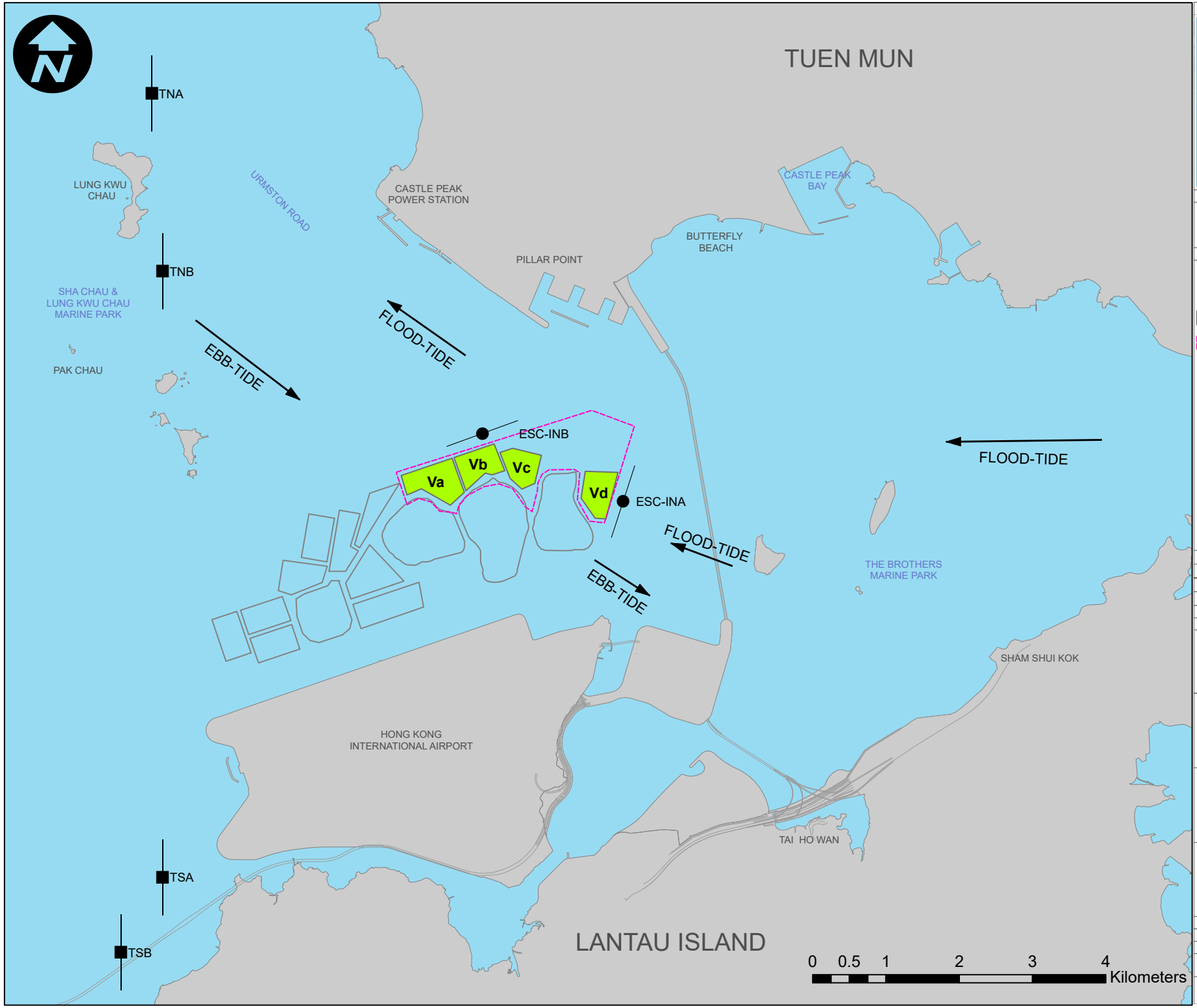
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 4.6



Key Plan:

Notes:

Key to symbols:

LEGEND

- ESC CMP V
- ESC USABLE AREA 1

DEMERSAL TRAWL SAMPLING STATIONS

- IMPACT TRAWL STATION
- REFERENCE TRAWL STATION

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Title

MARINE BIOTA MONITORING STATIONS FOR ESC CMPS

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Drawn			Coordination		
Dwg check			Approved		
Scale at A3		Status		Rev	

