

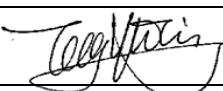
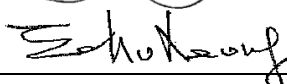
**China Harbour Engineering Company Limited**

Contract No. HY/2010/02

**Hong Kong – Zhuhai – Macao Bridge  
Hong Kong Boundary Crossing  
Facilities –  
Reclamation Works**

**Quarterly EM&A Summary Report for  
March 2017 – May 2017**

[3/2019]

	Name	Signature
Prepared & Checked:	Y T Tang	
Reviewed, Approved and Certified:	Echo Leong (ETL)	

Version:	Rev. 0	Date: 27 March 2019
<p><b>Disclaimer</b></p> <p>This report is prepared for China Harbour Engineering Company Limited and is given for its sole benefit in relation to and pursuant to Contract No. HY/2010/02 Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities-Reclamation Works and may not be disclosed to, quoted to or relied upon by any person other than China Harbour Engineering Company Limited without our prior written consent. No person (other than China Harbour Engineering Company Limited) into whose possession a copy of this report comes may rely on this report without our express written consent and China Harbour Engineering Company Limited may not rely on it for any purpose other than as described above.</p>		

AECOM Asia Co. Ltd.  
15/F, Grand Central Plaza, Tower 1, 138 Shatin Rural Committee Road, Shatin, NT, Hong Kong  
Tel: (852) 3922 9000 Fax: (852) 2317 7609 www.aecom.com

28 March 2019

By Fax (3698 5999) and By Post

Ove Arup & Partners Hong Kong Ltd.  
Chief Resident Engineer's Office  
11 Tung Chung Waterfront Road, Tung Chung, Lantau  
Hong Kong

Attention: Mr. Seven Yau

Dear Sir,

**Re: Agreement No. CE 48/2011 (EP)  
Environmental Project Office for the  
HZMB Hong Kong Link Road, HZMB Hong Kong Boundary Crossing Facilities,  
and Tuen Mun-Chek Lap Kok Link – Investigation**

**Contract No. HY/2010/02 – HZMB HKBCF – Reclamation Works  
Quarterly EM&A Summary Report for March 2017 to May 2017**

Reference is made to the Environmental Team's submission of the Quarterly EM&A Summary Report for March 2017 to May 2017 certified by the ET Leader (ET's ref.: "60249820/C/RMKY19032701" dated 27 March 2019) and provided to us via e-mail on 27 March 2019.

We are pleased to inform you that we have no adverse comments on the captioned Quarterly EM&A Summary Report for March 2017 to May 2017.

Please be reminded that our verification to your report does not release any of your obligations in the EM&A manuals under the applicable Environmental Permit(s) for this Project.

Thank you very much for your attention and please feel free to contact the undersigned should you require further information.

Yours faithfully,  
For and on behalf of  
Ramboll Hong Kong Limited



Ray Yan  
Independent Environmental Checker

c.c.	HyD	Mr. Andrew Chow	(By Fax: 3188 6614)
	HyD	Ms. Molly Kwan	(By Fax: 3188 6614)
	AECOM	Ms. Echo Leong	(By Fax: 2317 7609)
	CHEC	Mr. Lim Kim Chuan	(By Fax: 2578 0413)

Internal: DY, YH, DF, HW, ENPO Site

Q:\Projects\HYDHZMBEEM00\02\_Proj\_Mgt\02\_Corr\HYDHZMBEEM00\_0\_7305L.19.doc

Ramboll Hong Kong Limited 英環香港有限公司

21/F, BEA Harbour View Centre, 56 Gloucester Road, Wan Chai, Hong Kong Tel: 852.3465 2888 Fax: 852.3465 2899

[www.ramboll.com](http://www.ramboll.com)

## TABLE OF CONTENTS

	PAGE
EXECUTIVE SUMMARY	3
1 INTRODUCTION	6
1.1 Background	6
1.2 Scope of Report	6
1.3 Contract Organization	7
1.4 Summary of Construction Works	8
2 SUMMARY OF EM&A PROGRAMME REQUIREMENTS	9
2.1 Monitoring Parameters	9
2.2 Environmental Quality Performance (Action/Limit Levels)	11
2.3 Environmental Mitigation Measures	11
3 MONITORING RESULTS	12
3.1 Air Quality Monitoring	12
3.2 Noise Monitoring	14
3.3 Water Quality Monitoring	15
3.4 Dolphin Monitoring	21
3.5 Environmental Site Inspection and Audit	22
4 ADVICE ON THE SOLID AND LIQUID WASTE MANAGEMENT STATUS	24
4.1 Summary of Solid and Liquid Waste Management	24
5 IMPLEMENTATION STATUS OF ENVIRONMENTAL MITIGATION MEASURES	25
5.1 Implementation Status of Environmental Mitigation Measures	25
6 SUMMARY OF EXCEEDANCES OF THE ENVIRONMENTAL QUALITY PERFORMANCE LIMIT	27
6.1 Summary of Exceedances of the Environmental Quality Performance Limit	27
7 SUMMARY OF COMPLAINTS, NOTIFICATION OF SUMMONS AND SUCCESSFUL PROSECUTIONS	28
7.1 Summary of Environmental Complaints, Notification of Summons and Successful Prosecutions	28
8 COMMENTS, RECOMMENDATIONS AND CONCLUSIONS	29
8.1 Comments on mitigation measures	29
8.2 Recommendations on EM&A Programme	30
8.3 Conclusions	31

## List of Tables

Table 1.1	Contact Information of Key Personnel
Table 3.1	Summary of Number of Monitoring Events for 1-hr & 24-hr TSP Concentration
Table 3.2	Summary of Number of Exceedances for 1-hr & 24-hr TSP Monitoring
Table 3.3	Summary of Number of Monitoring Events for Impact Noise
Table 3.4	Summary of Number of Monitoring Exceedances for Impact Noise
Table 3.6	Summary of Key Dolphin Survey Findings in Mar 2017 – May 2017
Table 3.7	Summary of STG and ANI encounter rates in March 2017 – May 2017

## Figures

Figure 1	General Contract Layout Plan
Figure 2	Impact Air Quality and Noise Monitoring Stations and Wind Station
Figure 3	Impact Water Quality Monitoring Stations
Figure 4A	Impact Dolphin Monitoring Line Transect Layout Map
Figure 4B	Impact Dolphin Monitoring Line Transect Layout Map (Effective after 12 May 2017)
Figure 5	Environmental Complaint Handling Procedure

