土木工程拓展署
Civil Engineering and Development Department

Agreement No. CE 63/2016 (EP)

Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2017-2020) – Investigation

Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – January to March 2020

Revision 0

May 2020

Environmental Resources Management
2507, 25/F
One Harbourfront
18 Tak Fung Street
Hunghom, Kowloon
Hong Kong
Telephone (852) 2271 3000
Facsimile (852) 2723 5660

www.erm.com

ERM

The business of sustainability

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

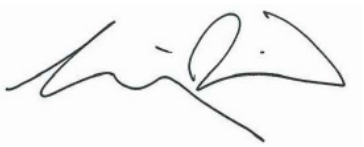
Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau – January to March 2020

Revision 0

Document Code: 0400720_CMP Quarterly Jan-Mar 2020_v0.doc

Environmental Resources Management

2507, 25/F
One Harbourfront
18 Tak Fung Street
Hunghom, Kowloon
Hong Kong
Telephone: (852) 2271 3000
Facsimile: (852) 2723 5660
E-mail: post.hk@erm.com
http://www.erm.com

Client:	Project No:
Civil Engineering and Development Department (CEDD)	0400720
Summary: This document presents the Quarterly EM&A Report for *Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau*.	Date: 29 May 2020 Approved by:  Craig A. Reid *Partner*

Revision	Description	By	Checked	Approved	Date
v0	Quarterly EM&A Report for ESC CMPs	GS	RC	CAR	29/5/20

Distribution

☐ Internal

☒ Public

☐ Confidential

OHSAS 18001:2007
Certificate No. OHS 515956

ISO 9001 : 2008
Certificate No. FS 32515

土木工程拓展署
Civil Engineering and Development Department

ERM

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

Environmental Certification Sheet
EP-312/2008/A

Reference Document/Plan

Document/~~Plan~~ to be ~~Certified~~/ Verified:	Quarterly EM&A Report for Contaminated Mud Pits to the East of Sha Chau - January to March 2020
Date of Report:	29 May 2020
Date prepared by ET:	29 May 2020
Date received by IA:	29 May 2020

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 in the EM&A Manual. Any changes to the monitoring and audit requirements shall be justified by the ET leader and verified by the Independent Auditor as conforming to the requirements set out in the EM&A Manual, and shall seek the prior approval from the Director before implementation.

ET Certification

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

Craig A. Reid,
Environmental Team Leader:  Date: 29/5/2020

IA Verification

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

Dr Wang Wen Xiong,
Independent Auditor:  Date: 29/5/2020

CONTENTS

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

Quarterly Environmental Monitoring and Audit (EM&A) Report for January to March 2020

EXECUTIVE SUMMARY

Water Column Profiling, Routine Water Quality Monitoring, Pit Specific Sediment Chemistry, Cumulative Impact Sediment Chemistry, Sediment Toxicity Test, Demersal Trawling and *Water Quality Monitoring during Capping Operation of ESC CMPs* were carried out for the Contaminated Mud Pits (CMPs) to the East of Sha Chau (ESC) during the quarterly period of January to March 2020. 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 / Vd – January to March 2020

Results indicated that levels of Salinity, pH and Dissolved Oxygen (DO) complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream stations. Levels of DO, Turbidity and Suspended Solids (SS) complied with the Action and Limit Levels at all stations. Overall, the results indicated that the mud disposal operation at ESC CMP Vb / Vd did not appear to cause any unacceptable impact in water quality during this quarterly period.

Routine Water Quality Monitoring of ESC CMPs – January and February 2020

Results of Routine Water Quality Monitoring conducted in January and February 2020 showed that levels of DO, Salinity and pH complied with the WQOs at all 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 CMP Vb / Vd have not caused any unacceptable impact in water quality during the reporting period.

Water Quality Monitoring during Capping Operation of ESC CMPs – February 2020

Concentrations of DO, pH and SS complied with the WQOs at all stations in February 2020. Concentrations of DO, Turbidity and SS complied with the Action and Limit Levels at all stations in February 2020. From the statistical

analysis, there were no trends indicating any increase in the concentrations of contaminants with proximity to the pit or with time. Overall, the results indicated that capping operations at ESC CMPs did not appear to cause any unacceptable water quality impact during the reporting period.

Sediment Quality Monitoring for ESC CMPs

Pit Specific Sediment Chemistry of ESC CMP Vb / Vd – January to March 2020

Monitoring results showed that the concentrations of inorganic contaminants were generally 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 did not cause any unacceptable impact in sediment quality of ESC CMP Vb / Vd during the reporting period.

Cumulative Impact Sediment Chemistry of ESC CMPs – February 2020

Monitoring results showed that the concentrations of inorganic contaminants were generally below the LCELs at all 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 is considered that mud disposal operations at ESC CMP Vb / Vd have not caused any unacceptable impact in sediment quality during the reporting period.

Sediment Toxicity Test of ESC CMPs – February 2020

Statistical analysis showed that there were no significant differences between Impact and Reference stations in the toxicity tests of all tested marine benthos. Therefore, 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

During the sampling period in January and February 2020, the mean number of faunal species caught was generally lower at Impact stations in January and February 2020. 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, except the Biomass and YPUE at Impact station ESC-INA were higher than those at most Reference stations in January 2020, and the Biotic abundance and CPUE at Impact station ESC-INB were higher than those at most Reference stations in January 2020.

合約編號 第CE 63/2016（EP）號

沙洲以東海泥卸置設施的環境監察及審核（2017–2020）–勘查研究

環境監察及審核季度報告（二零二零年一月至三月）

行政摘要

在2020年1月至3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、沉積物毒性測試、底棲漁業資源監察及泥坑覆蓋過程之水質監察。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–2020年1月至3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 / Vd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–2020年1月和2月

2020年1月和2月的例行水質監察結果顯示受影響監測站、中距離監測站及參考監測站的溶解氧含量、鹽度及酸鹼值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。

泥坑覆蓋過程之水質監察–2020年2月

在2020年2月，所有監測站的溶解氧濃度、酸鹼值水平及懸浮固體含量均符合水質指標 (WQOs) ，而所有監測站的溶解氧濃度、渾濁度及懸浮固體含量均符合行動及極限水平。從統計結果顯示，海水內的污染物濃度並沒有因越接近污泥

坑而趨向增加，亦沒有隨著時間而增加。總括而言，結果顯示在報告期內泥坑的覆蓋運作並沒有引致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–2020年1月至3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–2020年2月

監察結果顯示，所有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。

沙洲以東污泥坑之沉積物毒性測試–2020年2月

從統計結果顯示，所有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。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

監察結果顯示，2020年1月和2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2020年1月及2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普遍錄得較低的數值，除了在1月期間受影響監測站ESC-INA的生物重量及單位努力生產量比大部份參考監測站錄得高的數值，而受影響監測站ESC-INB的生物量及單位努力漁獲量則比大部份參考監測站錄得高的數值。

1 INTRODUCTION

1.1 PROJECT DESCRIPTION

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

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

1.1.3 The present EM&A programme under *Agreement No. CE 63/2016 (EP)* ("the Study") covers the dredging, disposal and capping operations of the ESC CMP V as well as the capping operations of the SB CMPs (see *Annex A* for the EM&A programme). The scheduled EM&A programme for SB CMPs was completed in December 2018.

(1) ERM (2013). Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau. Final Report. For CEDD.

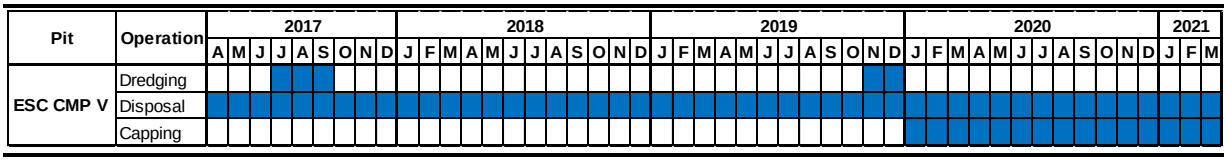
(2) ERM (2017). Environmental Monitoring and Audit for Contaminated Mud Pit V at East of Sha Chau (2012 - 2017). Final Report. For CEDD.

1.2 ACTIVITIES CONDUCTED DURING THE REPORTING PERIOD

1.2.1 Detailed works schedule for ESC CMP V and SB CMPs is shown in *Figure 1.1*. During the reporting period of January to March 2020, the following works were being undertaken at the CMPs:

- Disposal of contaminated mud at ESC CMP Vd up to 15 January 2020;
- Disposal of contaminated mud at ESC CMP Vb since 16 January 2020; and
- Capping operations at ESC CMP Vd since 16 January 2020.

Figure 1.1 Works Schedule for ESC CMPs



1.2.2 The records for contaminated mud disposal at ESC CMP Vd and Vb during the reporting period are presented in *Annex B1* and *Annex B2*, respectively. The record for capping operation at ESC CMP Vd during the reporting period is presented in *Annex B3*.

1.3 OBJECTIVES OF THE MONITORING AND AUDIT PROGRAMME

1.3.1 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;
2) To monitor and report on the environmental impacts due to capping operations of the exhausted pits;
3) To monitor and report on the environmental impacts of the disposal of contaminated marine sediments in the active pits 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 toxicity of sediment adjacent to the pits;
    c. changes/trends caused by disposal activities in the concentrations of contaminants in tissues of demersal marine life adjacent to and remote from the pits;
    d. impacts on water quality and benthic ecology caused by the disposal activities; and

e. 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 and specifically to determine whether the methods of disposal are effective in reducing the risks of unacceptable environmental impacts.

5) To monitor and report on the benthic recolonisation of the capped pits 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.

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.

1.3.2 The purpose of this *Quarterly EM&A Report for January to March 2020* is to provide information regarding the findings in the quarterly reporting period of January to March 2020 on the environmental impacts resulting from backfilling operation at ESC CMP Vb and 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.

1.3.3 The objectives of this report are to:

- Confirm that all activities, tests, analyses, assessments etc. have been carried out as stated in the *EM&A Manual*; and,

- Report on any trend resulting from dredging, backfilling and capping operations at the CMPs.

2 ENVIRONMENTAL MONITORING & AUDITING PROGRAMME

2.1 ENVIRONMENTAL MONITORING & AUDITING TASKS

2.1.1 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 ANALYSES

2.2.1 Details regarding the methodologies for the field sampling and laboratory analyses of the monitoring tasks listed in *Section 2.1* are presented in the *EM&A Manual* (1) as well as in *Contract No. CV/2017/04 (Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Sampling (2018-2022))* and *Contract No. CV/2017/05 (Sediment Disposal Facilities to the East of Sha Chau and East of Tung Lung Chau – Testing (2018-2022)).* Lam Geotechnics Limited and Wellab Limited were responsible for sampling under *Contract No. CV/2017/04* and laboratory analyses under *Contract No. CV/2017/05*, respectively, during the quarterly period.

(1) ERM (2017). Updated EM&A Manual for ESC CMP V. Environmental Monitoring and Audit for Disposal Facility to the East of Sha Chau (2017-2020) – Investigation. Agreement No. CE 63/2016 (EP).

3 MONITORING & AUDITING RESULTS

3.1 OVERVIEW OF THE MONITORING & AUDITING ACTIVITIES

3.1.1 Sampling & Laboratory Analysis

3.1.2 Schedules of the EM&A programme are presented in *Annex A*. The samplings, *in-situ* measurements and analyses of samples were conducted in accordance with the *EM&A Manual* during this reporting period. The samplings 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 of January to March 2020

Key Task	Date of Sampling & *in-situ* Measurement	Date of Results Received from the Contractors
ESC CMPs		
Water Column Profiling of ESC CMP Vb / Vd	7 January 2020 3 February 2020 4 March 2020	11 February 2020 4 March 2020 27 March 2020
Routine Water Quality Monitoring of ESC CMPs	8 January 2020 4 February 2020	11 February 2020 4 March 2020
Pit Specific Sediment Chemistry of ESC CMP Vb / Vd	3 January 2020 5 February 2020 3 March 2020	11 February 2020 4 March 2020 27 March 2020
Cumulative Impact Sediment Chemistry of ESC CMPs	6 & 7 February 2020	4 March 2020
Sediment Toxicity Test of ESC CMPs	6 & 7 February 2020	6 March 2020
Demersal Trawling of ESC CMPs	6 & 7 January 2020 4 & 5 February 2020	7 February 2020 9 March 2020
Water Quality Monitoring during Capping Operation of ESC CMPs	10 February 2020	2 March 2020

3.1.3 The monitoring results of the above environmental monitoring components for ESC CMPs have been presented in the respective *Monthly EM&A Reports* for this Study. The statistical analyses 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 / Vd* as the monitoring stations were mobile depending on the location of backfilling operation during the monitoring event.

3.2 *SUMMARY OF MONITORING RESULTS AND STATISTICAL ANALYSES FOR ESC CMPS*

3.2.1 *Water Column Profiling of ESC CMP Vb / Vd*

3.2.2 *Water Column Profiling* for ESC CMP Vb / Vd was conducted once every month from January to March 2020 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 and Dissolved Oxygen (DO) complied with the Water Quality Objectives (WQOs) at both Upstream and Downstream stations in January, February and March 2020. Levels of DO, Turbidity and Suspended Solids (SS) also complied with the Action and Limit Levels at all stations during the quarterly period.