Drawing Number

FIGURE 4.7

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		
			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
Pit Specific Sediment Chemistry *																																																																
Active-Pit																																																																
	ESC-NPAA	Monthly	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	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	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	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	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	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	2
Cumulative Impact Sediment Chemistry *																																																																
Near-field Stations																																																																
	ESC-RNA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RNB1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Mid-field Stations																																																																
	ESC-RMA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RMB	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Capped Pit Stations																																																																
	ESC-RCA1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RCB1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Far-field Stations																																																																
	ESC-RFA	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
	ESC-RFB	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Ma Wan Station																																																																
	MW1	4 times per year		6				6		6				6		6				6		2				2		2				2		2				2		2				2		2				2		2				2		2				2		2	
Sediment Toxicity Tests																																																																
Near-pit Stations																																																															
	ESC-TDA	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
	ESC-TDB1	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
Reference Stations																																																																
	ESC-TRA	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
	ESC-TRB	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
Ma Wan Station																																																																
	MW1	2 times per year		5						5							5#					5						5						5						5						5						5						5						5	
Tissue / Whole Body Sampling																																																																
Near-pit Stations																																																																
	ESC-INA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	ESC-INB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Reference North																																																																
	TNA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	TNB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Reference South																																																																
	TSA	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
	TSB	2 times per year		*						*						*							*					*						*						*						*						*						*						*	
Demersal Trawling																																																																
Near-pit Stations																																																																
	ESC-INA	4 times per year	5	5					5	5					5	5						5^	5^				5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	ESC-INB	4 times per year	5	5					5	5					5	5						5^	5^				5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Reference North																																																																
	TNA	4 times per year	5	5					5	5					5	5						5^	5^				5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	TNB	4 times per year	5	5					5	5					5	5						5^	5^				5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Reference South																																																																
	TSA	4 times per year	5	5					5	5					5	5						5^	5^				5	5					5	5					5	5					5	5					5	5					5	5					5	5	
	TSB	4 times per year	5	5					5	5					5	5						5^	5^				5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Capping *																																																																
Ebb Tide																																																																
Impact Station Downcurrent																																																																
	ESC-IPE1A	4 times per year *																																																															
	ESC-IPE2A	4 times per year *																																																															
	ESC-IPE3	4 times per year *																																																															
	ESC-IPE4	4 times per year *																																																																
	ESC-IPE5	4 times per year *																																																															
Intermediate Station Downcurrent																																																																
	ESC-INE1A	4 times per year *																																																															
	ESC-INE2A	4 times per year *																																																															
	ESC-INE3A	4 times per year *																																																															
	ESC-INE4A	4 times per year *																																																															
	ESC-INE5A	4 times per year *																																																															
Reference Station Upcurrent																																																																
	ESC-RFE1	4 times per year *																																																															
	ESC-RFE2	4 times per year *																																																															
	ESC-RFE3	4 times per year *																																																															
	ESC-RFE4	4 times per year *																																																															
	ESC-RFE5	4 times per year *																																																															
Ma Wan Station																																																																
	MW1	4 times per year *																																																															
Flood Tide																																																																
Impact Station Downcurrent																																																																
	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 *																																																																
Ebb Tide																																																																
Impact Station Downcurrent																																																																
	ESC-IPE1A	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	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	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	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	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	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	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	2	2	2
	ESC-INE3A	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-INE4A	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-INE5A	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Reference Station Upcurrent																																																																
	ESC-RFE1	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-RFE2	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-RFE3	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-RFE4	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-RFE5	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ma Wan Station																																																																
	MW1	Monthly*				4	4	4		4		4	4			4		4	4	4		2		2			2	2		2	2		2			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flood Tide																																																																
Impact Station Downcurrent																																																																
	ESC-IPF1	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-IPF2	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-IPF3	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Intermediate Station Downcurrent																																																																
	ESC-INF1	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-INF2	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-INF3	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Reference Station Upcurrent																																																																
	ESC-RFF1A	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-RFF2A	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	ESC-RFF3	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ma Wan Station																																																																
	MW1	Monthly*	4	4	4				4		4			4	4		4				2		2		2	2			2			2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Water Column Profiling *																																																																
Plume Stations																																																																
	WCP1	Monthly*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	WCP2	Monthly*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Benthic Recoloinisation Studies																																																																
Capped Stations at CMP V																																																																
	ESCV-CPA	2 times per year																																																															
	ESCV-CPB	2 times per year																																																															
	ESCV-CPC	2 times per year																																																															
	ESCV-CPD	2 times per year																																																															
Reference Stations																																																																
	RBA	2 times per year																																																														
	RBB	2 times per year																																																															
	RBC1	2 times per year																																																															
Impact Monitoring for Dredging																																																																
Upstream Stations																																																																
	US1	3 times per week														2	2	2	2	2																																													
	US2	3 times per week														2	2	2	2	2																																													
Downstream Stations																																																																
	DS1	3 times per week														2	2	2	2	2																																													
	DS2	3 times per week														2	2	2	2	2																																													
	DS3	3 times per week														2	2	2	2	2																																													
	DS4	3 times per week														2	2	2	2	2																																													
	DS5	3 times per week														2	2	2	2	2																																													
Ma Wan Station																																																																
	MW1	3 times per week														2	2	2	2	2																																													