## List of Appendices

Appendix A	Contract Organization for Environmental Works
Appendix B	Three Month Rolling Construction Programmes
Appendix C	Implementation Schedule of Environmental Mitigation Measures (EMIS)
Appendix D	Summary of Action and Limit Levels
Appendix E	Graphical Presentation of Impact Air Quality Monitoring Results
Appendix F	Graphical Presentation of Impact Daytime Construction Noise Monitoring Results
Appendix G	Graphical Presentation of Impact Water Quality Monitoring Results
Appendix H	Impact Dolphin Monitoring Survey Findings and Analysis
Appendix I	Quarterly Summary of Waste Flow Table
Appendix J	Cumulative Statistics on Exceedances, Complaints, Notifications of Summons and Successful Prosecutions
Appendix K	Event Action Plan
Appendix L	Incident Report on Action Level or Limit Level Non-compliance for Impact Dolphin Monitoring

## EXECUTIVE SUMMARY

Contract No. HY/2010/02 – Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities – Reclamation Works (here below, known as “the Contract”) mainly comprises reclamation at the northeast of the Hong Kong International Airport of an area of about 130-hectare for the construction of an artificial island for the development of the Hong Kong Boundary Crossing Facilities (HKBCF), and about 19-hectare for the southern landfall of the Tuen Mun - Chek Lap Kok Link (TMCLKL). It is a designated Project and is governed by the current permits for the Project, i.e. the amended Environmental Permits (EPs) issued on 11 April 2016 (EP-353/2009/K) and 13 March 2015 (EP-354/2009/D) (for TMCLKL Southern Landfall Reclamation only).

Ove Arup & Partners Hong Kong Limited (Arup) was appointed by Highways Department (HyD) as the consultants for the design and construction assignment for the Project’s reclamation works (i.e. the Engineer for the Contract).

China Harbour Engineering Company Limited (CHEC) was awarded by HyD as the Contractor to undertake the construction work of the Contract.

Ramboll Environ Hong Kong Limited was employed by HyD as the Independent Environmental Checker (IEC) and Environmental Project Office (ENPO) for the Project.

AECOM Asia Co. Ltd. (AECOM) was appointed by CHEC to undertake the role of Environmental Team for the Contract for carrying out the environmental monitoring and audit (EM&A) works.

The construction phase of the Project under the EPs was commenced on 12 March 2012. The EM&A programme, including air quality, noise, water quality and dolphin monitoring and environmental site inspections, was commenced on 12 March 2012.

This report documents the findings of EM&A works conducted in the period between 1 March 2017 and 31 May 2017. As informed by the Contractor, major activities in the reporting quarter were:-

### **Marine-base**

- Sloping Seawalls
- Rubble Mound Seawall
- Maintenance of silt curtain

### **Land-base**

- Surcharge removal & laying
- Construction of Permanent Seawall
- Maintenance works of Site Office at Works Area WA2
- Maintenance works of Public Works Regional Laboratory at Works Area WA3
- Maintenance of Temporary Marine Access at Works Area WA2

A summary of monitoring and audit activities conducted in the reporting quarter is listed below:

24-hour Total Suspended Particulates (TSP) monitoring	18 sessions
1-hour TSP monitoring	18 sessions
Noise monitoring	14 sessions
Impact water quality monitoring	39 sessions
Impact dolphin monitoring	6 surveys
Joint Environmental site inspection	13 sessions

### **Breaches of Action and Limit Levels for Air Quality**

All 1-Hour TSP and 24-Hour TSP results were below the Action and Limit Level in the reporting quarter.

### **Breaches of Action and Limit Levels for Noise**

For construction noise, no exceedance was recorded at all monitoring stations in the reporting quarter.

### **Breaches of Action and Limit Levels for Water Quality**

In March 2017, 1 action level exceedance of turbidity were recorded at both SR4(N) and IS8 during flood tide on 24 March 2017; 1 action level exceedance and 1 limit level exceedance of suspended solids were recorded at SR4(N) and IS8 respectively during flood tide on 24 March 2017; 1 action level exceedance of suspended solids were recorded at both SR4(N) and IS8 during ebb tide on 24 March 2017. The exceedances were considered unrelated to this Contract's activities after investigation. No other exceedance was recorded at all monitoring stations in the March 2017.

In April 2017, 1 action level exceedance of suspended solids was recorded at IS(Mf)11 during flood tide on 28 April 2017. The exceedance was considered unrelated to this Contract's activities after investigation; No other exceedance was recorded at all monitoring stations in the April 2017.

### **Breaches of Action and Limit Levels for Impact Dolphin Monitoring**

One (1) Limit Level exceedance of dolphin monitoring was recorded in the reporting quarter. After investigation, it was concluded that the HZMB works is one of the contributing factors affecting the dolphins. It was also concluded the contribution of impacts due to the HZMB works as a whole (or individual marine contracts) cannot be quantified nor separate from the other stress factors. Event Action Plan for Impact Dolphin Monitoring was triggered. For detail of investigation, please refer to appendix L.

### **Implementation Status and Review of Environmental Mitigation Measures**

Most of the recommended mitigation measures, as included in the EM&A programme, were implemented properly in the reporting quarter.

The recommended environmental mitigation measures effectively minimize the potential environmental impacts from the Project. The EM&A programme effectively monitored the environmental impacts from the construction activities and ensure the proper implementation of mitigation measures. No particular recommendation was advised for the improvement of the programme.

Moreover, regular review and checking on the construction methodologies, working processes and plants were carried out to ensure the environmental impacts were kept minimal and recommended environmental mitigation measures were implemented effectively.

### **Complaint, Notification of Summons and Successful Prosecution**

One environmental complaint was received on 27 March 2017, and the complainant complained that a very loud sound was intermittently heard by the Complainant since 10pm on 26 March and such loud sound was heard by the complainant until midnight. It was suspected that the sound came from the Hong Kong-Zhuhai-Macao Bridge (HZMB) construction works near the artificial island. In addition, a large area of pollution was observed on sea in the morning of the day the complainant made the complaint. It was suspected that was caused by the HZMB construction works. After investigation, there is no adequate information to conclude the

No notification of summons or prosecution was received in the reporting period complaint is related to this Contract. Nevertheless, the Contractor was reminded to continue to fully maintain all noise and water quality mitigation measures.