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

3.2.4 *Routine Water Quality Monitoring of ESC CMPs*

Background

3.2.5 *Routine Water Quality Monitoring* for ESC CMPs was conducted in January and February 2020 as presented in *Table 3.1*. A total of sixteen (16) and ten (10) stations were sampled in January and February 2020 respectively, and locations of the monitoring stations are presented in *Figures 3.1* and *3.2*. The disposal volume during the reporting period is detailed in *Annex B*. The monitoring results showed that levels of DO, Salinity and pH complied with the WQOs and the levels of DO, Turbidity and SS also complied with the Action and Limit Levels at all stations in January and February 2020.

Summary of Statistical Analyses

3.2.6 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. For most parameters, only low concentrations were measured from February 2012 to February 2020 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. Spatio-temporal differences in *in-situ* parameters, dissolved metal, inorganic and organic contaminant contents were then tested by three-factor partially-nested Analysis of Variance (ANOVA). Area, Period and Station were treated as fixed factors under investigation with Station nested within Area.

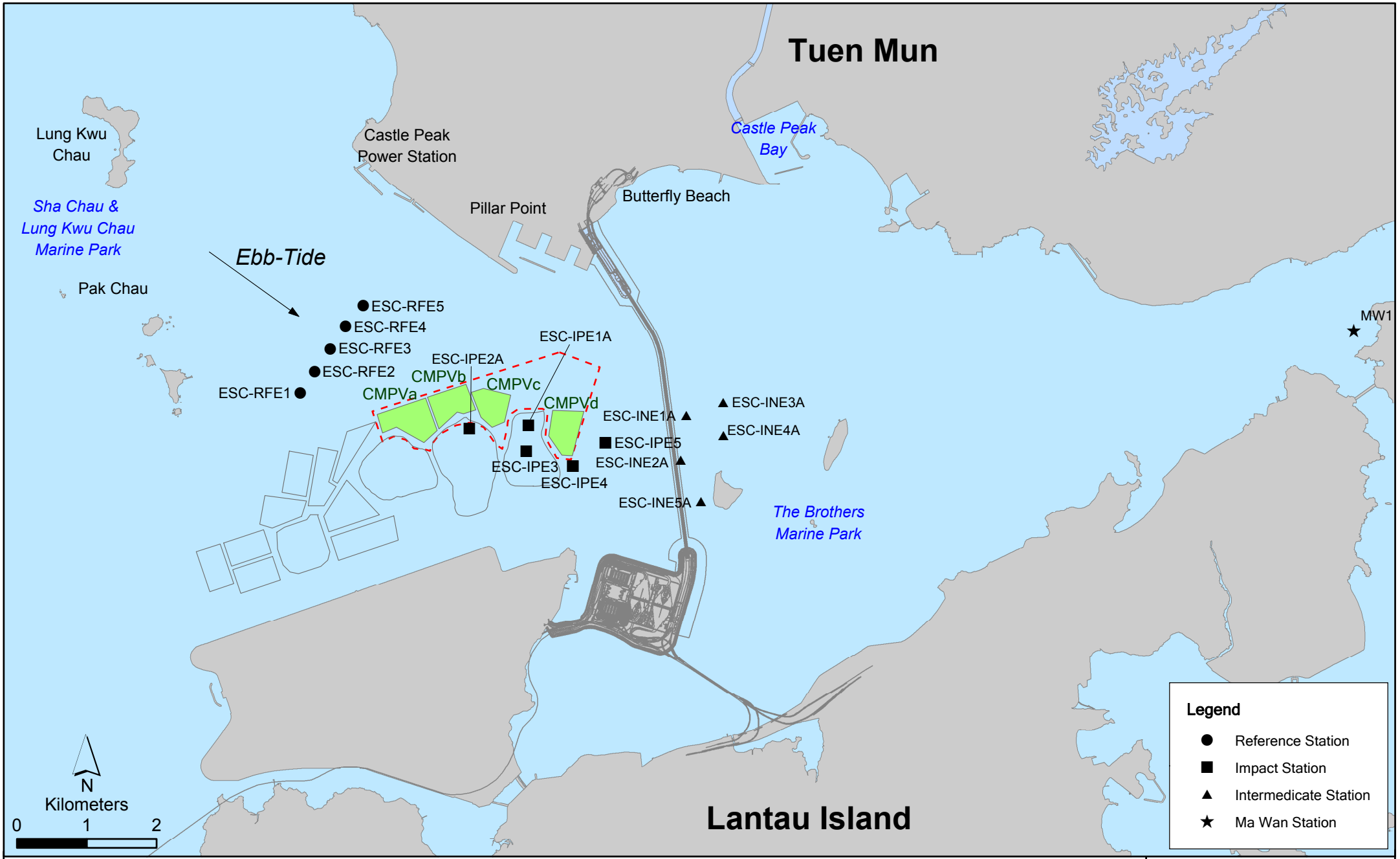


Figure 3.1

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

File: T:\GIS\CONTRACT\0175086\Mxd\updated_20170419\0175086_R_C_WQMS_ebb.mxd
Date: 19/4/2017

Environmental Resources Management

ERM

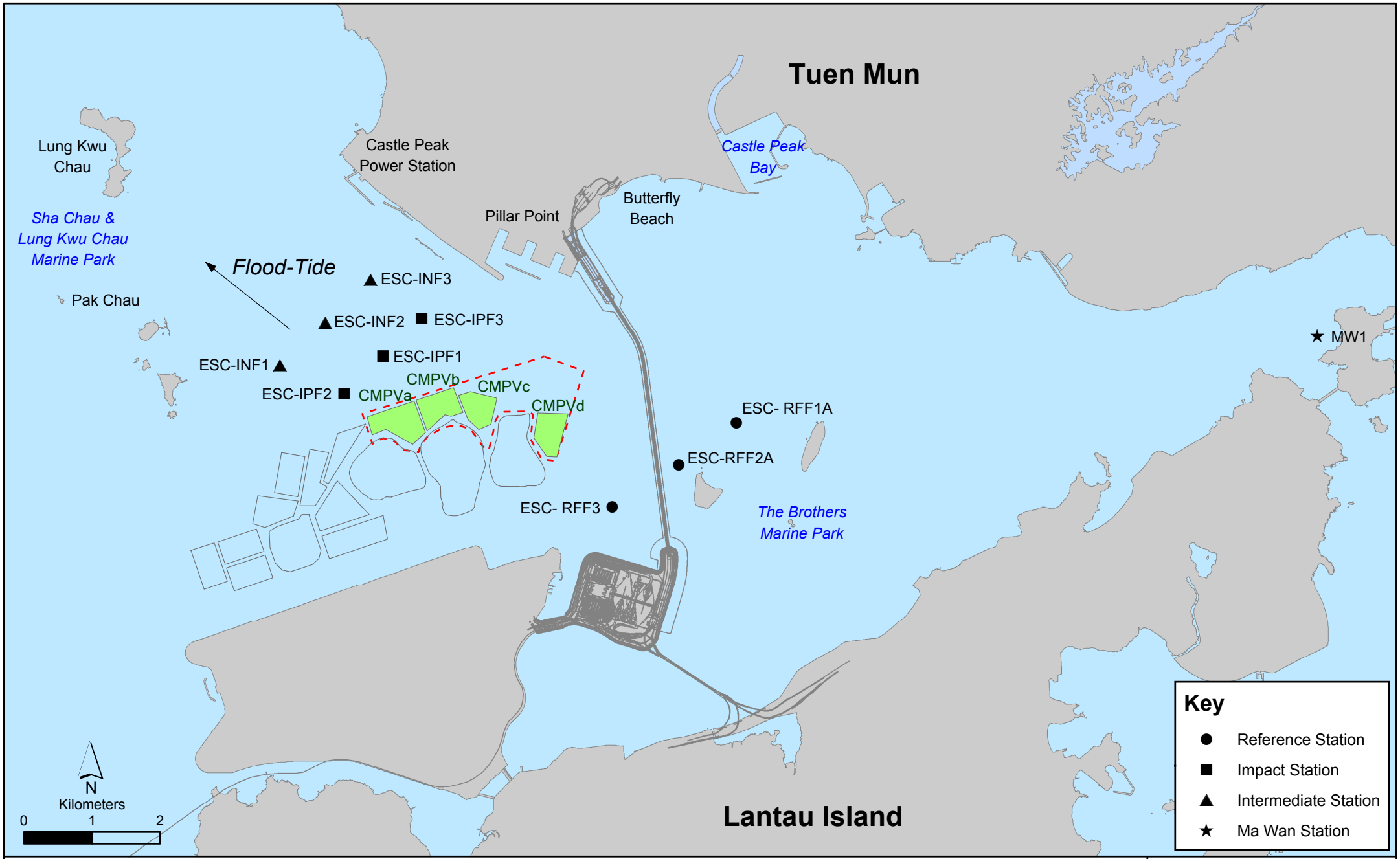


Figure 3.2

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

File: T:\GIS\CONTRACT\0175086\Mxd\updated_20170419\0175086_R_C_WQMS_flood.mxd
Date: 25/4/2017

Environmental Resources Management

ERM

3.2.7 Should spatial or temporal trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit or over time) be detected by ANOVA, linear regression analyses would be performed to examine the significance of the trend. Linear regression analysis makes assumptions of equal variance and normal distribution of data. Therefore, the significance level of the test was set at 1 % (i.e. $p = 0.01$) to reduce the chance of committing a Type 1 error. If a significant regression relationship was found between contaminant concentration and time (i.e. $p < 0.01$), r^2 value from the analysis would be further assessed. This value represents the proportion of the total variation in the dependent variable (i.e. contaminant concentration) that is accounted for by the fitted regression line and is referred to as the coefficient of determination. An r^2 value of 1 indicates a perfect relationship (or fit) whereas a value of 0 indicates that there is no relationship (or no fit) between the dependent and independent variables.

3.2.8 As there are no specific criteria to indicate how meaningful an r^2 value is, for the purposes of this EM&A programme a value of 0.60 was adopted to indicate a meaningful regression. If $r^2 < 0.60$ then it was considered that there was a weak relationship between contaminant concentration and time or proximity to the pit, or none at all. If the regression analysis indicated $r^2 > 0.60$ then it had been interpreted that there was in fact a strong relationship between the dependent and independent variables (i.e. a strong temporal trend of increasing contaminant concentration with time or strong spatial trend of increasing contaminant concentration with proximity to the pit). Details regarding the statistical analyses results are presented in *Annex C*.

In-situ Measurement

Dissolved Oxygen (DO)

3.2.9 DO levels varied significantly with sampling periods and areas. There was no consistent spatial trend of decreasing concentrations of DO with proximity to the pit or consistent temporal trend of decreasing concentrations of DO over time. DO levels were highest in February 2017 and were the lowest in July 2013, August 2016 and July 2019. DO levels were highest at Intermediate and Impact stations.

Turbidity

3.2.10 Turbidity levels varied significantly with sampling periods and areas. There was no consistent spatial trend of increasing concentrations of Turbidity with proximity to the pit or consistent temporal trend of increasing concentrations of Turbidity over time. Turbidity levels highest in November 2017 and were lowest in February 2017. Turbidity was highest at Impact and Reference stations.

Metals and Metalloid

3.2.11 The majority of dissolved metals had high percentage of their values below the limit of reporting (i.e. > 60% of values were below the limit of reporting during February 2012 to February 2020). Copper, Nickel and Zinc were the exceptions, and all varied significantly over area and time as indicated by results of the ANOVA tests (*Annex C*), but without any consistent spatial or temporal trends. The concentration of Copper was highest in August 2013 when compared to all other sampling periods. The concentration of Nickel was significantly highest in April 2012, August 2013 and May 2013. The concentration of Zinc was highest in November 2017 when compared to all other sampling periods. The concentrations of Copper were highest at Ma Wan and Reference stations. The concentrations of Nickel were highest at Reference stations. The concentrations of Zinc were highest at Ma Wan stations.

Inorganic Contaminants

Ammonia Nitrogen (NH_3-N)

3.2.12 NH_3-N concentrations varied significantly with sampling periods and areas. There was no consistent spatial trend of increasing concentrations of NH_3-N with proximity to the pit or consistent temporal trend of increasing concentrations of NH_3-N over time. Concentrations of NH_3-N were highest in April 2012. Concentrations of NH_3-N were highest at Reference and Ma Wan stations.

Total Inorganic Nitrogen (TIN)

3.2.13 TIN concentrations varied significantly with sampling periods and stations. There was no consistent spatial trend of increasing concentrations of TIN with proximity to the pit or consistent temporal trend of increasing concentrations of TIN over time. Concentrations of TIN were highest in April 2012 and May 2018. Concentrations of TIN were highest at Reference and Impact stations.

5-Day Biochemical Oxygen Demand (BOD_5)

3.2.14 Levels of BOD_5 varied significantly with sampling area and periods. There was no consistent spatial trend of increasing concentrations of BOD_5 with proximity to the pit or consistent temporal trend of increasing concentrations of BOD_5 over time. Levels of BOD_5 were highest in August 2016. Levels of BOD_5 were highest at Ma Wan and Reference stations.

Suspended Solids (SS)

3.2.15 SS levels varied significantly with sampling areas and periods. There was no consistent temporal trend of increasing concentrations of SS over time. SS levels were highest in November 2017. SS levels were highest at Impact stations, then at Intermediate stations and in turn higher than at Reference stations. Subsequent regression analysis between SS levels and proximity to the pit (i.e. Area) indicated that there was significant spatial trend of increasing SS level with proximity to the pit ($p < 0.01$), but there was a weak relationship between SS level and proximity to the pit ($r^2 < 0.60$).

3.2.16 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 operations at CMP Vb / Vd of the ESC area.