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

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

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

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

Remarks:
***** A proposal on the change of number of sample replication of water quality & sediment monitoring and combination of routine water quality monitoring and water quality monitoring during capping operation was submitted to EPD and agreed by EPD on 3 December 2020. The proposed changes have been implemented for the EM&A activities since December 2020. Water Quality Monitoring during Capping Operation and Routine Water Quality Monitoring are combined such that Routine Water Quality Monitoring have been conducted monthly starting in December 2020. A technical note presenting the data review results served as a supplementary information was submitted to EPD and presented that Phase 2 optimization of sample replication of water quality and sediment monitoring for the Project will be implemented in 2022 was provided to EPD in April 2022. Phase 2 optimization of sample replication has been effective for the EM&A activities since July 2022.
Due to the logistic problem induced by the pandemic which adversely affecting the supply of international species adopted in testing programme of Sediment Toxicity Tests, as such, Sediment Toxicity Tests of ESC CMPs originally scheduled in February 2022 were postponed to March 2022.
^ To enable the required Research Fishing Permit could be granted by the time undertaking the Demersal Trawling, trawling originally scheduled in July and August 2022 was postponed to August and September 2022.

Appendix B. Disposal and Capping Records

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Jul 2023	0	963,124
2 Jul 2023	0	963,124
3 Jul 2023	0	963,124
4 Jul 2023	0	963,124
5 Jul 2023	0	963,124
6 Jul 2023	0	963,124
7 Jul 2023	75	963,199
8 Jul 2023	0	963,199
9 Jul 2023	0	963,199
10 Jul 2023	0	963,199
11 Jul 2023	0	963,199
12 Jul 2023	0	963,199
13 Jul 2023	0	963,199
14 Jul 2023	0	963,199
15 Jul 2023	63	963,262
16 Jul 2023	0	963,262
17 Jul 2023	0	963,262
18 Jul 2023	0	963,262
19 Jul 2023	0	963,262
20 Jul 2023	0	963,262
21 Jul 2023	0	963,262
22 Jul 2023	93	963,355
23 Jul 2023	0	963,355
24 Jul 2023	0	963,355
25 Jul 2023	0	963,355
26 Jul 2023	0	963,355
27 Jul 2023	0	963,355
28 Jul 2023	496	963,851
29 Jul 2023	456	964,307
30 Jul 2023	0	964,307
31 Jul 2023	27	964,334

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Aug 2023	385	964,719
2 Aug 2023	0	964,719
3 Aug 2023	0	964,719
4 Aug 2023	0	964,719
5 Aug 2023	0	964,719
6 Aug 2023	0	964,719
7 Aug 2023	0	964,719
8 Aug 2023	0	964,719
9 Aug 2023	0	964,719
10 Aug 2023	0	964,719
11 Aug 2023	39	964,758
12 Aug 2023	0	964,758
13 Aug 2023	0	964,758
14 Aug 2023	0	964,758
15 Aug 2023	1,151	965,909
16 Aug 2023	0	965,909
17 Aug 2023	370	966,279
18 Aug 2023	0	966,279
19 Aug 2023	409	966,688
20 Aug 2023	0	966,688
21 Aug 2023	0	966,688
22 Aug 2023	81	966,769
23 Aug 2023	68	966,837
24 Aug 2023	0	966,837
25 Aug 2023	0	966,837
26 Aug 2023	0	966,837
27 Aug 2023	0	966,837
28 Aug 2023	97	966,934
29 Aug 2023	0	966,934
30 Aug 2023	168	967,102
31 Aug 2023	0	967,102

B1. Disposal Record at ESC CMP Vb

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Sep 2023	0	967,102
2 Sep 2023	0	967,102
3 Sep 2023	0	967,102
4 Sep 2023	0	967,102
5 Sep 2023	0	967,102
6 Sep 2023	0	967,102
7 Sep 2023	200	967,302
8 Sep 2023	0	967,302
9 Sep 2023	100	967,402
10 Sep 2023	0	967,402
11 Sep 2023	0	967,402
12 Sep 2023	369	967,771
13 Sep 2023	200	967,971
14 Sep 2023	300	968,271
15 Sep 2023	200	968,471
16 Sep 2023	300	968,771
17 Sep 2023	0	968,771
18 Sep 2023	300	969,071
19 Sep 2023	200	969,271
20 Sep 2023	271	969,542
21 Sep 2023	200	969,742
22 Sep 2023	200	969,942
23 Sep 2023	200	970,142
24 Sep 2023	0	970,142
25 Sep 2023	200	970,342
26 Sep 2023	100	970,442
27 Sep 2023	200	970,642
28 Sep 2023	100	970,742
29 Sep 2023	100	970,842
30 Sep 2023	0	970,842