One environmental complaint was received on 17 April 2017, the organization which made the complaint, Green Sense, complained that “muddy water was observed at area surrounding the Hong Kong-Zhuhai-Macao Bridge (HZMB) artificial island, it is suspected that there were overflow muddy water from the artificial island. Tam Hoi-pong of Green Sense stated that there should not be too much muddy water if reclamation was conducted according to the EIA report. He suspected that there are problems of reclamation works, silt curtain have not effectively screen out the mud and sand, the construction works is not ideal and unable to ensure water quality. After investigation, there is no adequate information to conclude the complaint is related to this Contract. Nevertheless, the Contractor was reminded to continue to fully maintain all water quality mitigation measures.

No notification of summons or prosecution was received in the reporting period

## 1 INTRODUCTION

### 1.1 Background

- 1.1.1 Contract No. HY/2010/02 – Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities – Reclamation Works (here below, known as “the Contract”) mainly comprises reclamation at the northeast of the Hong Kong International Airport of an area of about 130-hectare for the construction of an artificial island for the development of the Hong Kong Boundary Crossing Facilities (HKBCF), and about 19-hectare for the southern landfall of the Tuen Mun - Chek Lap Kok Link (TMCLKL).
- 1.1.2 The environmental impact assessment (EIA) reports (Hong Kong – Zhuhai – Macao Bridge Hong Kong Boundary Crossing Facilities – EIA Report (Register No. AEIAR-145/2009) (HKBCFEIA) and Tuen Mun – Chek Lap Kok Link – EIA Report (Register No. AEIAR-146/2009) (TMCLKLEIA), and their environmental monitoring and audit (EM&A) Manuals (original EM&A Manuals), for the Project were approved by Environmental Protection Department (EPD) in October 2009.
- 1.1.3 EPD subsequently issued the Environmental Permit (EP) for HKBCF in November 2009 (EP-353/2009) and the Variation of Environmental Permit (VEP) in June 2010 (EP-353/2009/A), November 2010 (EP-353/2009/B), November 2011 (EP-353/2009/C), March 2012 (EP-353/2009/D), October 2012 (EP-353/2009/E), April 2013 (EP-353/2009/F), August 2013 (EP-353/2009/G), January 2015 (EP-353/2009/H), July 2015 (EP-353/2009/I), February 2016 (EP-353/2009/J) and April 2016 (EP-353/2009/K). Similarly, EPD issued the Environmental Permit (EP) for TMCLKL in November 2009 (EP-354/2009) and the Variation of Environmental Permit (VEP) in December 2010 (EP-354/2009/A), January 2014 (EP-354/2009/B), December 2014 (EP-354/2009/C) and March 2015 (EP-354/2009/D).
- 1.1.4 The Project is a designated Project and is governed by the current permits for the Project, i.e. the amended EPs issued on 11 April 2016 (EP-353/2009/K) and 13 March 2015 (EP-354/2009/D) (for TMCLKL Southern Landfall Reclamation only).
- 1.1.5 A Contract Specific EM&A Manual, which included all Contract -relation contents from the original EM&A Manuals for the Contract, was issued in May 2012.
- 1.1.6 Ove Arup & Partners Hong Kong Limited (Arup) was appointed by Highways Department (HyD) as the consultants for the design and construction assignment for the Project’s reclamation works (i.e. the Engineer for the Contract).
- 1.1.7 China Harbour Engineering Company Limited (CHEC) was awarded by HyD as the Contractor to undertake the construction work of the Contract.
- 1.1.8 Ramboll Environ Hong Kong Limited was employed by HyD as the Independent Environmental Checker (IEC) and Environmental Project Office (ENPO) for the Project.
- 1.1.9 AECOM Asia Co. Ltd. (AECOM) was appointed by CHEC to undertake the role of Environmental Team for the Contract for carrying out the EM&A works.
- 1.1.10 The construction phase of the Project under the EPs was commenced on 12 March 2012.
- 1.1.11 According to the Contract Specific EM&A Manual, there is a need of an EM&A programme including air quality, noise, water quality and dolphin monitoring and environmental site inspections. The EM&A programme of the Contract commenced on 12 March 2012.

### 1.2 Scope of Report

- 1.2.1 This is the twenty first quarterly EM&A Report under the Contract No. HY/2010/02 Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities – Reclamation Works. This report presents a summary of the environmental monitoring and audit works, list of activities and mitigation measures proposed by the ET for the Contract from 1 March 2017 to 31 May 2017.



**1.3 Contract Organization**

1.3.1 The Contract organization structure is shown in Appendix A. The key personnel contact names and numbers are summarized in Table 1.1.

**Table 1.1 Contact Information of Key Personnel**

<b>Party</b>	<b>Position</b>	<b>Name</b>	<b>Telephone</b>	<b>Fax</b>
<b>Engineer's Representative (ER)</b>  (Ove Arup & Partners Hong Kong Limited)	Chief Resident Engineer	Paul Appleton	3698 5889	2698 5999
<b>IEC / ENPO</b>  (Ramboll Environ Hong Kong Limited)	Independent Environmental Checker	Raymond Dai	3465 2888	3465 2899
	Environmental Project Office Leader	Y. H. Hui	3456 2850	3465 2899
<b>Contractor</b>  (China Harbour Engineering Company Limited)	Environmental Officer	Louie Chan	36932254	2578 0413
	24-hour Hotline	Alan C.C. Yeung	9448 0325	--
<b>ET</b>  (AECOM Asia Company Limited)	ET Leader	Echo Leong	3922 9280	2317 7609

#### **1.4 Summary of Construction Works**

- 1.4.1 The construction phase of the Project under the EP commenced on 12 March 2012.
- 1.4.2 As informed by the Contractor, details of the major works carried out in the reporting quarter are listed below:-

##### ***Marine-base***

- Sloping Seawalls
- Rubble Mound Seawall
- Maintenance of silt curtain

##### ***Land-base***

- Surcharge removal & laying
- Construction of Permanent Seawall
- Maintenance works of Site Office at Works Area WA2
- Maintenance works of Public Works Regional Laboratory at Works Area WA3
- Maintenance of Temporary Marine Access at Works Area WA2

- 1.4.3 The 3-month rolling construction programme of the Contract is shown in Appendix B.
- 1.4.4 The general layout plan of the Contract site showing the detailed works areas is shown in Figure 1.
- 1.4.5 The environmental mitigation measures implementation schedule are presented in Appendix C.