3.2.17 ***Water Quality Monitoring during Capping of ESC CMPs – February 2020***

Background

3.2.18 Water Quality Monitoring during Capping of ESC CMPs was conducted in February 2020 as presented in *Table 3.1*. A total of sixteen (16) stations were sampled in February 2020, and locations of the monitoring stations are presented in *Figure 3.1*. The capping volume during the reporting period is detailed in *Annex B3*. The monitoring results showed that levels of DO, Turbidity and SS complied with the Action and Limit Levels at all stations in February 2020.

Summary of Statistical Analyses

3.2.19 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 ESC CMPs in December 2013. Spatio-temporal differences in DO, Turbidity and SS were tested by two-factor partially-nested Analysis of Variance (ANOVA). Area and Period were treated as fixed factors under investigation with Station nested within Area.

3.2.20 Should spatial or temporal trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit or over time) be detected by ANOVA, linear regression analyses would be performed to examine the significance of the trend. The assumptions of the linear regression analyses are discussed in *Sections 3.2.7* and *3.2.8*. Detailed results of statistical analyses are presented in *Annex C*.

Dissolved Oxygen (DO)

3.2.21 DO levels varied significantly with sampling areas and periods. However, there was no consistent spatial trend of decreasing concentrations of DO with proximity to the pit or consistent temporal trend of decreasing concentrations of DO over time.

Turbidity

3.2.22 Turbidity levels varied significantly with sampling areas and periods. However, there was no consistent spatial trend of increasing concentrations of Turbidity with proximity to the pit or consistent temporal trend of increasing concentrations of Turbidity over time.

Suspended Solids (SS)

3.2.23 SS levels varied significantly with sampling areas and periods. However, there was no consistent spatial trend of increasing concentrations of SS with proximity to the pit or consistent temporal trend of increasing concentrations of SS over time.

3.2.24 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 capping operations at ESC CMPs.

3.2.25 ***Pit Specific Sediment Chemistry of ESC CMP Vd and Vb***

Background

3.2.26 *Pit Specific Sediment Chemistry of ESC CMP Vb / Vd* was conducted once every month from January to March 2020 as presented in *Table 3.1*. A total of six (6) monitoring stations for ESC CMP Vb / Vd were sampled in each monitoring event and the monitoring locations are shown in *Figure 3.3*. The monitoring results showed that the concentrations of most inorganic contaminants were below the Lower Chemical Exceedance Levels (LCELs) at most stations from January to March 2020, except the concentrations of some inorganic contaminants were higher than LCELs or Upper Chemical Exceedance Levels (UCELs) at Active Pit stations (Arsenic, Copper, Silver and Zinc), Pit-Edge stations (Arsenic) and Near-Pit (Arsenic) stations from January to March 2020.

Summary of Statistical Analyses

3.2.27 Statistical analyses were performed for data obtained from *Pit Specific Sediment Chemistry of ESC CMP Vb* and *Vd* since March 2016. Statistical tests were run to examine the difference in contaminant concentrations amongst Active-Pit, Pit-Edge and Near-Pit stations and amongst sampling periods. ANOVA was employed as the statistical test, with Area, Period and Station as fixed factors and Station nested within Area.

3.2.28 Should spatial or temporal trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit or over time) be detected by ANOVA, linear regression analyses would be performed to examine the significance of the trend. The assumptions of the linear regression analyses are discussed in *Sections 3.2.7* and *3.2.8*. Detailed results of statistical analyses are presented in *Annex C*.

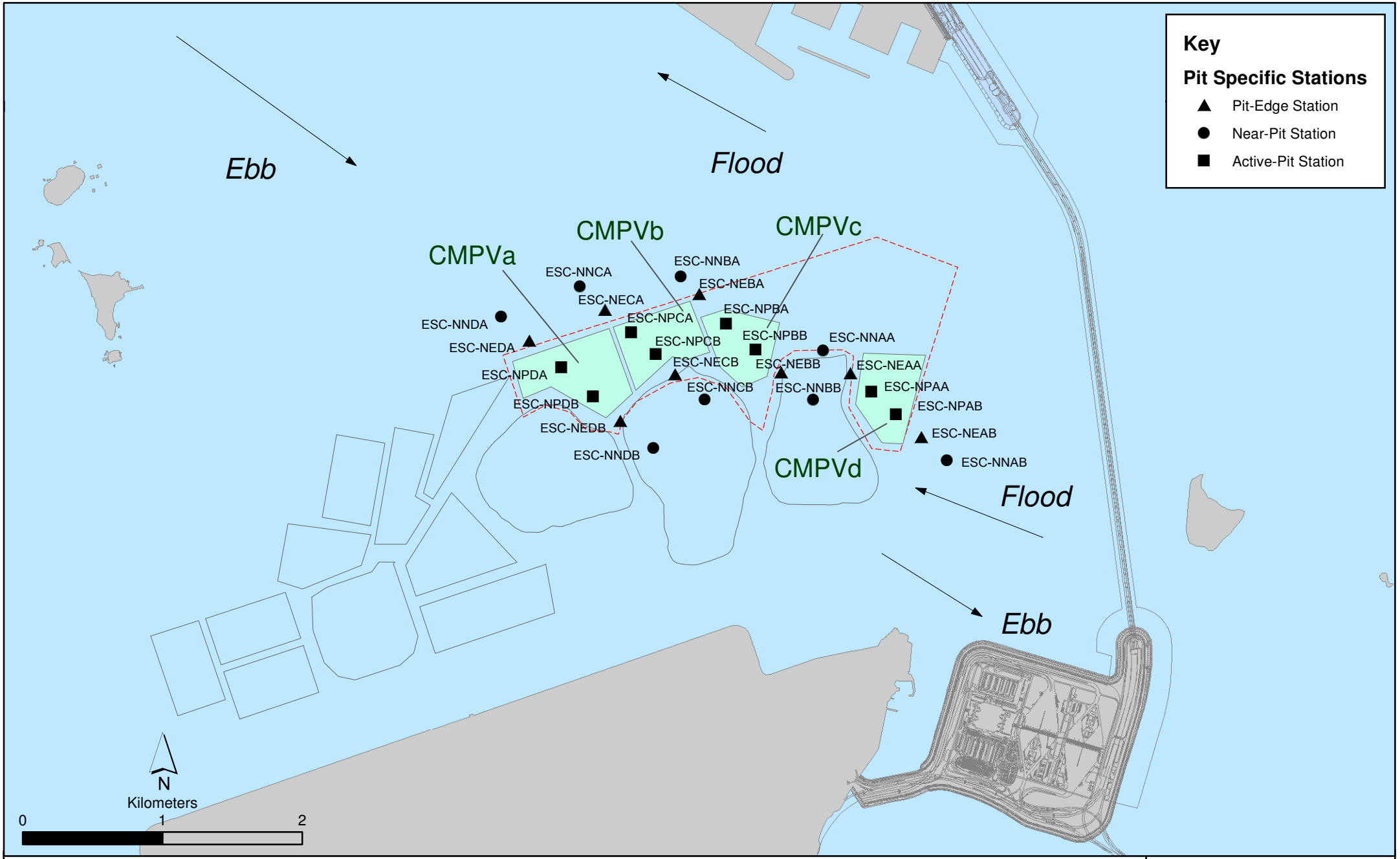


Figure 3.3

Pit Specific Sediment Quality Monitoring Stations for CMPV

File: T:\GIS\CONTRACT\0400720\Mxd\0400720_SQMS_pit specific.mxd
Date: 9/5/2017

Environmental Resources Management

ERM

Metals and Metalloids

3.2.29 There were significant spatial and temporal variations in the concentrations of all metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Mercury, Silver and Zinc). The concentrations of all measured metals and metalloids did not appear to increase over time. Subsequent linear regression analysis for Arsenic, Cadmium, Chromium, Mercury, Nickel and Zinc levels and proximity to the pit (i.e. Area) indicated that there were significant spatial trends ($p < 0.01$), but there was a weak relationship between Arsenic, Cadmium, Chromium, Mercury, Nickel and Zinc levels and proximity to the pit ($r^2 < 0.60$).

Organic Contaminants

3.2.30 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.

3.2.31 In this reporting period, only Total Organic Carbon (TOC) concentrations were statistically analysed. Levels of TOC varied significantly with sampling area and time. The concentrations of TOC did not appear to increase over time. Subsequent linear regression analysis for TOC levels and proximity to the pit (i.e. Area) indicated that there were significant spatial trends ($p < 0.01$), but there was a weak relationship between TOC levels and proximity to the pit ($r^2 < 0.60$). There was no consistent temporal trend of increasing concentrations of TOC over time.

3.2.32 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 / Vd.

3.2.33 ***Cumulative Impact Sediment Chemistry of ESC CMPs***

Background

3.2.34 *Cumulative Impact Sediment Chemistry of ESC CMPs* was conducted in February 2020 as presented in *Table 3.1*. A total of nine (9) monitoring stations were sampled and the monitoring locations are shown in *Figure 3.4*. The monitoring results showed that the concentrations of all inorganic contaminants were generally below the LCELs at all monitoring stations in February 2020, except concentrations of Arsenic were higher than the LCEL at Capped Pit station ESC-RCB, Near-field station ESC-RNB, and Mid-field stations ESC-RMA and ESC-RMB.

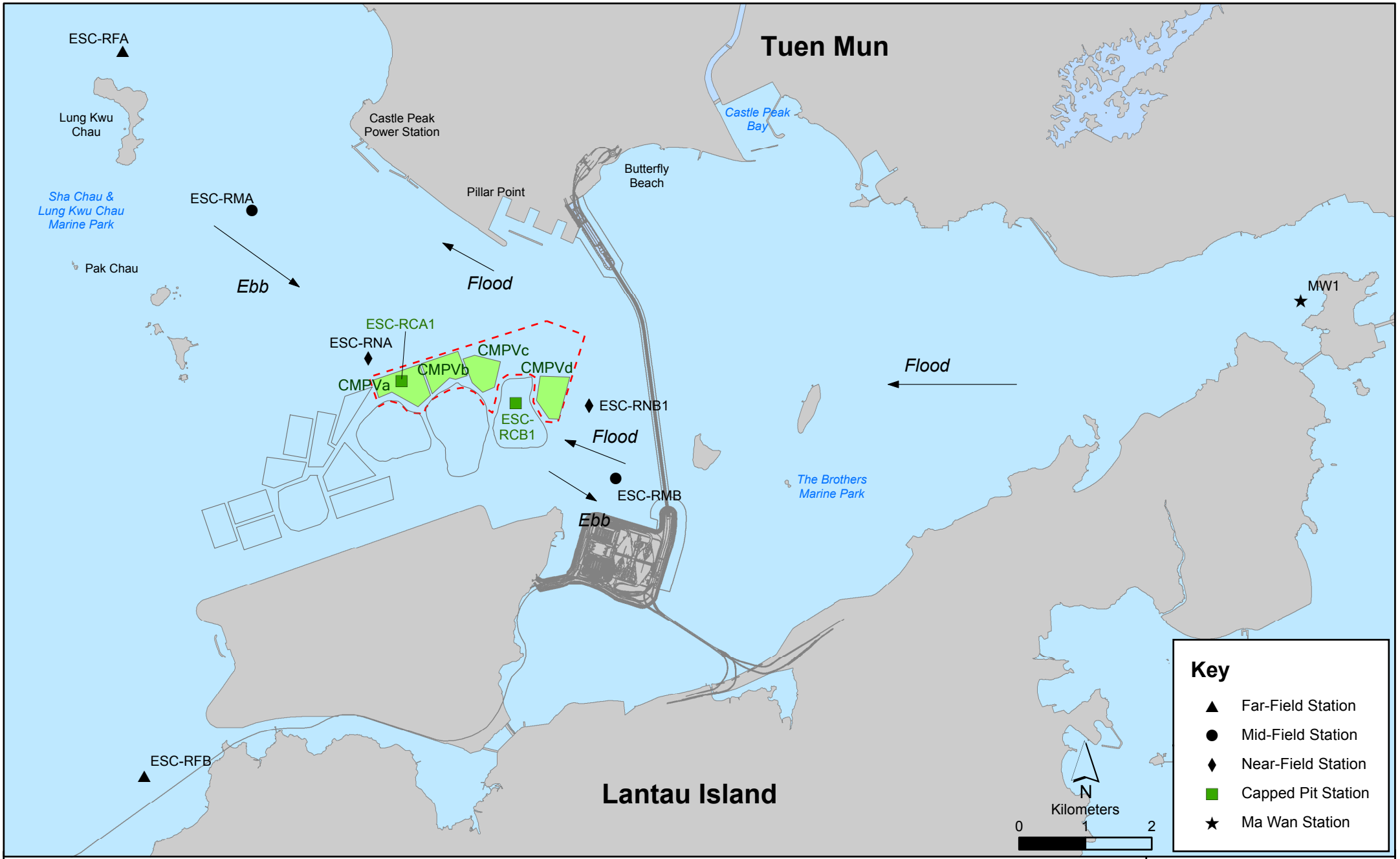


Figure 3.4

Cumulative Impacts Sediment Quality Monitoring Stations for ESC CMPs

File: T:\GIS\CONTRACT\0175086\Mxd\updated_20170419\0175086_SQMS_cum_impact.mxd
Date: 19/4/2017

Environmental Resources Management

ERM

Summary of Statistical Analysis

3.2.35 Data obtained during this reporting period were statistically compared with previous data obtained since monitoring began for ESC CMPs in June 2016. 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 and Station nested within Area.