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Jul 2023	1,818	607,898
2 Jul 2023	645	608,543
3 Jul 2023	644	609,187
4 Jul 2023	647	609,834
5 Jul 2023	2,300	612,134
6 Jul 2023	1,293	613,427
7 Jul 2023	1,938	615,365
8 Jul 2023	1,296	616,661
9 Jul 2023	1,753	618,414
10 Jul 2023	1,296	619,710
11 Jul 2023	1,286	620,996
12 Jul 2023	1,937	622,933
13 Jul 2023	648	623,581
14 Jul 2023	1,293	624,874
15 Jul 2023	1,933	626,807
16 Jul 2023	0	626,807
17 Jul 2023	0	626,807
18 Jul 2023	648	627,455
19 Jul 2023	1,295	628,750
20 Jul 2023	1,294	630,044
21 Jul 2023	1,293	631,337
22 Jul 2023	1,295	632,632
23 Jul 2023	1,937	634,569
24 Jul 2023	1,295	635,864
25 Jul 2023	1,294	637,158
26 Jul 2023	2,974	640,132
27 Jul 2023	1,292	641,424
28 Jul 2023	1,942	643,366
29 Jul 2023	1,295	644,661
30 Jul 2023	1,295	645,956
31 Jul 2023	645	646,601

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Aug 2023	646	647,247
2 Aug 2023	645	647,892
3 Aug 2023	641	648,533
4 Aug 2023	1,293	649,826
5 Aug 2023	934	650,760
6 Aug 2023	1,290	652,050
7 Aug 2023	0	652,050
8 Aug 2023	643	652,693
9 Aug 2023	647	653,340
10 Aug 2023	641	653,981
11 Aug 2023	1,141	655,122
12 Aug 2023	1,141	656,263
13 Aug 2023	1,143	657,406
14 Aug 2023	1,136	658,542
15 Aug 2023	1,141	659,683
16 Aug 2023	450	660,133
17 Aug 2023	496	660,629
18 Aug 2023	1,144	661,773
19 Aug 2023	1,136	662,909
20 Aug 2023	441	663,350
21 Aug 2023	1,087	664,437
22 Aug 2023	1,143	665,580
23 Aug 2023	506	666,086
24 Aug 2023	498	666,584
25 Aug 2023	1,100	667,684
26 Aug 2023	1,093	668,777
27 Aug 2023	503	669,280
28 Aug 2023	442	669,722
29 Aug 2023	454	670,176
30 Aug 2023	440	670,616
31 Aug 2023	0	670,616

B2. Capping Record at ESC CMP Vd

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1 Sep 2023	0	670,616
2 Sep 2023	0	670,616
3 Sep 2023	0	670,616
4 Sep 2023	947	671,563
5 Sep 2023	999	672,562
6 Sep 2023	495	673,057
7 Sep 2023	498	673,555
8 Sep 2023	0	673,555
9 Sep 2023	25	673,580
10 Sep 2023	1,006	674,586
11 Sep 2023	499	675,085
12 Sep 2023	496	675,581
13 Sep 2023	994	676,575
14 Sep 2023	990	677,565
15 Sep 2023	501	678,066
16 Sep 2023	502	678,568
17 Sep 2023	1,005	679,573
18 Sep 2023	998	680,571
19 Sep 2023	502	681,073
20 Sep 2023	496	681,569
21 Sep 2023	2,121	683,690
22 Sep 2023	1,000	684,690
23 Sep 2023	996	685,686
24 Sep 2023	1,008	686,694
25 Sep 2023	993	687,687
26 Sep 2023	1,002	688,689
27 Sep 2023	496	689,185
28 Sep 2023	1,002	690,187
29 Sep 2023	997	691,184
30 Sep 2023	0	691,184

Appendix C. Statistical Analysis

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

Dissolved Oxygen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	158.96	41	377.47	**
Area	0.80	3	25.83	**
Period:Area	7.87	123	6.23	**
Residuals	51.20	4985		

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	6428.93	42	1168.63	**
Area	62.86	3	159.97	**
Period:Area	64.90	126	3.93	**
Residuals	445.47	3401		

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	2235.34	41	270.70	**
Area	154.08	3	255.00	**
Period:Area	290.62	123	11.73	**
Residuals	1004.01	4985		

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	94693.65	42	121.98	**
Area	3467.08	3	62.52	**
Period:Area	13445.29	126	5.77	**
Residuals	62864.30	3401		

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	9.88	6	48.84	**
Area	0.12	3	1.19	N.S.
Period:Area	1.07	18	1.76	N.S.
Residuals	6.64	197		

Note:

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

SNK Results:

- Overall result:
  Ma Wan = Impact = Reference = 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.