## 2 SUMMARY OF EM&A PROGRAMME REQUIREMENTS

### 2.1 Monitoring Parameters

- 2.1.1 The Contract Specific EM&A Manual designated 4 air quality monitoring stations, 2 noise monitoring stations, 21 water monitoring stations (9 Impact Stations, 7 Sensitive Receiver Stations and 5 Control/Far Field Stations) to monitor environmental impacts on air quality, noise and water quality respectively. Pre-set and fixed transect line vessel based dolphin survey was required in two AFCD designated areas (Northeast and Northwest Lantau survey areas). The impact dolphin monitoring at each survey area should be conducted twice per month.
- 2.1.2 For impact air quality monitoring, monitoring locations AMS2 (Tung Chung Development Pier) and AMS7 (Hong Kong SkyCity Marriott Hotel) were set up at the proposed locations in accordance with Contract Specific EM&A Manual. The conditional omission of Monitoring Station AMS6 was effective since 19 November 2012. For monitoring location AMS3 (Ho Yu College), as proposed in the Contract Specific EM&A Manual, approval for carrying out impact monitoring could not be obtained from the principal of the school. Permission on setting up and carrying out impact monitoring works at nearby sensitive receivers, like Caribbean Coast and Coastal Skyline, was also sought. However, approvals for carrying out impact monitoring works within their premises were not obtained. Impact air quality monitoring was conducted at site boundary of the site office area in Works Area WA2 (AMS3B) respectively. Same baseline and Action Level for air quality, as derived from the baseline monitoring data recorded at Ho Yu College, was adopted for this alternative air quality location.
- 2.1.3 For impact noise monitoring, monitoring locations NMS2 (Seaview Crescent Tower 1) was set up at the proposed locations in accordance with Contract Specific EM&A Manual. However, for monitoring location NMS3 (Ho Yu College), as proposed in the Contract Specific EM&A Manual, approval for carrying out impact monitoring could not be obtained from the principal of the school. Permission on setting up and carrying out impact monitoring works at nearby sensitive receivers, like Caribbean Coast and Coastal Skyline, was also sought. However, approvals for carrying out impact monitoring works within their premises were not obtained. Impact noise monitoring was conducted at site boundary of the site office area in Works Area WA2 (NMS3B) respectively. Same baseline noise level, as derived from the baseline monitoring data recorded at Ho Yu College was adopted for this alternative noise monitoring location. Reference is made to ET's proposal of relocation of air quality monitoring station (AMS7) dated on 2 February 2015, with no further comment received from IEC on 2 February 2015 and no objection received from EPD on 5 February 2015, the impact air quality monitoring station AMS7 (Hong Kong SkyCity Marriott Hotel) has been relocated to AMS7A (Chu Kong Air-Sea Union Transportation Company Limited) on 3 February 2015. Action Level for air quality, as derived from the baseline monitoring data recorded at Hong Kong SkyCity Marriott Hotel, was adopted for this alternative air quality location.
- 2.1.4 As informed by the premises owner of (AMS7A) - Chu Kong Air-Sea Union Transportation Co. LTD would not grant us the permission to install air quality monitoring equipment (High volume sampler) and conduct 1-hour TSP/24 hour TSP monitoring at the premises of Chu Kong Air-Sea Union Transportation Co. LTD after December 2015. In order to fulfil the EM&A requirement of this Contract, as permission to conduct impact air quality monitoring at the premise of Hong Kong SkyCity Marriott Hotel has been granted in December 2015, ET proposed relocation of air quality monitoring station (AMS7A) on 15 December 2015, with no further comment received from IEC on 15 December 2015 and no particular comment received from EPD on 21 December 2015, the impact air quality monitoring station AMS7A (Chu Kong Air-Sea Union Transportation Company Limited) has been relocated to AMS7 (Hong Kong SkyCity Marriott Hotel) on 30 December 2015. The impact air quality monitoring for December 2015 was conducted before the relocation of AQM Station from AMS7A to AMS7. The impact air quality monitoring has been conducted at AMS7 (Hong Kong SkyCity Marriott Hotel) since 1 January 2016, Action Level for air quality, as derived from the baseline monitoring data recorded at Hong Kong SkyCity Marriott Hotel will be adopted for this air quality monitoring location.
- 2.1.5 In accordance with the Contract Specific EM&A Manual, twenty-one stations were designated for impact water quality monitoring. The nine Impact Stations (IS) were chosen on the basis of their proximity to the reclamation and thus the greatest potential for water quality impacts, the seven Sensitive Receiver Stations (SR) were chosen as they are close to the key sensitive receives and the

five Control/ Far Field Stations (CS) were chosen to facilitate comparison of the water quality of the IS stations with less influence by the Project/ ambient water quality conditions.

- 2.1.6 Due to safety concern and topographical condition of the original locations of SR4 and SR10B, alternative impact water quality monitoring stations, naming as SR4(N) and SR10B(N), were adopted, which are situated in vicinity of the original impact water quality monitoring stations (SR4 and SR10B) and could be reachable. Same baseline and Action Level for water quality, as derived from the baseline monitoring data recorded, were adopted for these alternative impact water quality monitoring stations.
- 2.1.7 The monitoring locations used during the reporting quarter are depicted in Figures 2, 3, 4A & 4B respectively.
- 2.1.8 With respect to the commencement of marine work of the Expansion of Hong Kong International Airport into a Three-Runway System (3RS Project), large portion works site boundary are established at the northern part of the existing airport Island. The works area of 3RS project affected several water quality monitoring stations and dolphin monitoring transect lines which are being used for conducting monitoring under Contract No. HY/2010/02 and therefore, the EM&A Programme for this Contract is affected. As a result, the “Proposal for Alteration of Transect Line of Dolphin Monitoring and Alternative Monitoring Location for Impact Water Quality Monitoring (IWQM) Stations” was prepared by ET in September 2016 in accordance with condition 5.1 of EP-353/2009/K and condition 4.1 of EP-354/2009/D, to relocate water quality monitoring stations from SR5, IS10, CS(Mf)3 and alternate the transect lines of dolphin monitoring 2, 3, 4, 5, 6 and 7. Comment was subsequently received from IEC/ENPO. A revised proposal has been updated and sent to IEC/ENPO for their further review on 24 March 2017 and IEC/ENPO verified the revised proposal on the same date. The revised proposal has been sent to authority by project team for review and approval on 3 April 2017. The authority subsequently approved the proposal on 12 May 2017. Relocation of water quality monitoring stations from SR5, IS10, CS(Mf)3 to SR5(N), IS10(N), CS(Mf)3(N) and alternation of transect lines of dolphin monitoring 2, 3, 4, 5, 6, 7 and 24 are adopted starting from 15 May 2017 and 17 May 2017 respectively.
- 2.1.9 The Contract Specific EM&A Manual also required environmental site inspections for air quality, noise, water quality, chemical, waste management, marine ecology and landscape and visual impact.