3.2.36 Should spatial or temporal trend of potential concern (i.e. increasing contaminant concentration with proximity to the pit or over time) be detected by ANOVA, linear regression analyses would be performed to examine the significance of the trend. The assumptions of the linear regression analyses are discussed in *Sections 3.2.7* and *3.2.8*. Detailed results of statistical analyses are presented in *Annex C*.

Metals and Metalloid

3.2.37 There were significant spatial variations in the concentrations of all metal and metalloid contaminants (Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Mercury, Silver and Zinc), but no consistent trend (i.e. Near-Field > Mid-Field > Far-Field) was observed. In most cases, metal concentrations were highest at Mid-Field or Ma Wan stations. The concentrations of all measured metals and metalloids varied significantly with sampling time, but did not appear to increase over time.

Organic Contaminants

3.2.38 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.

3.2.39 In this reporting period, only TOC and Tributyltin (TBT) concentrations were statistically analysed. Levels of TOC and TBT varied significantly with sampling area and time. They were highest at Ma Wan station. There was no consistent spatial trend of increasing concentrations of TOC/TBT with proximity to the pit or consistent temporal trend of increasing concentrations of TOC/TBT over time.

3.2.40 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 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 / Vd during the quarterly period.

3.2.41 ***Sediment Toxicity Test – February 2020***

3.2.42 Sediment Toxicity Tests were undertaken for sediments collected from the Impact (Near Pit), Reference and Ma Wan stations (see *Figure 3.5* for the sampling locations) in February 2020 using three international species (burrowing amphipod *Leptocheirus plumulosus*, marine benthic polychaete *Neanthes arenaceodentata* and marine bivalve *Crassostrea gigas*) and two local species (barnacles *Balanus amphitrite* and shrimp *Penaeus vannaamei*).

3.2.43 Appropriate statistical test, i.e. ANOVA, was applied for comparing and determining the level of significance in the results in February 2020. For all of the ANOVA techniques, initial analyses were performed to ensure that the data are independent of each other, normally distributed and homogeneous. Should the data not comply with these assumptions then the appropriate transformation would be applied to the data. Data transformation (e.g. natural logarithm of chemical concentrations, square-root of a count and arcsine square-root of a proportion or percentage) would be used to reduce the within class heterogeneity of variance. If, after transformation, the data are still non-compliant (i.e. the residual errors are not normally distributed or variances are still heterogeneous) then rank transformed data would be applied to parametric or non-parametric equivalents to ANOVA such as Kruskal-Wallis tests. When significant difference are detected then multiple comparison procedures would be used (e.g. Student Newman Keuls Test or Turkey's HSD or Dunn's Test) to isolate where the differences is occurring.

3.2.44 Results of the Sediment Toxicity Tests in February 2020 showed that there were no significant differences between Impact and Reference stations in the toxicity tests of all marine benthos. Therefore, there did not appear to be any evidence of unacceptable impacts to sediment toxicity due to the mud disposal operations at ESC CMP Vb / Vd.

3.2.45 ***Demersal Trawling – January and February 2020***

3.2.46 Fishery resources monitoring by demersal trawling was carried out at two (2) impact and four (4) reference stations (see *Figure 3.6* for locations) in January and February 2020. Monitoring results are presented in the following sections.

Abundance and Biomass

3.2.47 The average number of species collected in the period of January and February 2020 is presented in *Table 3.2*. Mean number of faunal species caught at Impact stations was lower than at Reference stations in January and February 2020.

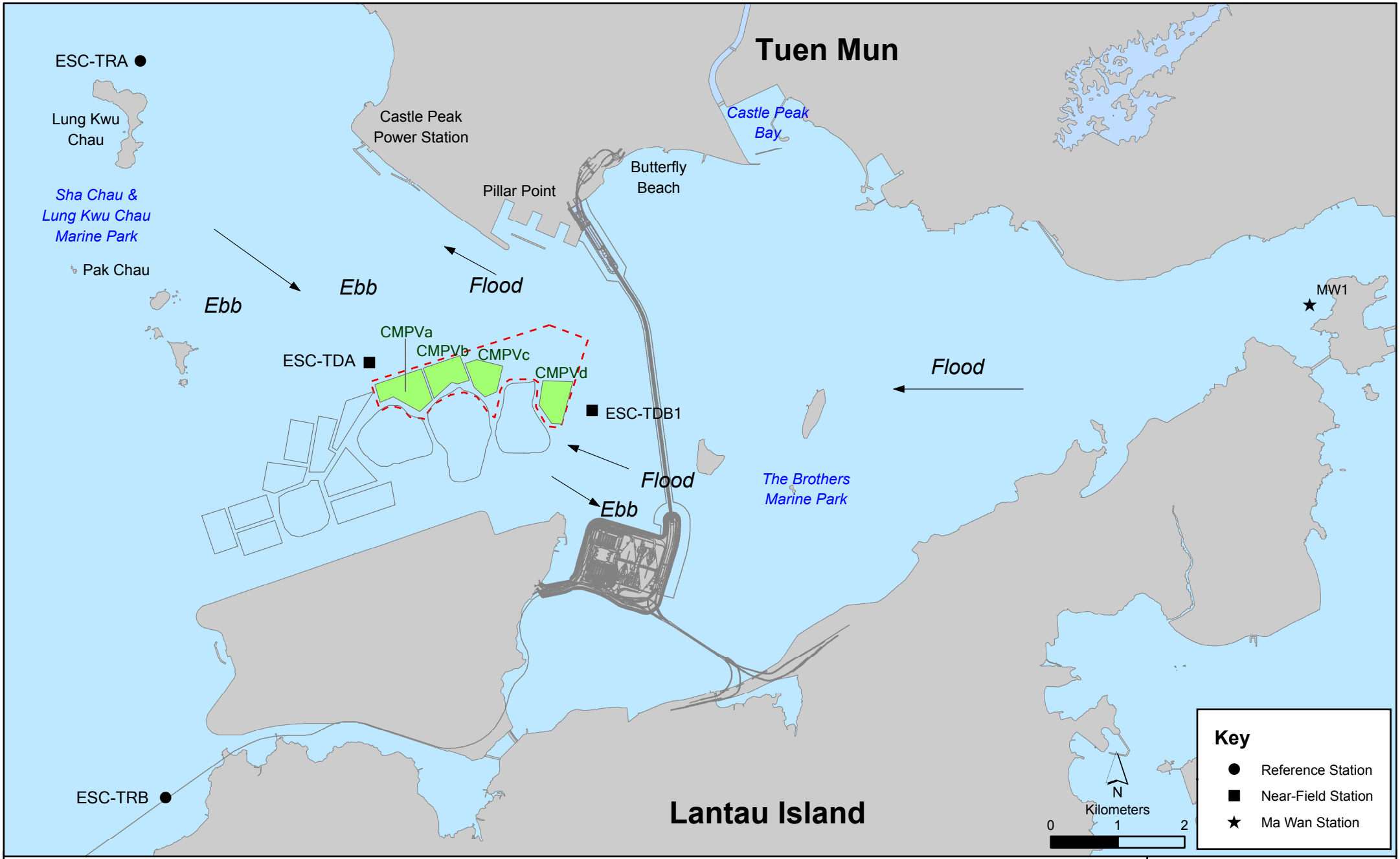


Figure 3.5

Sediment Toxicity Monitoring Stations for ESC CMPs

File: T:\GIS\CONTRACT\0175086\Mxd\updated_20170419\0175086_sed_toxicity.mxd
Date: 19/4/2017

Environmental Resources Management

ERM

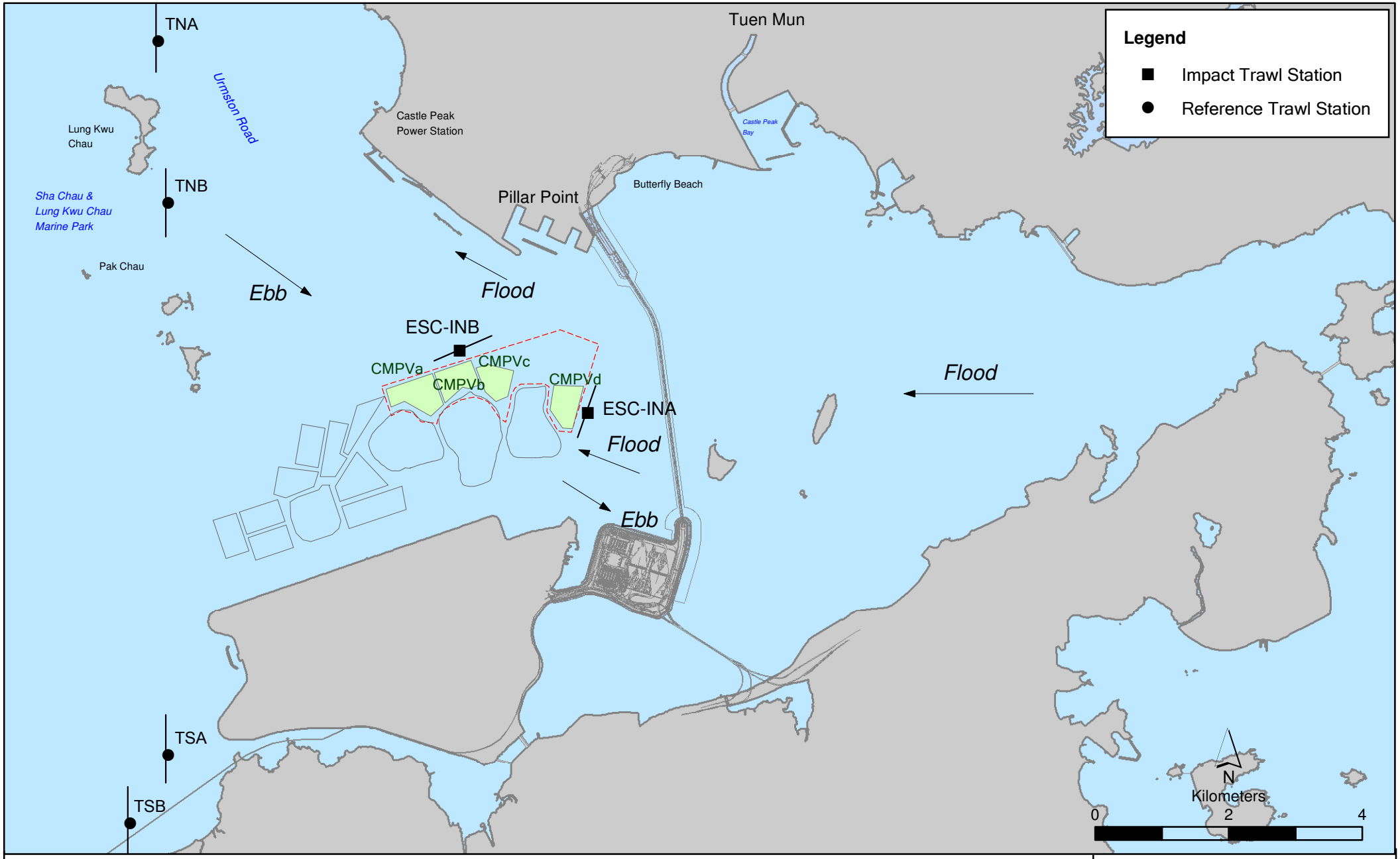


Figure 3.6

Marine Biota Monitoring Stations for CMPV

File: T:\GIS\CONTRACT\0400720\Mxd\0400720_Marine_Biota_2017.mxd
Date: 2/6/2017

Environmental Resources Management

ERM

3.2.48 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 during the monitoring period, except the Biomass and YPUE at Impact station ESC-INA were higher than those at most Reference stations in January 2020, and the Biotic abundance and CPUE at Impact station ESC-INB, were higher than those at most Reference stations in January 2020 (*Table 3.3*). Annual trend and statistical analyses will be conducted in the Annual EM&A Review Report to determine whether there is any evidence of unacceptable impact to fishery resources caused by the mud disposal operations at ESC CMP Vb / Vd.

Table 3.2 ***Summary of the Mean Number of Faunal Species Caught during January and February 2020 Monitoring***

Mean Number of Faunal Species	Impact Stations		Reference Stations			
	ESC-INA	ESC-INB	TNA	TNB	TSA	TSB
January 2020	16.8	18.4	31.4	25.4	28.4	19.2
February 2020	21.6	19.2	30.2	29.4	41.6	33.2

Table 3.3 **Summary of CPUE and YPUE during January and February 2020 Monitoring**

Date	Stations	Stations	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)
Jan 2020	ESC-INA	Impact	517	19720.4	103.4	3944.08
Jan 2020	ESC-INB	Impact	899	9690.9	179.8	1938.18
Jan 2020	TNA	Reference	1195	18677.2	239	3735.44
Jan 2020	TNB	Reference	827	20654.8	165.4	4130.96
Jan 2020	TSA	Reference	519	17354.7	103.8	3470.94
Jan 2020	TSB	Reference	339	6451.7	67.8	1290.34
Feb 2020	ESC-INA	Impact	740	13002	148	2600.4
Feb 2020	ESC-INB	Impact	1219	8691.8	243.8	1738.36
Feb 2020	TNA	Reference	1436	21260.2	287.2	4252.04
Feb 2020	TNB	Reference	1596	37958.2	319.2	7591.64
Feb 2020	TSA	Reference	2020	51963.2	404	10392.64
Feb 2020	TSB	Reference	1496	33469.4	299.2	6693.88

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)

4 FINDINGS OF THE FIELD EVENTS AND LABORATORY TESTS AND ANALYSES BY THE INDEPENDENT AUDITOR

4.1.1 During the reporting period of January to March 2020, there was no scheduled inspection conducted by the Independent Auditor (IA).