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1.75	7	32.24	**
Area	0.03	3	1.47	N.S.
Period:Area	0.43	21	2.66	**
Residuals	0.99	128		

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	0.00867	6	7.92	**
Area	0.00078	3	1.43	N.S.
Period:Area	0.00458	18	1.39	N.S.
Residuals	0.03594	197		

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	0.00709	7	5.28	**
Area	0.00024	3	0.41	N.S.
Period:Area	0.00392	21	0.97	N.S.
Residuals	0.02454	128		

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	10.09	6	8.49	**
Area	0.51	3	0.86	N.S.
Period:Area	6.49	18	1.82	**
Residuals	38.99	197		

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	2.49	7	5.51	**
Area	0.23	3	1.19	N.S.
Period:Area	1.19	21	0.88	N.S.
Residuals	8.26	128		

Note:

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

SNK Results:

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

Copper

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	12.53	6	59.40	**
Area	0.61	3	5.75	**
Period:Area	1.38	18	2.18	**
Residuals	6.93	197		

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	1.91	7	8.85	**
Area	1.13	3	12.25	**
Period:Area	1.24	21	1.91	**
Residuals	3.95	128		

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

SNK Results:
- Overall result:

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

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

Mercury

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1.58×10^{-04}	6	5.36	**
Area	4.18×10^{-06}	3	0.28	N.S.
Period:Area	7.40×10^{-05}	18	0.84	N.S.
Residuals	9.65×10^{-04}	197		

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	4.04×10^{-03}	7	7.52	**
Area	1.97×10^{-04}	3	0.86	N.S.
Period:Area	1.02×10^{-03}	21	0.63	N.S.
Residuals	9.82×10^{-03}	128		

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

SNK Results:
- Overall result:
  Reference = Ma Wan = 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.

Nickel

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	11.31	6	133.31	**
Area	0.44	3	10.41	**
Period:Area	0.59	18	2.32	**
Residuals	2.78	197		

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	4.59	7	33.81	**
Area	1.28	3	21.97	**
Period:Area	0.47	21	1.14	N.S.
Residuals	2.48	128		

Note:

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

SNK Results:

- Overall result:

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

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

Zinc

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	21.56	6	7.21	**
Area	16.50	3	11.04	**
Period:Area	27.72	18	3.09	**
Residuals	98.16	197		

Note:

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

SNK Results:

- Overall result:

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

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

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	10.38	7	8.38	**
Area	14.56	3	27.44	**
Period:Area	19.78	21	5.32	**
Residuals	22.65	128		

Note:

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

SNK Results:

- Overall result:

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

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

Ammonia Nitrogen

Ebb Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	1160.98	41	339.22	**
Area	16.67	3	66.56	**
Period:Area	102.50	123	9.98	**
Residuals	325.30	3897		

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	860.33	42	112.55	**
Area	7.26	3	13.29	**
Period:Area	63.01	126	2.75	**
Residuals	456.09	2506		

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	564.42	41	466.00	**
Area	21.89	3	246.95	**
Period:Area	40.19	123	11.06	**
Residuals	115.12	3897		

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

SNK Results:
- Overall result:

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

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

Flood Tide

Source	Type II Sum of Square	Df	F value	Significance Level
Period	651.98	42	304.39	**
Area	12.71	3	83.07	**
Period:Area	41.74	126	6.50	**
Residuals	127.80	2506		

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	590.72	41	111.72	**
Area	14.21	3	36.73	**
Period:Area	191.23	123	12.06	**
Residuals	502.55	3897		

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	725.55	42	182.11	**
Area	21.45	3	75.37	**
Period:Area	153.66	126	12.86	**
Residuals	237.72	2506		

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	888.85	41	240.96	**
Area	42.88	3	158.86	**
Period:Area	150.17	123	13.57	**
Residuals	350.62	3897		

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	652.82	42	157.22	**
Area	15.85	3	53.42	**
Period:Area	126.26	126	10.14	**
Residuals	247.75	2506		