## **2.2 Environmental Quality Performance (Action/Limit Levels)**

- 2.2.1 The environmental quality performance limits (i.e. Action and/or Limit Levels) of air and water quality monitoring were derived from the baseline air and water quality monitoring results at the respective monitoring stations, while the environmental quality performance limits of noise monitoring were defined in the EM&A Manual.
- 2.2.2 The environmental quality performance limits of air quality, noise and water monitoring are given in Appendix D.

## **2.3 Environmental Mitigation Measures**

- 2.3.1 Relevant environmental mitigation measures were stipulated in the Particular Specification and EPs (EP-353/2009/K and EP-354/2009/D) (for TMCLKL Southern Landfall Reclamation only) for the Contractor to adopt. A list of environmental mitigation measures and their implementation statuses are given in Appendix C.

### 3 MONITORING RESULTS

#### 3.1 Air Quality Monitoring

- 3.1.1 In accordance with the Contract Specific EM&A Manual, impact 1-hour Total Suspended Particulates (TSP) monitoring was conducted for at least three times every 6 days, while impact 24-hour TSP monitoring was carried out for at least once every 6 days at the 4 monitoring stations (AMS2, AMS3B, AMS6 and AMS7).
- 3.1.2 The monitoring locations for impact air quality monitoring are depicted in Figure 2. However, for AMS6 (Dragonair/CNAC (Group) Building), permission on setting up and carrying out impact monitoring works was sought, however, access to the premise has not been granted yet on this report issuing date.
- 3.1.3 As informed by the premises owner of (AMS7A) - Chu Kong Air-Sea Union Transportation Co. LTD would not grant us the permission to install air quality monitoring equipment (High volume sampler) and conduct 1-hour TSP/24 hour TSP monitoring at the premises of Chu Kong Air-Sea Union Transportation Co. LTD after December 2015. In order to fulfil the EM&A requirement of this Contract, as permission to conduct impact air quality monitoring at the premise of Hong Kong SkyCity Marriott Hotel has been granted in December 2015, ET proposed relocation of air quality monitoring station (AMS7A) on 15 December 2015, with no further comment received from IEC on 15 December 2015 and no particular comment received from EPD on 21 December 2015, the impact air quality monitoring station AMS7A (Chu Kong Air-Sea Union Transportation Company Limited) has been relocated to AMS7 (Hong Kong SkyCity Marriott Hotel) on 30 December 2015. The impact air quality monitoring for December 2015 was conducted before the relocation of AQM Station from AMS7A to AMS7. The impact air quality monitoring for this report quarter were conducted at AMS7 (Hong Kong SkyCity Marriott Hotel), Action Level for air quality, as derived from the baseline monitoring data recorded at Hong Kong SkyCity Marriott Hotel will be adopted for this air quality monitoring location.
- 3.1.4 The weather was mostly fine and sunny, with occasional cloudy in the reporting quarter. The major dust source in the reporting quarter included construction activities from the Project, as well as nearby traffic emissions.
- 3.1.5 The number of monitoring events and exceedances recorded in each month of the reporting quarter are presented in Table 3.1 and Table 3.2 respectively.

**Table 3.1 Summary of Number of Monitoring Events for 1-hr & 24-hr TSP Concentration**

Monitoring Parameter	Location	No. of monitoring events		
		Mar 17	Apr 17	May 17
1-hr TSP	AMS2	18	18	18
	AMS3B	18	18	18
	AMS7	18	18	18
24-hr TSP	AMS2	6	6	6
	AMS3B	6	6	6
	AMS7	6	6	6

**Table 3.2 Summary of Number of Exceedances for 1-hr & 24-hr TSP Monitoring**

Monitoring Parameter	Location	Level of Exceedance	Numbers of Exceedance		
			Mar 17	Apr 17	May 17
1-hr TSP	AMS2	Action	0	0	0
		Limit	0	0	0
	AMS3B	Action	0	0	0
		Limit	0	0	0
	AMS7	Action	0	0	0
		Limit	0	0	0
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>
24-hr TSP	AMS2	Action	0	0	0
		Limit	0	0	0

	AMS3B	Action	0	0	0
		Limit	0	0	0
	AMS7	Action	0	0	0
		Limit	0	0	0
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>

- 3.1.6 All 24-Hour TSP and 1-Hour TSP results were below the Action and Limit Level in the reporting quarter.
- 3.1.7 The event action plan is annexed in Appendix K.
- 3.1.8 Meteorological information collected from the wind station during the monitoring periods on the monitoring dates, as shown in Figure 2, including wind speed and wind direction, is annexed in Appendix H of monthly EM&A report March 2017, April 2017 and May 2017 respectively.