5 ACTIVITIES SCHEDULED FOR THE NEXT REPORTING PERIOD

5.1.1 The monitoring activities to be conducted in the next quarterly period of April to June 2020 for ESC CMPs include:

- *Water Column Profiling of ESC CMP Vb* in April, May and June 2020;
- *Routine Water Quality Monitoring of ESC CMPs* in April and May 2020;
- *Pit Specific Sediment Chemistry of ESC CMP Vb* in April, May and June 2020;
- *Cumulative Impact Sediment Chemistry of ESC CMPs* in June 2020; and
- *Water Quality Monitoring for Capping Operation of ESC CMPs* in June 2020.

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

Annex A

Sampling Schedule

Annex A1 - East of Sha Chau Environmental Monitoring and Audit Sampling Schedule for CMP (April 2017 - March 2021)

			2017									2018												2019												2020												2021		
Pit Specific Sediment Chemistry	**Code**	**Frequency**	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Active-Pit																																																			
	ESC-NPAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NPAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Pit-Edge																																																			
	ESC-NEAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NEAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Near-Pit																																																			
	ESC-NNAA	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	ESC-NNAB	Monthly	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Cumulative Impact Sediment Chemistry			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-field Stations																																																			
	ESC-RNA	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
	ESC-RNB1	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
Mid-field Stations																																																			
	ESC-RMA	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
	ESC-RMB	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
Capped Pit Stations																																																			
	ESC-RCA1	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
	ESC-RCB1	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
Far-Field Stations																																																			
	ESC-RFA	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
	ESC-RFB	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
Ma Wan Station																																																			
	MW1	4 times per year			12		12				12		12				12		12				12		12				12		12				12		12				12		12				12		12	
Sediment Toxicity Tests			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Near-Pit Stations																																																			
	ESC-TDA	2 times per year					5						5						5						5						5						5						5						5	
	ESC-TDB1	2 times per year					5						5						5						5						5						5						5						5	
Reference Stations																																																			
	ESC-TRA	2 times per year					5						5						5						5						5						5						5						5	
	ESC-TRB	2 times per year					5						5						5						5						5						5						5						5	
Ma Wan Station																																																			
	MW1	2 times per year					5						5						5						5						5						5						5						5	
Tissue/ Whole Body Sampling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
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			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
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	
	ESC-INB	4 times per year				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	
	TNB	4 times per year				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	
	TSB	4 times per year				5	5					5	5					5	5					5	5					5	5					5	5					5	5					5	5	
Capping			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																																																			
Impact Station Downcurrent																																																			
	ESC-IPE1A	4 times per year																																			3				3		3				3		3	
	ESC-IPE2A	4 times per year																																			3				3		3				3		3	
	ESC-IPE3	4 times per year																																			3				3		3				3		3	
	ESC-IPE4	4 times per year																																			3				3		3				3		3	
	ESC-IPE5	4 times per year																																			3				3		3				3		3	
Intermediate Station Downcurrent																																																			
	ESC-INE1A	4 times per year																																			3				3		3				3		3	
	ESC-INE2A	4 times per year																																			3				3		3				3		3	
	ESC-INE3A	4 times per year																																			3				3		3				3		3	
	ESC-INE4A	4 times per year																																			3				3		3				3		3	
	ESC-INE5A	4 times per year																																			3				3		3				3		3	
Reference Station Upcurrent																																																			
	ESC-RFE1	4 times per year																																			3				3		3				3		3	
	ESC-RFE2	4 times per year																																			3				3		3				3		3	
	ESC-RFE3	4 times per year																																			3				3		3				3		3	
	ESC-RFE4	4 times per year																																			3				3		3				3		3	
	ESC-RFE5	4 times per year																																			3				3		3				3		3	
Ma Wan Station																																																			
	MW1	4 times per year																																			3				3		3				3		3	
Flood Tide																																																			
Impact Station Downcurrent																																																			
	ESC-IPF1	4 times per year																																			3				3		3				3		3	
	ESC-IPF2	4 times per year																																			3				3		3				3		3	
	ESC-IPF3	4 times per year																																			3				3		3				3		3	
Intermediate Station Downcurrent																																																			
	ESC-INF1	4 times per year																																			3				3		3				3		3	
	ESC-INF2	4 times per year																																			3				3		3				3		3	
	ESC-INF3	4 times per year																																			3				3		3				3		3	
Reference Station Upcurrent																																																			
	ESC-RFF1A	4 times per year																																			3				3		3				3		3	
	ESC-RFF2A	4 times per year																																			3				3		3				3		3	
	ESC-RFF3	4 times per year																																			3				3		3				3		3	
Ma Wan Station																																																			
	MW1	4 times per year																																			3				3		3				3		3	
Routine Water Quality Monitoring			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Ebb Tide																																																			
Impact Station Downcurrent																																																			
	ESC-IPE1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE4	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPE5	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Intermediate Station Downcurrent																																																			
	ESC-INE1A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE2A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE3A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE4A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INE5A	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Reference Station Upcurrent																																																			
	ESC-RFE1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE2	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE3	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE4	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFE5	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Ma Wan Station																																																			
	MW1	8 times per year	8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Flood Tide																																																			
Impact Station Downcurrent																																																			
	ESC-IPF1	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPF2	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-IPF3	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Intermediate Station Downcurrent																																																			
	ESC-INF1	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INF2	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-INF3	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Reference Station Upcurrent																																																			
	ESC-RFF1A	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFF2A	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
	ESC-RFF3	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Ma Wan Station																																																			
	MW1	8 times per year	8	8		8	8		8	8					8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8		8	8	
Water Column Profiling			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Plume Stations	WCP1	Monthly	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	WCP2	Monthly	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Benthic Recolonisation Studies			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Capped Stations at CMPV																																																			
	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			A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
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:
The number shown in each cell represents the numbers of replicates per monitoring station
Impact Monitoring for Dredging will be scheduled when dredging operations commence.
Benthic Recolonisation Studies for CMP V will be scheduled when capping operation for CMP V is completed.

Annex B

Disposal & Capping Records

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1-Jan-2020	0	1662958
2-Jan-2020	2500	1665458
3-Jan-2020	2126	1667584
4-Jan-2020	2500	1670084
5-Jan-2020	0	1670084
6-Jan-2020	2000	1672084
7-Jan-2020	2500	1674584
8-Jan-2020	2500	1677084
9-Jan-2020	2500	1679584
10-Jan-2020	2000	1681584
11-Jan-2020	2500	1684084
12-Jan-2020	0	1684084
13-Jan-2020	2000	1686084
14-Jan-2020	1500	1687584
15-Jan-2020	1000	1688584
16-Jan-2020	0	1688584
17-Jan-2020	0	1688584
18-Jan-2020	0	1688584
19-Jan-2020	0	1688584
20-Jan-2020	0	1688584
21-Jan-2020	0	1688584
22-Jan-2020	0	1688584
23-Jan-2020	0	1688584
24-Jan-2020	0	1688584
25-Jan-2020	0	1688584
26-Jan-2020	0	1688584
27-Jan-2020	0	1688584
28-Jan-2020	0	1688584
29-Jan-2020	0	1688584
30-Jan-2020	0	1688584
31-Jan-2020	0	1688584
1-Feb-2020	0	1688584
2-Feb-2020	0	1688584
3-Feb-2020	0	1688584
4-Feb-2020	0	1688584
5-Feb-2020	0	1688584
6-Feb-2020	0	1688584
7-Feb-2020	0	1688584
8-Feb-2020	0	1688584
9-Feb-2020	0	1688584
10-Feb-2020	0	1688584
11-Feb-2020	0	1688584
12-Feb-2020	0	1688584
13-Feb-2020	0	1688584
14-Feb-2020	0	1688584
15-Feb-2020	0	1688584
16-Feb-2020	0	1688584
17-Feb-2020	0	1688584
18-Feb-2020	0	1688584
19-Feb-2020	0	1688584
20-Feb-2020	0	1688584
21-Feb-2020	0	1688584
22-Feb-2020	0	1688584

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
23-Feb-2020	0	1688584
24-Feb-2020	0	1688584
25-Feb-2020	0	1688584
26-Feb-2020	0	1688584
27-Feb-2020	0	1688584
28-Feb-2020	0	1688584
29-Feb-2020	0	1688584
1-Mar-2020	0	1688584
2-Mar-2020	0	1688584
3-Mar-2020	0	1688584
4-Mar-2020	0	1688584
5-Mar-2020	0	1688584
6-Mar-2020	0	1688584
7-Mar-2020	0	1688584
8-Mar-2020	0	1688584
9-Mar-2020	0	1688584
10-Mar-2020	0	1688584
11-Mar-2020	0	1688584
12-Mar-2020	0	1688584
13-Mar-2020	0	1688584
14-Mar-2020	0	1688584
15-Mar-2020	0	1688584
16-Mar-2020	0	1688584
17-Mar-2020	0	1688584
18-Mar-2020	0	1688584
19-Mar-2020	0	1688584
20-Mar-2020	0	1688584
21-Mar-2020	0	1688584
22-Mar-2020	0	1688584
23-Mar-2020	0	1688584
24-Mar-2020	0	1688584
25-Mar-2020	0	1688584
26-Mar-2020	0	1688584
27-Mar-2020	0	1688584
28-Mar-2020	0	1688584
29-Mar-2020	0	1688584
30-Mar-2020	0	1688584
31-Mar-2020	0	1688584

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1-Jan-2020	0	0
2-Jan-2020	0	0
3-Jan-2020	0	0
4-Jan-2020	0	0
5-Jan-2020	0	0
6-Jan-2020	0	0
7-Jan-2020	0	0
8-Jan-2020	0	0
9-Jan-2020	0	0
10-Jan-2020	0	0
11-Jan-2020	0	0
12-Jan-2020	0	0
13-Jan-2020	0	0
14-Jan-2020	0	0
15-Jan-2020	0	0
16-Jan-2020	2000	2000
17-Jan-2020	1000	3000
18-Jan-2020	1309	4309
19-Jan-2020	0	4309
20-Jan-2020	2500	6809
21-Jan-2020	2116	8925
22-Jan-2020	1500	10425
23-Jan-2020	1000	11425
24-Jan-2020	0	11425
25-Jan-2020	0	11425
26-Jan-2020	0	11425
27-Jan-2020	0	11425
28-Jan-2020	0	11425
29-Jan-2020	500	11925
30-Jan-2020	500	12425
31-Jan-2020	2006	14431
1-Feb-2020	1500	15931
2-Feb-2020	0	15931
3-Feb-2020	1000	16931
4-Feb-2020	2345	19276
5-Feb-2020	1000	20276
6-Feb-2020	1000	21276
7-Feb-2020	954	22230
8-Feb-2020	1700	23930
9-Feb-2020	0	23930
10-Feb-2020	1000	24930
11-Feb-2020	1500	26430
12-Feb-2020	1000	27430
13-Feb-2020	1537	28967
14-Feb-2020	1408	30375
15-Feb-2020	1526	31901
16-Feb-2020	500	32401
17-Feb-2020	4000	36401
18-Feb-2020	3280	39681
19-Feb-2020	925	40606
20-Feb-2020	1500	42106
21-Feb-2020	761	42867
22-Feb-2020	1500	44367

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
23-Feb-2020	330	44697
24-Feb-2020	1000	45697
25-Feb-2020	1945	47642
26-Feb-2020	2460	50102
27-Feb-2020	1000	51102
28-Feb-2020	1500	52602
29-Feb-2020	1500	54102
1-Mar-2020	0	54102
2-Mar-2020	1500	55602
3-Mar-2020	1917	57519
4-Mar-2020	2500	60019
5-Mar-2020	3000	63019
6-Mar-2020	4000	67019
7-Mar-2020	5000	72019
8-Mar-2020	3547	75566
9-Mar-2020	4655	80221
10-Mar-2020	3000	83221
11-Mar-2020	4339	87560
12-Mar-2020	3000	90560
13-Mar-2020	2000	92560
14-Mar-2020	2046	94606
15-Mar-2020	1477	96083
16-Mar-2020	2000	98083
17-Mar-2020	2355	100438
18-Mar-2020	2037	102475
19-Mar-2020	3422	105897
20-Mar-2020	4473	110370
21-Mar-2020	4257	114627
22-Mar-2020	4317	118944
23-Mar-2020	1300	120244
24-Mar-2020	2792	123036
25-Mar-2020	1500	124536
26-Mar-2020	2000	126536
27-Mar-2020	1000	127536
28-Mar-2020	4100	131636
29-Mar-2020	2800	134436
30-Mar-2020	2200	136636
31-Mar-2020	1500	138136

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
1-Jan-2020	0	0
2-Jan-2020	0	0
3-Jan-2020	0	0
4-Jan-2020	0	0
5-Jan-2020	0	0
6-Jan-2020	0	0
7-Jan-2020	0	0
8-Jan-2020	0	0
9-Jan-2020	0	0
10-Jan-2020	0	0
11-Jan-2020	0	0
12-Jan-2020	0	0
13-Jan-2020	0	0
14-Jan-2020	0	0
15-Jan-2020	0	0
16-Jan-2020	0	0
17-Jan-2020	0	0
18-Jan-2020	0	0
19-Jan-2020	0	0
20-Jan-2020	0	0
21-Jan-2020	0	0
22-Jan-2020	0	0
23-Jan-2020	0	0
24-Jan-2020	0	0
25-Jan-2020	0	0
26-Jan-2020	0	0
27-Jan-2020	0	0
28-Jan-2020	0	0
29-Jan-2020	0	0
30-Jan-2020	0	0
31-Jan-2020	0	0
1-Feb-2020	0	0
2-Feb-2020	0	0
3-Feb-2020	0	0
4-Feb-2020	0	0
5-Feb-2020	0	0
6-Feb-2020	0	0
7-Feb-2020	0	0
8-Feb-2020	0	0
9-Feb-2020	0	0
10-Feb-2020	0	0
11-Feb-2020	1000	1000
12-Feb-2020	2500	3500
13-Feb-2020	2500	6000
14-Feb-2020	2000	8000
15-Feb-2020	3000	11000
16-Feb-2020	500	11500
17-Feb-2020	0	11500
18-Feb-2020	0	11500
19-Feb-2020	1000	12500
20-Feb-2020	3000	15500
21-Feb-2020	3000	18500
22-Feb-2020	2000	20500