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 September 2023

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	80.83	43	113.89	**
Area	7.81	2	236.48	**
Direction	9.09	1	550.56	**
Period:Area	18.66	86	13.15	**
Period:Direction	6.51	43	9.17	**
Area:Direction	8.65	2	261.92	**
Period:Area:Direction	17.07	86	12.03	**
Residuals	21.78	1320		

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

SNK Results:
- Overall result:
  $\left.\begin{array}{l}\text{Pit Edge} > \text{Active Pit} \\ \text{Pit Edge} > \text{Near Pit} \\ \text{Active Pit} > \text{Near Pit}\end{array}\right\}$ ∴ 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	80.85	43	17.82	**
Area	117.28	2	555.84	**
Direction	1.83	1	17.37	**
Period:Area	62.59	86	6.90	**
Period:Direction	29.26	43	6.45	**
Area:Direction	36.76	2	174.24	**
Period:Area:Direction	47.10	86	5.19	**
Residuals	139.26	1320		

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

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

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

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

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Period	33.72	43	53.94	**
Area	21.93	2	754.44	**
Direction	6.49	1	446.58	**
Period:Area	9.57	86	7.66	**
Period:Direction	4.23	43	6.77	**
Area:Direction	17.81	2	612.79	**
Period:Area:Direction	8.10	86	6.48	**
Residuals	19.19	1320		

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
  - Ebb Tide: Apr 2020, Oct 2020, Nov 2020, May 2021, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023
- Potential project related spatial trend was detected in one month for flood tide direction over the reporting period.

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Period	35.47	43	24.16	**
Area	193.70	2	2837.03	**
Direction	17.86	1	523.16	**
Period:Area	31.44	86	10.71	**
Period:Direction	16.70	43	11.38	**
Area:Direction	54.67	2	800.69	**
Period:Area:Direction	38.81	86	13.22	**
Residuals	45.06	1320		

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
- No potential project related spatial trend were detected for the reporting months.

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Period	18.61	43	13.20	**
Area	28.60	2	436.06	**
Direction	8.37	1	255.16	**
Period:Area	13.61	86	4.83	**
Period:Direction	4.78	43	3.39	**
Area:Direction	9.01	2	137.33	**
Period:Area:Direction	6.83	86	2.42	**
Residuals	43.28	1320		

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
  - 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
- Potential project related spatial trend was detected in one month for flood tide direction over the reporting period.

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Period	137.96	43	15.06	**
Area	111.02	2	260.66	**
Direction	76.43	1	358.88	**
Period:Area	77.30	86	4.22	**
Period:Direction	37.87	43	4.14	**
Area:Direction	107.60	2	252.62	**
Period:Area:Direction	39.55	86	2.16	**
Residuals	281.12	1320		

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	27.19	43	64.86	**
Area	22.50	2	1153.89	**
Direction	13.76	1	1411.02	**
Period:Area	11.51	86	13.73	**
Period:Direction	5.89	43	14.06	**
Area:Direction	22.24	2	1140.60	**
Period:Area:Direction	9.60	86	11.44	**
Residuals	12.87	1320		

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
  - Ebb Tide: Jun 2020, Jul 2020, Oct 2020, Oct 2021, Jan 2022, Feb 2022, Sep 2022, Mar 2023, Apr 2023
- Potential project related spatial trend was detected in one month for flood tide direction over the reporting period.

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Period	193.41	43	52.42	**
Area	347.14	2	2022.93	**
Direction	3.32	1	38.71	**
Period:Area	77.54	86	10.51	**
Period:Direction	37.79	43	10.24	**
Area:Direction	42.12	2	245.44	**
Period:Area:Direction	63.43	86	8.60	**
Residuals	113.26	1320		

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	20.12	43	40.78	**
Area	55.67	2	2426.46	**
Direction	3.60	1	314.20	**
Period:Area	16.28	86	16.50	**
Period:Direction	7.20	43	14.59	**
Area:Direction	9.85	2	429.27	**
Period:Area:Direction	12.15	86	12.32	**
Residuals	15.14	1320		

Note:

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

SNK Results:

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

Total Organic Carbon

Source	Type II Sum of Square	Df	F value	Significance Level
Period	114.16	43	136.48	**
Area	71.10	2	1827.48	**
Direction	8.59	1	441.61	**
Period:Area	45.09	86	26.95	**
Period:Direction	14.57	43	17.41	**
Area:Direction	12.38	2	318.16	**
Period:Area:Direction	32.27	86	19.29	**
Residuals	25.68	1320		

Note:

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

SNK Results:

- Overall result:
  Active Pit > Near Pit
  Active Pit > Pit Edge
  Near Pit > Pit Edge
  ∴ no overall significant project related impact.
- Months showing potential project related spatial trend (i.e. Active Pit > Pit Edge > Near Pit): Direction
  - Flood Tide: Feb 2020, Apr 2020, May 2020, Aug 2020, Oct 2020, May 2021, Jun 2021, Jul 2021, Sep 2021, Nov 2021, Feb 2022, Mar 2022, Jul 2022, Aug 2022, Jan 2023
  - Ebb Tide: Jul 2020, Oct 2020, May 2021, Jun 2021, Oct 2021, Jul 2022, Feb 2023, Mar 2023, Aug 2023
- Potential project related spatial trend was detected in one month for ebb tide direction over the reporting period.

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

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Period	70.71	29	123.76	**
Area	103.82	4	1317.50	**
Period:Area	67.68	116	29.62	**
Residuals	44.56	2262		

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	73.91	29	21.53	**
Area	70.56	4	148.99	**
Period:Area	60.05	116	4.37	**
Residuals	267.81	2262		

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	11164.23	29	40.36	**
Area	80366.97	4	2106.35	**
Period:Area	18962.23	116	17.14	**
Residuals	21576.40	2262		

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	13335.83	29	15.19	**
Area	265317.79	4	2190.39	**
Period:Area	28369.11	116	8.08	**
Residuals	68497.81	2262		

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	33799.58	29	82.51	**
Area	78098.84	4	1382.20	**
Period:Area	20942.22	116	12.78	**
Residuals	31952.54	2262		

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	417.22	29	32.52	**
Area	51.34	4	29.01	**
Period:Area	233.26	116	4.55	**
Residuals	1000.71	2262		

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	3409.45	29	26.53	**
Area	29483.31	4	1663.57	**
Period:Area	9595.71	116	18.67	**
Residuals	10022.31	2262		

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	177.46	29	37.35	**
Area	819.71	4	1250.94	**
Period:Area	88.69	116	4.67	**
Residuals	370.56	2262		

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	17.61	29	25.70	**
Area	147.85	4	1565.10	**
Period:Area	49.51	116	18.07	**
Residuals	53.42	2262		

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	2141910212	29	48.72	**
Area	3712408930	4	612.21	**
Period:Area	4009260828	116	22.80	**
Residuals	3429181296	2262		

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 23 July 2023)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.45	4	41.90	**
Residuals	0.11	13		

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

SNK Results:

- $\text{Mid-Field} > \text{Far-Field} > \text{Near-Field} > \text{Maw Wan} > \text{Capped-pit}$

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0175	4	9.2673	**
Residuals	0.0061	13		

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Mid-Field} = \text{Far-Field} = \text{Near-Field} \\ \text{Ma Wan, Mid-Field, Far-Field, Near-Field} > \text{Capped-pit} \end{cases}$

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	875.05	4	33.94	**
Residuals	83.80	13		

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Mid-Field} = \text{Far-Field} \\ \text{Ma Wan, Mid-Field, Far-Field} > \text{Near-Field} \\ \text{Near-Field} > \text{Capped-pit} \\ \text{Ma Wan, Mid-Field, Far-Field} > \text{Capped-pit} \end{cases}$

Copper

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.63	4	16.58	**
Residuals	0.52	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Mid-Field} = \text{Far-Field} \\ \text{Ma Wan} > \text{Mid-Field, Far-Field} \\ \text{Ma Wan} > \text{Near-Field} \\ \text{Mid-Field, Far-Field} > \text{Near-Field} \\ \text{Ma Wan} > \text{Capped-pit} \\ \text{Mid-Field, Far-Field} > \text{Capped-pit} \\ \text{Near-Field} > \text{Capped-pit} \end{cases}$

Lead

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.04	4	19.28	**
Residuals	0.18	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Far-Field} = \text{Mid-Field} \\ \text{Ma Wan} > \text{Far-Field, Mid-Field} \\ \text{Ma Wan} > \text{Near-Field} \\ \text{Far-Field, Mid-Field} > \text{Near-Field} \\ \text{Ma Wan} > \text{Capped-pit} \\ \text{Far-Field, Mid-Field} > \text{Capped-pit} \\ \text{Near-Field} > \text{Capped-pit} \end{cases}$

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0136	4	8.6001	**
Residuals	0.0052	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Far-Field} = \text{Mid-Field} \\ \text{Far-Field} = \text{Mid-Field} = \text{Near-Field} \\ \text{Near-Field} = \text{Capped-pit} \\ \text{Ma Wan} > \text{Near-Field, Capped-pit} \\ \text{Far-Field, Mid-Field} > \text{Capped-pit} \end{cases}$