### 3.2 Noise Monitoring

- 3.2.1 Impact noise monitoring was conducted at the 2 monitoring stations (NMS2 and NMS3B) for at least once per week during 07:00 – 19:00 in the reporting quarter.
- 3.2.2 The monitoring locations used during the reporting quarter are depicted in Figure 2.
- 3.2.3 The measured noise level on 30 Mar 2017 at NMS3B exceeded the noise level of 65dB(A) during examination period but it is higher than the baseline level. Therefore, baseline correction was carried out and the corrected noise level which solely represent the noise level of Construction works is 53 dB(A) which is lower than the exceedance level of 65dB(A). Therefore, it is not considered as an exceedance. As such the EAP was not triggered. Other noise sources during the noise monitoring included construction activities of the Contract, construction activities by other contracts and nearby traffic noise. Nonetheless, the Contractor of Contract No.HY/2010/02 was reminded to continue to properly implement all noise mitigation measures
- 3.2.4 The measured noise level on 5 May 2017 at NMS3B exceeded the noise level of 65 dB(A) during examination period but it was below the baseline level. Therefore, it is not considered as an exceedance. As such the EAP was not triggered. Other major noise sources during the noise monitoring included construction activities of the Contract, construction activities by other contracts and nearby traffic noise. Nonetheless, the Contractor of Contract No.HY/2010/02 was reminded to continue to properly implement all noise mitigation measures.
- 3.2.5 No Action or Limit Level Exceedance of construction noise was recorded in the reporting quarter.
- 3.2.6 Major noise sources during the noise monitoring included construction activities of the Project and nearby traffic noise.
- 3.2.7 The number of impact noise monitoring events and exceedances are summarized in Table 3.3 and Table 3.4 respectively.

**Table 3.3 Summary of Number of Monitoring Events for Impact Noise**

Monitoring Parameter	Location	No. of monitoring events		
		Mar 17	Apr 17	May 17
	NMS2	5	4	5
	NMS3B	5	4	5

**Table 3.4 Summary of Number of Monitoring Exceedances for Impact Noise**

Monitoring Parameter	Location	Level of Exceedance	Level of Exceedance		
			Mar 17	Apr 17	May 17
NMS2		Action	0	0	0
		Limit	0	0	0
NMS3B		Action	0	0	0
		Limit	0	0	0
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>

- 3.2.8 The graphical plots of the trends of the monitoring results are provided in Appendix F. No specific trend of the monitoring results or existence of persistent pollution source was noted.
- 3.2.9 The event action plan is annexed in Appendix K.



### 3.3 Water Quality Monitoring

3.3.1 The monitoring locations used during the reporting quarter are depicted in Figure 3.

3.3.2 Due to marine work of the Expansion of Hong Kong International Airport into a Three-Runway System (3RS Project), original locations of water quality monitoring stations SR5, IS10 and CS(Mf)3 are enclosed by works boundary of 3RS Project. Alternative impact water quality monitoring stations, naming as SR5(N), IS10(N) and CS(Mf)3(N) are adopted starting from 15 May 2017 to replace the original locations of water quality monitoring. For details and status of the proposed changes, please refer to section 5.1.9.

Table 3.5 Summary of Water Quality Exceedances in Mar 2017 – May 2017

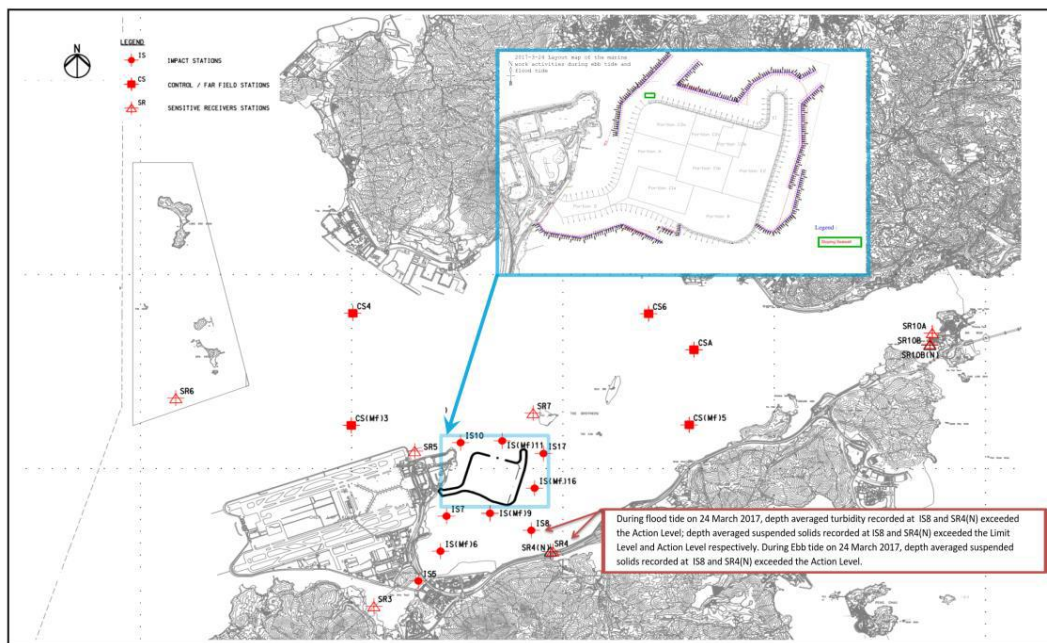
Station	Exceedance Level	DO (S&M)		DO (Bottom)		Turbidity		SS		Total	
		Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
IS5	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
IS(Mf)6	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
IS7	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
IS8	Action	0	0	0	0	0	(1) 24 Mar 2017	(1) 24 Mar 2017	0	1	1
	Limit	0	0	0	0	0	0	0	(1) 24 Mar 2017	0	1
IS(Mf)9	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
IS10	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
IS(Mf)11	Action	0	0	0	0	0	0	0	(1) 28 Apr 2017	0	1
	Limit	0	0	0	0	0	0	0	0	0	0
IS(Mf)16	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
IS17	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
SR3	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
SR4(N)	Action	0	0	0	0	0	(1) 24 Mar 2017	(1) 24 Mar 2017	(1) 24 Mar 2017	1	2
	Limit	0	0	0	0	0	0	0	0	0	0
SR5	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
SR6	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
SR7	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
SR10A	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0
SR10B (N)	Action	0	0	0	0	0	0	0	0	0	0
	Limit	0	0	0	0	0	0	0	0	0	0

Station	Exceedance Level	DO (S&M)		DO (Bottom)		Turbidity		SS		Total	
		Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood	Ebb	Flood
<b>Total</b>	<b>Action</b>	0	0	0	0	0	2	2	2	6	
	<b>Limit</b>	0	0	0	0	0	0	0	1	1	

Note: S: Surface;  
 M: Mid-depth;

3.3.3 Two turbidity action level exceedances on 24 March 2017 at monitoring stations IS8 and SR4(N) during flood tide; One suspended solids action level and one suspended solids limit level exceedance were recorded at monitoring station SR4(N) and IS8 respectively during flood tide. During ebb tide on 24 March 2017, two suspended solids action level were recorded at monitoring station SR4(N) and IS8.