Date	Daily Disposal Volume (m^3)	Accumulative Disposal Volume (m^3)
23-Feb-2020	3000	23500
24-Feb-2020	3000	26500
25-Feb-2020	2500	29000
26-Feb-2020	2800	31800
27-Feb-2020	2600	34400
28-Feb-2020	3500	37900
29-Feb-2020	1500	39400
1-Mar-2020	3500	42900
2-Mar-2020	2500	45400
3-Mar-2020	3000	48400
4-Mar-2020	3000	51400
5-Mar-2020	3500	54900
6-Mar-2020	1000	55900
7-Mar-2020	0	55900
8-Mar-2020	0	55900
9-Mar-2020	0	55900
10-Mar-2020	0	55900
11-Mar-2020	0	55900
12-Mar-2020	0	55900
13-Mar-2020	1200	57100
14-Mar-2020	2000	59100
15-Mar-2020	2400	61500
16-Mar-2020	2000	63500
17-Mar-2020	1600	65100
18-Mar-2020	2800	67900
19-Mar-2020	1600	69500
20-Mar-2020	0	69500
21-Mar-2020	0	69500
22-Mar-2020	0	69500
23-Mar-2020	1200	70700
24-Mar-2020	2400	73100
25-Mar-2020	2000	75100
26-Mar-2020	2000	77100
27-Mar-2020	1200	78300
28-Mar-2020	0	78300
29-Mar-2020	0	78300
30-Mar-2020	400	78700
31-Mar-2020	1200	79900

Annex C

Statistical Analysis

Routine Water Quality Monitoring for ESC CMPs – Analysis of Variance and Linear Regression Analysis up to February 2020

Dissolved Oxygen

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Area	4774611.9	3	1591537.3	28.435	**
Period	2693120703	44	61207289	1093.536	**
Area * Period	133306569	132	1009898.2	18.043	**
Error	196909122	3518	55971.894		
Total	16863764559	3698			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Feb 17 ≥ Feb 13 ≥ Apr 16 ≥ Jan 17 > Feb 18 = Jan 13 > Jan 18 = Feb 12 ≥ Feb 19 ≥ Nov 18 ≥ **Feb 20** > Jan 19 > Apr 13 = Apr 17> **Jan 20** > Apr 18 = Nov 16 = Apr 19 > Nov 17 = Nov 19 > Apr 12 = May 13 > Nov 12 = May 19 = May 16 = May 18 > Oct 16 = Oct 12 > Jul 12 > May 17 = May 12 ≥ Jul 18 ≥ Oct 19 > Jul 16 = Aug 17 = Oct 18 = Oct 17 > Aug 12 > Aug 13 = Aug 18 = Aug 19 ≥ Jul 17 ≥ Aug 16 = Jul 13 = Jul19
- Intermediate = Impact > Reference > Ma Wan Station

Turbidity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Area	125241589.6	3	41747196.54	159.299	**
Period	1770177297	44	40231302.21	153.515	**
Area * Period	416941588.8	132	3158648.4	12.053	**
Error	921953522.3	3518	262067.516		
Total	16863561332	3698			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Nov 17 > Oct 17 = Aug 13 ≥ Jan 19 ≥ Apr 17 = Apr 12 = Aug 12 = May 19 = Aug 18 = Nov 18 = Nov 16 ≥ Oct 16 ≥ Jul 18 ≥ Nov 12 ≥ Jul 16 ≥ Jul 17 ≥ May 16 = Oct 18 = Aug 19 ≥ Apr 13 ≥ Feb 12 > Oct 19 ≥ Apr 16 ≥ Jul 19 = Jan 17 ≥ May 18 ≥ Oct 12 ≥ Apr 19 = Jul 12 ≥ Jan 18 = Aug 17 ≥ Aug 16 ≥ Feb 13 ≥ Feb 18 = May 12 ≥ Jan 13 = **Jan 20** ≥ Feb 19 = Apr 18 ≥ Jul 13 ≥ Nov 19 = **Feb 20** ≥ May 17 = May 13 > Feb 17
- Impact = Reference > Intermediate > Ma Wan Station

Copper

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	4570557620	43	106292038	664.473	**
Area	24854236.78	3	8284745.6	51.791	**
Station(Area)	68713443.18	24	2863060.1	17.898	**
Period * Area	756559290.5	126	6004438.8	37.536	**
Period * Station(Area)	1039816820	378	2750838.1	17.197	**
Error	651695382.4	4074	159964.5		
Total	33612328880	4656			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Aug 13 > May 18 > Feb 12 > Nov 18 = Jul 18 = Aug 19 ≥ Nov 19 ≥ Jul 13 ≥ Apr 12 ≥ **Feb 20** ≥ Oct 19 > Feb 19 = Oct 18 = Aug 18 = Jan 13 > **Jan 20** = Jan 19 = May 16 = Apr 13 ≥ Apr 18 = May 19 = Nov 12 ≥ Apr 17 > May 12 > Apr 16 = Oct 12 > Jan 18 = May 13 = Jul 16 = May 17 = Apr 19 > Aug 16 > Aug 12 = Jul 19 ≥ Jul 12 = Nov 17 ≥ Feb 13 ≥ Feb 18 ≥ Aug 17 = Oct 17 > Jan 17 = Oct 16 =Jul 17 ≥ Feb 17 ≥ Nov 16
- Ma Wan Station = Reference > Impact > Intermediate

Nickel

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	4423693134	43	102876584.5	401.12	**
Area	45058267.52	3	15019422.51	58.561	**
Station(Area)	122253235.5	24	5093884.815	19.861	**
Period * Area	845993756.9	126	6714236.166	26.179	**
Period * Station(Area)	614231575.8	378	1624951.259	6.336	**
Error	1044358567	4072	256473.125		
Total	33495275921	4654			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Apr 12 = Aug 13 = May 13 > May 12 ≥ Apr 13 = Jul 13 = Aug 16 ≥ Oct 12 = Jan 13 ≥ Aug 12 = Feb 12 = Nov 12 > Jul 17 = Jul 12= Apr 18 > Aug 17 = Feb 17 > May 18 = Apr 17 = **Jan 20** = Nov 18 = Jul 18 = Feb 18 > Oct 18 = Aug 18 = Jan 18 = May 19 = Oct 19 = Feb 13 ≥ Apr 19 ≥ Oct 17 = Aug 19 > May 17 ≥ Oct 16 ≥ Jul 16 ≥ Nov 17 ≥ **Feb 20** ≥ Nov 19 > Jul 19 = Jan 17 > Apr 16 ≥ Nov 16 = Jan 19 = Feb 19 ≥ May 16
- Reference > Impact > Intermediate > Ma Wan Station

Zinc

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	5037248182	43	117145307	501.062	**
Area	91737998.06	3	30579333	130.796	**
Station(Area)	90994969.38	24	3791457.1	16.217	**
Period * Area	565579258.8	126	4488724.3	19.199	**
Period * Station(Area)	883606707.5	378	2337583.9	9.998	**
Error	952477209.3	4074	233794.11		
Total	33654116307	4656			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Nov 17 ≥ Jul 17 ≥ Oct 17 ≥ Feb 17 ≥ Apr 17 = Aug 17 = Feb 18 ≥ Jan 18 = May 17 = Nov 18 = Jul 18 ≥ Apr 18 > Aug 19 > Nov 19 = May 18 > Apr 12 = Feb 12 = Aug 13 > Oct 19 ≥ Oct 18 = Aug 18 ≥ Jul 12 ≥ Nov 12 ≥ Apr 19 ≥ Jul 13 ≥ **Feb 20** = Feb 19 = **Jan 20** ≥ May 16 ≥ May 12 = Jan 19 > Jan 17 ≥ Jan 13 = Apr 13 = Apr 16 = Oct 16 = Oct 12 = May 19 > Jul 16 = Nov 16 > Jul 19 > May 13 = Aug 12 > Aug 16 = Feb 13
- Ma Wan Station > Reference > Impact > Intermediate

Ammonia Nitrogen

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	5629910089	43	130928142	630.101	**
Area	6836380.136	3	2278793.4	10.967	**
Station(Area)	28481581.87	24	1186732.6	5.711	**
Period * Area	365713718.6	126	2902489.8	13.968	**
Period * Station(Area)	308395342.6	378	815860.7	3.926	**
Error	846532570.9	4074	207789.05		
Total	33638406432	4656			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Apr 12 > Apr 13 = **Jan 20** = Apr 16 > May 13 = Feb 19 = Jan 18 = Apr 17 > May 19 ≥ Feb 17 ≥ May 17 ≥ Feb 12 = Apr 19 ≥ Apr 18 > Feb 18 = May 16 ≥ Jan 13 ≥ Jan 17 ≥ Nov 17 = Jul 16 > Jul 18 = May 18 > Oct 17 = Jan 19 > Oct 19 ≥ Jul 13 ≥ Nov 16 ≥ Aug 19 ≥ **Feb 20** = Aug 16 = Nov 19 = Jul 19 ≥ Aug 12 ≥ Aug 17 ≥ May 12 > Oct 16 = Jul 17 = Aug 18 > Oct 12 = Oct 18 = Aug 13 > Nov 12 > Jul 12 = Feb 13 > Nov 18
- Reference = Ma Wan Station > Impact > Intermediate

Total Inorganic Nitrogen

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Period	5505990984	43	128046302	1191.413	**
Area	99212825.41	3	33070942	307.71	**
Station(Area)	131646630.7	24	5485276.3	51.038	**
Period * Area	438193654.5	126	3477727.4	32.359	**
Period * Station(Area)	441662543.3	378	1168419.4	10.872	**
Error	437850377.1	4074	107474.32		
Total	33653953421	4656			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Apr 12 = May 18 > Aug 13 > Apr 17 > Aug 19 = Jul 16 = May 13 > Jul 12 > Nov 18 = Aug 17 > Jul 17 > May 12 = Aug 16 > Jul 19 = May 17 = Aug 12 = Apr 18 = Jul 18 > Jul 13 = May 16 = **Jan 20** > May 19 > Aug 18 = Oct 17 > Apr 13 > Feb 17 = Apr 16 = Jan 18 > Oct 12 = Apr 19 ≥ Feb 19 ≥ Feb 12 > Nov 16 > Oct 18 = Jan 17 = Oct 16 = Oct 19 > Nov 12 > Feb 18 > Jan 19 = Nov 19 > Nov 17 = Jan 13 > Feb 13 = **Feb 20**
- Reference = Impact > Intermediate > Ma Wan Station

BOD_5

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	3072186339	43	71446194	192.3	**
Area	110518428	3	36839476	99.155	**
Station(Area)	71744380	24	2989349.2	8.046	**
Period * Area	1403078112	126	11135541	29.972	**
Period * Station(Area)	1168978139	378	3092534.8	8.324	**
Error	1513636132	4074	371535.62		
Total	33630172824	4656			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Aug 16 > Aug 19 = Nov 16 = Apr 16 > Jan 17 ≥ Apr 19 = May 12 ≥ Oct 19 ≥ **Jan 20** > Jan 13 = Aug 18 ≥ May 18 ≥ Jul 17 ≥ Nov 17 = May 17 = May 16 ≥ **Feb 20** ≥ Apr 18 = Jul 19 = Oct 18 ≥ Feb 12 = Nov 18 = Jul 18 = May 19 = Feb 18 = Apr 17 = Oct 16 > Nov 19 ≥ Oct 17 = Feb 19 ≥ Apr 13 ≥ Nov 12 ≥ Jan 19 = Apr 12 = Jul 12 ≥ Feb 13 = Oct 12 > Feb 17 > May 13 = Jul 16 = Aug 17 > Aug 12 = Jan 18 > Aug 13 > Jul 13
- Ma Wan Station = Reference > Impact > Intermediate

Suspended Solids

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	4467931074	43	103905374	1275.047	**
Area	35764257.74	3	11921419	146.29	**
Station(Area)	243751860.8	24	10156328	124.631	**
Period * Area	894566411.3	126	7099733.4	87.122	**
Period * Station(Area)	1657144677	378	4383980.6	53.797	**
Error	331996042.4	4074	81491.419		
Total	33653334570	4656			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Nov 17 > Jul 12 > Nov 12 = Jan 19 > Nov 16 = Jul 16 = Oct 16 = Aug 12 > Apr 12 = Apr 17 ≥ Oct 17 ≥ May 16 ≥ Oct 12 ≥ May 19 > Aug 13 > Nov 18 = Jan 17 = Jul 18 ≥ Apr 16 = Aug 18 = Oct 18 = Jul 17 ≥ Apr 13 > Aug 19 = Feb 12 > Jan 18 > Oct 19 > Aug 16 > May 18 > Feb 13 = **Jan 20** > Feb 18 = Apr 19 = Apr 18 = **Feb 20** = Jan 13 > Aug 17 > Feb 19 = Nov 19 ≥ May 13 = Jul 19 ≥ Jul 13 ≥ May 12 > May 17 > Feb 17
- Impact > Intermediate > Reference > Ma Wan Station

Linear Regression Analysis

Source	df	Slope	r	r^2	P
Area	1	-23.169	0.219	0.048	**

Note: Linear regression analysis on spatial changes of contaminant concentrations.