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	382.06	4	24.26	**
Residuals	51.19	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Far-Field} = \text{Mid-Field} \\ \text{Ma Wan, Far-Field, Mid-Field} > \text{Near-Field} \\ \text{Ma Wan, Far-Field, Mid-Field} > \text{Capped-pit} \\ \text{Near-Field} > \text{Capped-pit} \end{cases}$

Silver

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.395	4	47.687	**
Residuals	0.027	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Mid-Field} = \text{Far-Field} = \text{Near-Field} = \text{Capped-pit} \\ \text{Ma Wan} > \text{Mid-Field, Far-Field, Near-Field, Capped-pit} \end{cases}$

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	3.22	4	47.48	**
Residuals	0.22	13		

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

Sediment Chemistry of ESC CMPs after a Major Storm Event (on 5 September 2023)

Arsenic

Source	Type II Sum of Square	Df	F value	Significance Level
Area	1.89	4	18.23	**
Residuals	0.34	13		

Note:

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

SNK Results:

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

Cadmium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0114	4	6.2407	**
Residuals	0.0059	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Mid-Field} = \text{Far-Field} \\ \text{Mid-Field} = \text{Far-Field} = \text{Near-Field} \\ \text{Near-Field} = \text{Capped-pit} \\ \text{Ma Wan} > \text{Near-Field, Capped-pit} \\ \text{Mid-Field, Far-Field} > \text{Capped-pit} \end{cases}$

Chromium

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.39	4	29.15	**
Residuals	0.27	13		

Note:

3. Assume Gamma distribution
4. 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	4.39	4	14.62	**
Residuals	0.98	13		

Note:

3. Assume Gamma distribution
4. 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	1.67	4	17.07	**
Residuals	0.32	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Near-Field} = \text{Far-Field} \\ \text{Ma Wan} > \text{Near-Field, Far-Field} > \text{Mid-Field} > \text{Capped-pit} \end{cases}$

Mercury

Source	Type II Sum of Square	Df	F value	Significance Level
Area	6.01	4	33.10	**
Residuals	0.59	13		

Note:

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

SNK Results:

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

Nickel

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.60	4	27.34	**
Residuals	0.31	13		

Note:

3. Assume Gamma distribution
4. 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	0.195	4	29.857	**
Residuals	0.021	13		

Note:

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

SNK Results:

- $\begin{cases} \text{Far-Field} = \text{Mid-Field} = \text{Near-Field} = \text{Capped-pit} \\ \text{Ma Wan} > \text{Far-Field, Mid-Field, Near-Field, Capped-pit} \end{cases}$

Zinc

Source	Type II Sum of Square	Df	F value	Significance Level
Area	2.39	4	37.04	**
Residuals	0.21	13		

Note:

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

SNK Results:

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

Sediment Toxicity for ESC CMPs – August 2023

Survival rate for burrowing amphipod *Leptochirus plumulosus*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0020	2	1.9629	N.S.
Residuals	0.0110	22		

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

Growth rate for benthic polychaete *Neanthes arenaceodentata*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0010	2	2.7280	N.S.
Residuals	0.0041	22		

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

Survival rate for marine bivalve *Crassostrea gigas*

Source	Type II Sum of Square	Df	F value	Significance Level
Area	0.0004	2	4.8500	**
Residuals	0.0008	22		

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

SNK Results:

- $\begin{cases} \text{Ma Wan} = \text{Reference} \\ \text{Reference} = \text{Near} - \text{Field} \\ \text{Ma Wan} > \text{Near} - \text{Field} \end{cases}$ $\therefore$ no significant project related impact.

Mortality rate for barnacles *Balanus Amphitrite*

Source	Df	F value	Significance Level
Area	2	8.7653	**
Residuals	21		

Note:

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

Post-hoc (Tukey's Test) Results:

- $\begin{cases} \text{Reference} = \text{Ma Wan} \\ \text{Near} - \text{Field} > \text{Reference} \\ \text{Near} - \text{Field} > \text{Ma Wan} \end{cases}$ $\therefore$ potential significant project related impact.

Mortality rate for shrimp *Penaeus vannaamei*

Source	Df	F value	Significance Level
Area	2	4.0950	**
Residuals	21		

Note:

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

Post-hoc (Tukey's Test) Results:

- $\begin{cases} \text{Reference} = \text{Ma Wan} \\ \text{Near} - \text{Field} > \text{Reference} \\ \text{Near} - \text{Field} > \text{Ma Wan} \end{cases}$ $\therefore$ potential significant project related impact.