3.3.3.1 Below layout map shows active works conducted on 24 March 2017. Construction of sloping seawall was conducted at Portion C2a as part of the HKBCF Reclamation Works during flood tide.



3.3.3.2 Investigation Results:

3.3.3.3 With refer to the layout map attached and as informed by the Contractor, no active works was conducted along the southern seawall on 24 March 2017 which is the part of the reclamation located closest to monitoring stations IS8 and SR4(N). Only construction of sloping seawall was conducted at Portion C2a on 24 March 2017, the works is located relatively far away from IS8 and SR4(N), in addition, there were no water quality exceedance at monitoring stations IS10, IS(Mf)11, IS(Mf)6 and IS(Mf)9 on 24 March 2017, which are located closer to active work than monitoring stations IS8 and SR4(N). It is unlikely that the turbidity and suspended solids exceedances recorded at IS8 and SR4(N) are caused by this Contract..

3.3.3.4 With referred to photo records taken in the vicinity of IS8 and SR4(N) on 24 March 2017, relatively turbid water was observed within the vicinity of monitoring station IS8 and SR4(N) but no siltplume was observed to flow from the inside of the perimeter silt curtain to the outside of the perimeter silt curtain during flood tide on 24 March 2017.

3.3.3.5 Photo record taken in the vicinity of SR4(N) on 24 March 2017 shows that vessels were observed in the vicinity monitoring station SR4(N). After checking with the Contractor, vessels shown in photo record were not working for this Contract.

3.3.3.6 Photo record of the sea condition near IS8 on 24 March 2017. The photo shows that no turbid water was observe at the side near HKBCF Reclamation works.



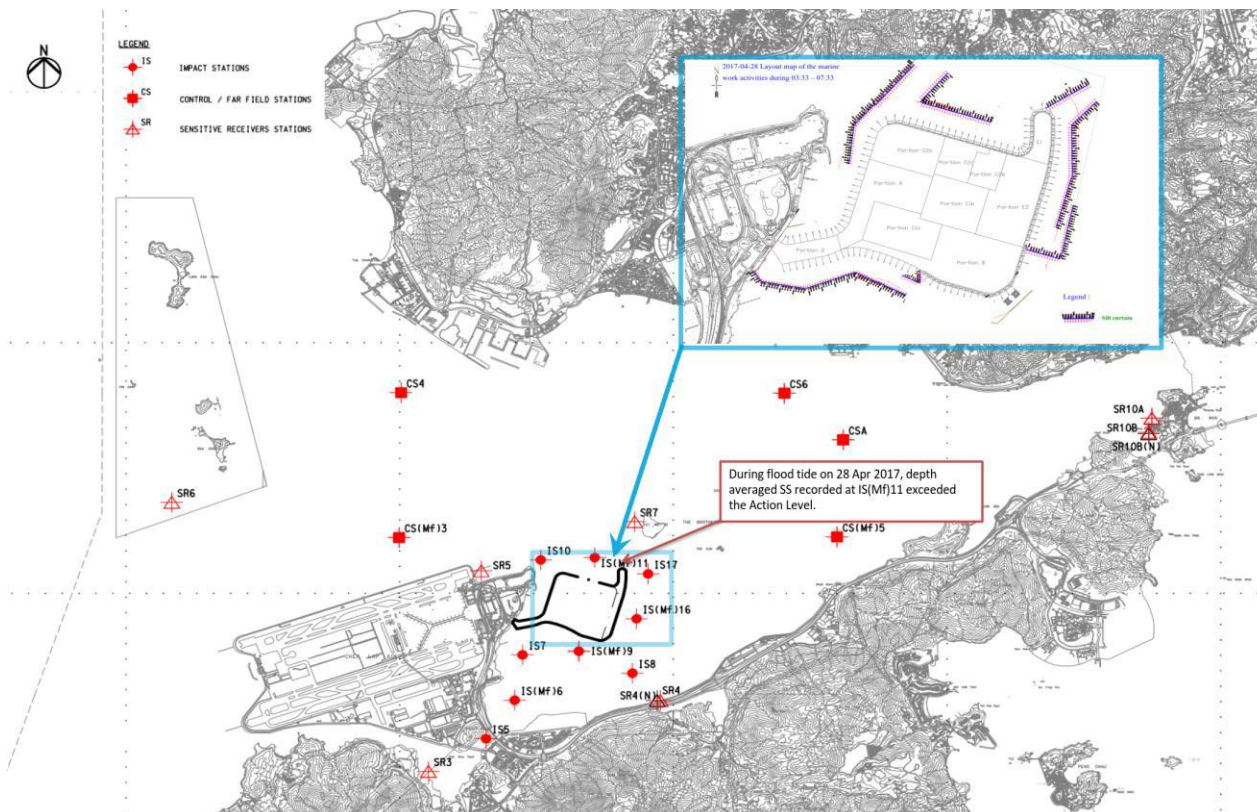
3.3.3.7 Photo record of the sea condition near SR4(N) on 24 March 2017



- 3.3.3.8 The exceedances were likely due to local effects in the vicinity of IS8 and SR4(N).
- 3.3.3.9 As such, the exceedances recorded at IS8 and SR4(N) on 24 March 2017 were unlikely to be contract related.
- 3.3.3.10 Action taken under the action plan:
1. *in situ* measurement was repeated to confirm findings if turbidity exceedances; not applicable to SS measurement as SS was not measured *in situ* ;
  2. After considering the above mentioned investigation results, it appears that it was unlikely that the exceedances were attributed to active construction activities of this Contract;
  3. IEC, contractor, ER and EPD were informed via email;
  4. Monitoring data, all plant, equipment and Contractor's working methods were checked;
  5. Since it is considered that the turbidity exceedance is unlikely to be project related, as such actions 5-7. under the EAP are not considered applicable.
- 3.3.3.11 Nevertheless, the Contractor was reminded to ensure provision of ongoing maintenance to the silt curtains and to carry out maintenance work once defects were found.
- 3.3.3.12 Maintenance work of the silt curtain will be provided by the Contractor on a daily basis except Sunday and public holiday, when defects were found.