Water Quality Monitoring during Capping of ESC CMPs – Analysis of Variance up to February 2020

Dissolved Oxygen

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Area	2539733.748	3	846577.916	62.694	**
Period	128499603.924	10	12849960.392	951.616	**
Area * Period	5922037.222	30	197401.241	14.619	**
Error	16798102.760	1244	13503.298		
Total	713064894.500	1288			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Feb 16 > Feb 15 > Feb 14 > **Feb 20** > Dc 14 = Dec 15 > Dec 13 > Jun 15 > Jun 14 = Aug 15 > Aug 14
- Impact > Reference = Intermediate > Ma Wan Station

Turbidity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Area	7084639.794	3	2361546.598	73.017	**
Period	105280283.709	10	10528028.371	325.517	**
Area * Period	8033616.754	30	267787.225	8.280	**
Error	40234079.354	1244	32342.508		
Total	713055776.000	1288			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Dec 13 > **Feb 20** ≥ Jun 15 ≥ Dec 15 > Aug 14 = Dec 14 = Aug 15 > Feb 15 > Feb 14 > Jun 14 > Feb 16
- Impact = Reference > Intermediate > Ma Wan Station

Suspended Solids

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Area	196474.207	3	65491.402	13.826	**
Period	3525811.083	10	352581.108	74.432	**
Area * Period	719633.310	30	23987.777	5.064	**
Error	1951628.522	412	4736.962		
Total	31708638.000	456			

Note:
1. Data are rank-transformed;
2. NS: No significant different;
3. **: Significant difference

SNK Results:

- Dec 13 > Jun 15 = **Feb 20** = Dec 15 > Ag 14 ≥ Feb 15 ≥Aug 15 ≥ Dec 14 > Feb 14 = Jun 14 = Feb 16
- Impact > Intermediate = Reference > Ma Wan Station

Pit Specific Sediment Chemistry for ESC CMP Vd – Analysis of Variance (up to March 2020)

Arsenic

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Period	2122489902	48	44218540	333.667	**
Area	48495231.14	2	24247616	182.969	**
Station(Area)	242137500.3	3	80712500	609.045	**
Period * Area	399749294.4	96	4164055.2	31.421	**
Period * Station(Area)	368517873.5	143	2577048.1	19.446	**
Error	426591903.3	3219	132523.11		
Total	14445098751	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- **Mar 20** = **Feb 20** > Sep 19 ≥ Jun 19 = Aug 19 ≥ Jul 19 = Oct 17 ≥ Jul 18 ≥ **Jan 20** = Jun 18 = Nov 18 = Oct 18 ≥ Feb 19 ≥ Oct 19 = Jan 19 ≥ Apr 19 = Mar 19 ≥ May 19 = Mar 18 = Jul 17 = May 18 = Dec 19 = Nov 19 ≥ Nov 17 > Aug 18 = Sep 18 ≥ Sep 17 = Aug 17 = Aug 16 = Dec 18 ≥ Apr 18 ≥ Dec 17 = Jan 18= Feb 18 = Mar 16 > May 17 ≥ Jun 17 = Jul 16 ≥ Apr 16 ≥ Feb 17 = Apr 17 > Oct 16 = May 16 = Nov 16 > Mar 17 = Jan 17 = Jun 16 = Sep 16 > Dec 16
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis					
Source	Df	Slope	r	r^2	P
Area	1	-124.951	0.101	0.010	**
Note: Linear regression analysis on spatial changes of contaminant concentrations.					

Cadmium

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	1006287358	48	20964320	94.849	**
Area	941544947.9	2	470772474	2129.918	**
Station(Area)	43439819.41	3	14479940	65.512	**
Period * Area	403868187.8	96	4206960.3	19.034	**
Period * Station(Area)	460052026.4	143	3217147	14.555	**
Error	710827415.7	3216	221028.43		
Total	14386238448	3509			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Oct 18 = **Mar 20** = Jun 18 > Oct 19 ≥ Jun 16 = May 17 ≥ **Feb 20** ≥ Dec 17 = Aug 19 = Jul 17 = Mar 18 ≥ May 18 ≥ Sep 19 ≥ Nov 17 = Nov 19 ≥ Oct 17 = **Jan 20** = Sep 17 = Aug 17 ≥ Apr 16 ≥ Apr 18 ≥ Apr 19 = May 16 ≥ May 19 ≥ Sep 16 = Nov 18 = Dec 19 = Aug 16 = Feb 17 ≥ Jun 17 ≥ Feb 18 = Jan 18 ≥ Dec 16 ≥ Sep 18 ≥ Jun 19 = Aug 18 ≥ Mar 17 ≥ Mar 16 = Nov 16 ≥ Apr 17 = Jul 19 ≥ Jan 17 = Jul 16 ≥ Jan 19 = Feb 19 ≥ Dec 18 = Mar 19 ≥ Jul 18 > Oct 16
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis					
Source	Df	Slope	r	r^2	P
Area	1	-593.095	0.479	0.229	**
Note: Linear regression analysis on spatial changes of contaminant concentrations.					

Chromium

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	1150773274	48	23974443	103.331	**
Area	346127586.6	2	173063793	745.915	**
Station(Area)	102997073.7	3	34332358	147.974	**
Period * Area	660652762.4	96	6881799.6	29.661	**
Period * Station(Area)	601449577.4	143	4205941.1	18.128	**
Error	746857658.8	3219	232015.43		
Total	14445336859	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jul 17 > Oct 17 ≥ **Feb 20** ≥ Dec 19 = Sep 19 ≥ Mar 16 = **Mar 20** ≥ Oct 19 ≥ Oct 18 ≥ Jun 18 ≥ Aug 19 ≥ Nov 17 ≥ Mar 19 ≥ Jan 19 = Feb 19 = Jul 19 ≥ Jul 18 ≥ Nov 18 ≥ Apr 19 = Jun 19 ≥ Sep 17 = Aug 17 ≥ **Jan 20** = Jun 16 ≥ Mar 18 ≥ Apr 16 ≥ May 18 = Nov 19 ≥ Aug 16 ≥ Feb 18 ≥ Jan 18 ≥ Jul 16 ≥ Aug 18 ≥ Sep 18 ≥ Dec 18 = Sep 16 = Apr 18 = May 16 ≥ Nov 16 ≥ Dec 16 ≥ Feb 17 = Oct 16 ≥ May 19 ≥ May 17 = Dec 17 = Jan 17 > Mar 17 = Jun 17 > Apr 17
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis

Source	Df	Slope	r	r^2	P
Area	1	-383.701	0.309	0.095	**

Note: Linear regression analysis on spatial changes of contaminant concentrations.

Copper

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	711644408.4	48	14825925	102.152	**
Area	1259873522	2	629936761	4340.334	**
Station(Area)	109031836.7	3	36343946	250.414	**
Period * Area	475662551.4	96	4954818.2	34.139	**
Period * Station(Area)	593803036.7	143	4152468.8	28.611	**
Error	467191289.3	3219	145135.54		
Total	14445337837	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Nov 18 ≥ Dec 19 = **Feb 20** = **Mar 20** = Nov 19 ≥ Aug 19 > Sep 19 ≥ Mar 19 = Oct 17 = Nov 17 ≥ Mar 18 = Apr 19 = Oct 18 ≥ Jun 18 ≥ Oct 19 = **Jan 20** ≥ May 18 = Dec 17 ≥ Jan 19 = = Feb 19 Aug 16 ≥ Feb 18 ≥ Apr 18 = Sep 17 = Aug 17 = Sep 18 = Dec 18 ≥ Aug 18 = Jul 18 = Feb 17 = Jun 16 ≥ Sep 16 ≥ Jan 18 = Jul 19 > Jun 19 ≥ Apr 16 ≥ Jun 17 ≥ Mar 16 = Dec 16 ≥ May 16 ≥ May 19 ≥ May 17 = Mar 17 ≥ Oct 16 ≥ Jan 17 = Jul 17 ≥ Nov 16 ≥ Jul 16 > Apr 17
- Active Pit > Near Pit > Pit Edge

Lead

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	955683909.8	48	19910081	81.895	**
Area	503298391.5	2	251649196	1035.094	**
Station(Area)	292835295.2	3	97611765	401.501	**
Period * Area	464797712.4	96	4841642.8	19.915	**
Period * Station(Area)	611724250.8	143	4277792	17.596	**
Error	782594542	3219	243117.29		
Total	14445337265	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Mar 17 = May 19 = **Feb 20** = Dec 19 > Nov 18 ≥ Mar 19 = Sep 19 = **Mar 20** = Oct 18 = Jul 17 ≥ Jun 18 = Oct 17 ≥ Nov 19 ≥ May 17 = Apr 19 = Aug 19 = Jul 18 ≥ Jul 19 = **Jan 20** = Oct 19 = Jan 19 = Feb 19 = Jun 19 ≥ Jun 17 = Sep 17 = Aug 17 = Mar 18 ≥ May 18 ≥ Nov 17 ≥ Apr 16 ≥ Mar 16 = Dec 18 = Jan 18 ≥ Jul 16 = Jun 16 ≥ Aug 16 ≥ Nov 16 = Apr 17 ≥ Aug 18 ≥ Feb 18 = May 16 = Sep 18 ≥ Dec 17 = Oct 16 = Apr 18 ≥ Feb 17 > Dec 16 > Sep 16 = Jan 17
- Active Pit > Pit Edge = Near Pit

Mercury

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	926737510.573	48	40900490	198.986	**
Area	48348369.475	2	84427900	410.752	**
Station(Area)	4662196.109	3	6015906.6	29.268	**
Period * Area	143590504.943	96	3635127.4	17.685	**
Period * Station(Area)	97377380.625	143	2004548.3	9.752	**
Error	280506043.264	3199	205544.53		
Total	6160370000.500	3492			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Apr 16 = Mar 16 > May 16 = Jun 16 > **Feb 20** ≥ Sep 16 = Jul 16 = Oct 19 ≥ Aug 16 ≥ **Mar 20** ≥ Oct 16 = Sep 19 ≥ Jun 17 ≥ Nov 16 > Dec 16 = May 17 = May 18 = Aug 19 = Oct 18 ≥ Nov 17 ≥ Jan 17 ≥ Jun 19 = Nov 19 = **Jan 20** ≥ Jun 18 = Mar 17 ≥ Apr 17 = Feb 17 = Sep 18 ≥ Jul 17 = Dec 19 = Oct 17 = Apr 19 = Jul 18 ≥ May 19 ≥ Aug 18 ≥ Dec 17 = Jan 19 = Feb 19 = Mar 19 = Sep 17 = Aug 17 = Nov 18 > Dec 18 > Mar 18 = Jul 19 = Jan 18 = Feb 18 = Apr 18
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis

Source	Df	Slope	r	r^2	P
Area	1	-255.697	0.209	0.044	**

Note: Linear regression analysis on spatial changes of contaminant concentrations.

Nickel

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	948187863.5	48	19753914	141.225	**
Area	490486782.9	2	245243391	1753.298	**
Station(Area)	334592024.2	3	111530675	797.357	**
Period * Area	700484933.3	96	7296718.1	52.166	**
Period * Station(Area)	684698226.7	143	4788099.5	34.231	**
Error	450259111.5	3219	139875.46		
Total	14445335823	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jul 17 = **Feb 20** ≥ Oct 17 = Dec 19 ≥ Sep 19 ≥ **Mar 20** ≥ Jun 18 = Oct 18 = Mar 16 = May 17 = Jun 17 = Oct 19 ≥ Nov 18 ≥ Aug 19 = Jul 19 ≥ Nov 17 ≥ Mar 19 = Sep 17 = Aug 17 ≥ Apr 19 = Jun 19 ≥ Jan 19 = Feb 19 ≥ Apr 16 ≥ Jul 18 ≥ Jul 16 ≥ Jun 16 ≥ Nov 19 ≥ **Jan 20** ≥ May 19 ≥ Dec 18 ≥ Mar 18 = May 18 = Jan 18 ≥ Nov 16 = Aug 18 = Sep 18 ≥ Feb 18 ≥ May 16 ≥ Aug 16 ≥ Sep 16 ≥ Apr 18 = Dec 17 = Dec 16= Feb 17 = Jan 17 = Apr 17 > Mar 17 > Oct 16
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis

Source	Df	Slope	r	r^2	P
Area	1	-453.858	0.365	0.133	**

Note: Linear regression analysis on spatial changes of contaminant concentrations.

Silver

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	473988008.3	48	9874750.172	56.277	**
Area	1324909025	2	662454512.7	3775.402	**
Station(Area)	19526177.37	3	6508725.789	37.094	**
Period * Area	633189010	96	6595718.854	37.59	**
Period * Station(Area)	580517641.1	143	4059563.924	23.136	**
Error	564649396.1	3218	175465.94		
Total	14428719200	3511			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- May 19 > Jul 19 ≥ Dec 17 ≥ Nov 17 ≥ May 17 ≥ Mar 19 = Apr 17 ≥ May 18 = Jun 16 = Aug 16 ≥ Jun 18 = Oct 18 ≥ Mar 18 = Aug 19 ≥ Jun 17 ≥ Oct 19 ≥ Mar 17 = Feb 17 = Jul 17 ≥ Sep 16 = **Mar 20** ≥ Sep 19 = Oct 17 ≥ Apr 19 ≥ **Jan 20** ≥ Apr 18 ≥ Nov 19 ≥ Feb 19 = Nov 18 ≥ Feb 18 = Sep 17 = Aug 17 = Jan 18 = Mar 16 = Apr 16 = **Feb 20** = Sep 18 ≥ May 16 = Aug 18 ≥ Dec 19 ≥ Jan 19 ≥ Dec 16 ≥ Jul 16 ≥ Nov 16 = Dec 18 ≥ Jan 17 ≥ Jul 18 ≥ Jun 19 > Oct 16
- Active Pit > Near Pit > Pit Edge

Zinc

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	1333241339	48	27775861.24	213.698	**
Area	580265445.6	2	290132722.8	2232.184	**
Station(Area)	249835962.8	3	83278654.27	640.718	**
Period * Area	550355491	96	5732869.698	44.107	**
Period * Station(Area)	478009055.2	143	3342720.666	25.718	**
Error	418396101.4	3219	129977.043		
Total	14445330476	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Sep 19 ≥ **Feb 20** ≥ Nov 18 ≥ Aug 19 = Dec 19 ≥ Jul 17 = Oct 17 = **Mar 20** ≥ Jun 18 = Mar 19 = Oct 18 = Nov 19 ≥ Oct 19 ≥ Nov 17 ≥ May 18 ≥ Mar 18 ≥ **Jan 20** ≥ Feb 19 ≥ Jul 19 ≥ Jul 18 ≥ Apr 18 = Apr 19 = Feb 18 = Mar 16 ≥ Jan 19 ≥ Jun 19 = Sep 17 = Aug 17 ≥ Apr 16 = Jan 18 ≥ Aug 16 ≥ Dec 17 ≥ Sep 18 = Aug 18 = Jun 16 ≥ Dec 18 = Jul 16 > Nov 16 = May 16 = Oct 16 = May 17 > Feb 17 = Dec 16 > Mar 17 = Jan 17 > Jun 17 = Apr 17 = Sep 16 > May 19
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis					
Source	Df	Slope	r	r^2	P
Area	1	-455.211	0.366	0.134	**
Note: Linear regression analysis on spatial changes of contaminant concentrations.					

Total Organic Carbon

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Period	1021221216	48	21275442	135.206	**
Area	380382060.5	2	190191030.2	1208.671	**
Station(Area)	119562382.4	3	39854127.45	253.274	**
Period * Area	810136070.7	96	8438917.403	53.63	**
Period * Station(Area)	772845523.2	143	5404514.148	34.346	**
Error	506527261.1	3219	157355.471		
Total	14444417678	3512			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- **Mar 20** ≥ Oct 17 = Feb 18 ≥ Jun 18 ≥ Aug 19 ≥ Dec 18 ≥ Apr 16 ≥ Aug 18 ≥ Nov 18 = Jul 17 = May 18 = Dec 19 = Mar 16 = Dec 17 = Jul 18 = Mar 18 = Nov 19 = Apr 19 ≥ Feb 19 ≥ Jun 16 ≥ **Jan 20** = Aug 16 = Jul 16 = Jan 19 = Oct 19 = Jun 19 = Nov 17 = Mar 19 = **Feb 20** = Nov 16 = Sep 19 ≥ Jan 17 > May 17 ≥ Sep 16 = Oct 16 = Dec 16 = May 16 = Sep 18 = Apr 18 ≥ Sep 17 = Aug 17= Jul 19 = Oct 18 ≥ Jun 17 ≥ May 19 > Jan 18 > Mar 17 = Apr 17 = Feb 17
- Active Pit > Pit Edge > Near Pit

Linear Regression Analysis					
Source	Df	Slope	r	r^2	P
Area	1	-396.708	0.319	0.102	**
Note: Linear regression analysis on spatial changes of contaminant concentrations.					

Cumulative Impact Sediment Chemistry for ESC CMPs – Analysis of Variance (up to February 2020)

Arsenic

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	115620867	15	7708057.8	498.73	**
Area	76380959	4	19095240	1235.508	**
Area * Station	6335172.7	4	1583793.2	102.475	**
Period * Area	184490089	59	3126950.7	202.321	**
Period * Area * Station	15906435	60	265107.25	17.153	**
Error	24481320	1584	15455.379		
Total	1.721E+09	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Dec 19 = Jun 19 = Aug 19 > Jun 18 > **Feb 20** > Dec 18 = Feb 19 = Dec 17 = Feb 18 > Aug 18 = Jun 17 > Jun 16 = Aug 17 > Dec 16 > Feb 17 = Aug 16
- Mid-Field > Ma Wan > Far-Field > Near-Field > Capped-Pit

Cadmium

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	49189380	15	3279292	42.292	**
Area	35475006	4	8868751.4	114.378	**
Area * Station	71676157	4	17919039	231.096	**
Period * Area	92597938	59	1569456.6	20.241	**
Period * Area * Station	51942451	60	865707.52	11.165	**
Error	122589634	1581	77539.3		
Total	1708534083	1725			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jun 16 ≥ Aug 16 ≥ **Feb 20** = Aug 19 = Aug 17 = Jun 18 = Feb 18 ≥ Dec 17 ≥ Dec 19 = Dec 18 > Jun 17 = Aug 18 = Feb 19 > Feb 17 = Jun 19 > Dec 16
- Mid-Field > Ma Wan > Far-Field > Near-Field = Capped-Pit

Chromium

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	20623710.77	15	1374914.1	62.31	**
Area	177652459.3	4	44413115	2012.77	**
Area * Station	29589395.75	4	7397348.9	335.242	**
Period * Area	115596160.5	59	1959257	88.792	**
Period * Area * Station	39642669.89	60	660711.17	29.943	**
Error	34952021.63	1584	22065.67		
Total	1721419748	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jun 16 > Aug 16 ≥ **Feb 20** = Dec 19 ≥ Aug 19 = Aug 17 ≥ Dec 17 ≥ Jun 18 ≥ Jun 17 ≥ Jun 19 = Feb 19 = Feb 18 ≥ Dec 16 > Dec 18 = Feb 17 > Aug 18
- Ma Wan > Mid-Field > Near-Field = Far-Field > Capped-Pit

Copper

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	18909193.43	15	1260612.9	54.435	**
Area	138278173.2	4	34569543	1492.761	**
Area * Station	113262176.1	4	28315544	1222.704	**
Period * Area	87717787.11	59	1486742.2	64.2	**
Period * Area * Station	21922808.26	60	365380.14	15.778	**
Error	36682477.21	1584	23158.13		
Total	1721419816	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- **Feb 20** = Dec 17 > Dec 19 > Aug 17 = Jun 18 = Feb 19 = Jun 16 = Jun 19 = Aug 16 = Aug 19 = Jun 17 > Dec 18 > Aug 18 = Dec 16 = Feb 18 = Feb 17
- Ma Wan > Mid-Field > Near-Field = Far-Field > Capped-Pit

Lead

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	103349239.1	15	6889949.3	271.997	**
Area	124124751	4	31031188	1225.029	**
Area * Station	19810835.14	4	4952708.8	195.52	**
Period * Area	111282613.6	59	1886146	74.46	**
Period * Area * Station	27692154.1	60	461535.9	18.22	**
Error	40124277.38	1584	25330.983		
Total	1721419750	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Aug 18 > Dec 18 > Aug 16 > Aug 19 = Dec 19 = Feb 19 = Aug 17 = Jun 18 > Jun 19 = Jun 16 = **Feb 20** > Feb 18 = Dec 17 > Dec 16 > Jun 17 > Feb 17
- Ma Wan > Mid-Field > Near-Field = Far-Field > Capped-Pit

Mercury

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Period	171066315.4	15	11404421	157.491	**
Area	22350815.06	4	5587703.8	77.164	**
Area * Station	15475606.81	4	3868901.7	53.428	**
Period * Area	61711489.02	59	1045957.4	14.444	**
Period * Area * Station	21558868.24	60	359314.47	4.962	**
Error	114340557.6	1579	72413.273		
Total	1701124420	1723			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jun 16 > Aug 16 > **Feb 20** > Dec 18 = Aug 18 = Dec 19 = Dec 16 > Feb 19 ≥ Feb 17 ≥ Aug 17 = Jun 19 = Jun 17 ≥ Dec 17 ≥ Jun 18 = Aug 19 > Feb 18
- Ma Wan > Far-Field = Capped-Pit ≥ Mid-Field ≥ Near-Field

Nickel

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	20075914.33	15	1338394.3	63.493	**
Area	155001566.7	4	38750392	1838.306	**
Area * Station	35838810.59	4	8959702.6	425.045	**
Period * Area	134350205.3	59	2277122.1	108.026	**
Period * Area * Station	43865054.91	60	731084.25	34.682	**
Error	33389771	1584	21079.401		
Total	1721419495	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jun 16 > Aug 18 > Dec 18 ≥ Dec 19 = Aug 17 = **Feb 20** = Dec 17 ≥ Aug 19 ≥ Dec 16 ≥ Jun 18 ≥ Jun 19 ≥ Jun 17 = Feb 18 = Feb 19 > Aug 16 > Feb 17
- Ma Wan > Mid-Field > Far-Field > Near-Field > Capped-Pit

Silver

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Period	55331797.44	15	3688786.5	106.733	**
Area	136067978.9	4	34016995	984.266	**
Area * Station	106881381.9	4	26720345	773.141	**
Period * Area	32103028.4	59	544119.13	15.744	**
Period * Area * Station	36677246.12	60	611287.44	17.687	**
Error	54744282.29	1584	34560.784		
Total	1720923841	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Aug 18 > Dec 18 > Dec 17 = Aug 16 = Feb 18 = Aug 17 > Feb 19 = Feb 17 = **Feb 20** = Aug 19 = Dec 19 = Dec 16 = Jun 17 > Jun 19 > Jun 16 > Jun 18
- Ma Wan > Mid-Field > Near-Field > Far-Field > Capped-Pit

Zinc

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	27574441.37	15	1838296.1	99.384	**
Area	134394168.8	4	33598542	1816.446	**
Area * Station	72081280.36	4	18020320	974.237	**
Period * Area	125224790	59	2122454.1	114.747	**
Period * Area * Station	24926224.09	60	415437.07	22.46	**
Error	29299023.88	1584	18496.859		
Total	1721418172	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- **Feb 20** = Dec 19 > Aug 16 > Aug 19 ≥ Jun 19 = Jun 18 ≥ Aug 17 = Jun 16 ≥ Dec 17 ≥ Jun 17 = Feb 19 ≥ Feb 18 = Dec 16 > Feb 17 > Dec 18 > Aug 18
- Ma Wan > Mid-Field > Near-Field > Far-Field > Capped-Pit

TOC

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	57731979.61	15	3848798.6	109.445	**
Area	102729590.9	4	25682398	730.306	**
Area * Station	16190899.44	4	4047724.9	115.101	**
Period * Area	125938000.6	59	2134542.4	60.698	**
Period * Area * Station	60310716.69	60	1005178.6	28.583	**
Error	55703918.46	1584	35166.615		
Total	1721272816	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Jun 16 > Dec 19 = **Feb 20** > Dec 16 = Aug 19 = Aug 16 > Dec 17 ≥ Feb 19 ≥ Jun 17 = Jun 18 ≥ Jun 19 ≥ Dec 18 = Feb 18 > Aug 17 ≥ Aug 18 > Feb 17
- Ma Wan > Mid-Field > Far-Field > Capped-Pit > Near-Field

TBT

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Period	103654022.2	15	6910268.1	94.458	**
Area	68253564.38	4	17063391	233.242	**
Area * Station	6367429.236	4	1591857.3	21.759	**
Period * Area	40039441.36	59	678634.6	9.276	**
Period * Area * Station	25530330.8	60	425505.51	5.816	**
Error	115881169.4	1584	73157.304		
Total	1671584499	1728			

Note:
1. Data are rank-transformed;
2. NS: No significant difference;
3. **: Significant difference

SNK Results:

- Feb 17 = Dec 16 = Aug 17 = Jun 17 = Aug 18 > Jun 16 ≥ Feb 18 = Dec 18 ≥ Feb 19 = Aug 16 = Dec 19 ≥ Dec 17 = Aug 19 = Jun 19 > Jun 18 = **Feb 20**
- Ma Wan > Capped-Pit > Near-Field = Far-Field > Mid Field

Sediment Toxicity for ESC CMPs – February 2020

Survival rate for burrowing amphipod Leptochirus plumulosus

	Survival
Chi-Square	0.040
Df	2
Asymp. Sig.	NS

Note:
1. NS: No significant difference;
2. **: Significant difference

Growth rate for benthic polychaete Neanthes arenaceodentata

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.020	2	0.010	0.945	NS
Within Groups	1.315	122	0.011		
Total	1.335	124			

Note:
1. NS: No significant difference;
2. **: Significant difference

Survival rate for marine bivalve Crassostrea gigas

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Between Groups	29.089	2	14.544	0.485	NS
Within Groups	3659.959	122	30		
Total	3689.048	124			

Note:
1. NS: No significant difference;
2. **: Significant difference

Mortality rate for barnacles Balanus Amphitrite

Source	Mortality
Chi-Square	1.299
Df	2
Asymp. Sig.	NS

Note:
1. NS: No significant difference;
2. **: Significant difference

Mortality rate for shrimp Penaeus vannaamei

Source	Mortality
Chi-Square	2.159
df	2
Asymp. Sig.	NS

Note:
1. NS: No significant difference;
2. **: Significant difference