3.3.4 One action level exceedance of SS is recorded at monitoring station IS(Mf)11 during flood tide on 28 Apr 2017.

3.3.4.1 Below layout map shows no construction activities was conducted as part of the HKBCF Reclamation Works during flood tide on 28 April 2017.



3.3.4.2 Investigation Result:

3.3.4.3 With referred to the layout map above, no construction activities was conducted when water quality monitoring was conducted at monitoring station IS(Mf)11 on 28 April 2017 during flood tide, as such, it is unlikely that exceedance of SS at IS(Mf)11 on 28 April 2017 during flood tide was due to construction activities.

3.3.4.4 In addition, with referred to silt curtain checking record of 28 April 2017, no defects of the silt curtain was observed.

3.3.4.5 With referred to monitoring record, no sediment plume has been observed to flow from inside of the perimeter silt curtain to the outside of the perimeter silt curtain during flood tide on 28 April 2017.

3.3.4.6 With referred to photo record below which shows the sea condition near monitoring station IS(Mf)11 on 28 April 2017 during flood tide, no adverse water quality impact indirectly caused by marine traffic was observed.



3.3.4.7 The exceedance was likely due to local effects in the vicinity of IS(Mf)11.

3.3.4.8 As such, the exceedance recorded at IS(Mf)11 recorded during flood tide on 28 April 2017 was unlikely to be contract related.

Action taken under the action plan:

1. Not applicable as SS was not measured in situ;
2. After considering the above mentioned investigation results, it appears that it was unlikely that the suspended solids exceedance was attributed to active construction activities of this Contract;
3. IEC, Contractor and ER were informed via email;
4. Monitoring data, all plant, equipment and Contractor's working methods were checked;
5. Since it is considered that the suspended solids exceedance is unlikely to be contract related, as such, actions 5-7 under the EAP are not considered applicable.

3.3.4.9 Nevertheless, the Contractor was reminded to ensure provision of ongoing maintenance to the silt curtains and to carry out maintenance work once defects were found.

3.3.4.10 Maintenance work of the silt curtain will be provided by the Contractor on a daily basis except Sunday and public holiday, when defects were found.

3.3.5 No other exceedance was recorded at all monitoring stations in the reporting quarter.

3.3.6 The event action plan is annexed in Appendix K.

### 3.4 Dolphin Monitoring

- 3.4.1 In accordance with the Contract Specific EM&A Manual, pre-set and fixed transect line vessel based dolphin survey was required in two AFCD designated areas (Northeast Lantau (NEL) and Northwest Lantau (NWL) survey areas). The impact dolphin monitoring at each survey area should be conducted twice per month.
- 3.4.2 The impact dolphin monitoring conducted is vessel-based and combines line-transect and photo-ID methodology, which have adopted similar survey methodologies as that adopted during baseline monitoring to facilitate comparisons between datasets.
- 3.4.3 The layout map of impact dolphin monitoring have been provided by AFCD and is shown in Figure 4.
- 3.4.4 The effort summary and sighting details during the reporting quarter are shown in the Appendix H. A summary of key findings of the dolphin surveys completed during the reporting quarter is shown below:

**Table 3.6 Summary of Key Dolphin Survey Findings in Mar 2017 – May 2017**

Number of Impact Surveys Completed <sup>^</sup>	6
Survey Distance Travelled under Favourable On- Effort Condition	610.9km
Number of Sightings	5 sightings (2 sightings are "on effort" (which are all under favourable condition), 3 sightings are "opportunistic")
Number of dolphin individual sighted	16 individuals (the best estimated group size)
Dolphin Encounter Rate <sup>#</sup>	NEL: 0 NWL: 0.5
Dolphin Group Size	Average of NEL: 0 Average of NWL: 3.2 Varied from 1-6 individuals
Most Often frequent dolphin sighting area	Northern Sha Chau and Lung Kwu Chau Marine Park, the western limit of NWL and Tai O area.

Remarks:

<sup>^</sup> Completion of line transect survey of NEL and NWL survey area once was counted as one complete survey.  
<sup>#</sup> Dolphin Encounter Rate = (Sum of 1<sup>st</sup> 2<sup>nd</sup>, 3<sup>rd</sup> month's total sighting/ Sum of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> month's total effort)\*100km (encounter rates are calculated using on effort sightings made under favourable conditions only.)

- 3.4.5 One (1) Limit Level exceedance of dolphin monitoring was recorded in the reporting quarter. After investigation, it was concluded that the HZMB works is one of the contributing factors affecting the dolphins. It was also concluded the contribution of impacts due to the HZMB works as a whole (or individual marine contracts) cannot be quantified nor separate from the other stress factors. Event Action Plan for Impact Dolphin Monitoring was triggered. For detail of investigation, please refer to appendix L.

**Table 3.7 Summary of STG and ANI encounter rates in March 2017 – May 2017**

	NEL	NWL	Level Exceeded
STG*	0	0.5	Limit
ANI**	0	2.9	

\*Quarterly Average Encounter Rate of Number of Dolphin Sightings (STG) presents averaged encounter rates of the three monitored months in terms of groups per 100km per survey event.

STG Encounter rate = (Average of (total number sighting/total effort) of 1st and 2nd completed survey# of 1st month+ Average of (total number sighting/total effort) of 1st and 2nd completed survey# of 2nd month + Average of (total number sighting/total effort) of 1st and 2nd completed survey# of 3rd month)/3\*100km

\*\*Quarterly Average Encounter Rate of Total Number of Dolphins (ANI) presents averaged encounter rates of the three monitored months in terms of individuals per 100km per survey event.

ANI Encounter rate = (Average of (total number of Individual/total effort) of 1st and 2nd completed survey# of 1st month+ Average of (total number of Individual/total effort) of 1st and 2nd completed survey# of 2nd month + Average of (total number of Individual/total effort) of 1st and 2nd completed survey# of 3rd month +)/3\*100km

- 3.4.6 Details of the comparison and analysis methodology and their findings and discussions are annexed in Appendix H.

### **3.5 Environmental Site Inspection and Audit**

- 3.5.1 Site Inspections were carried out on a weekly basis to monitor the implementation of proper environmental pollution control and mitigation measures for the Project. In the reporting quarter, 13 site inspections were carried out. Recommendations on remedial actions were given to the Contractors for the deficiencies identified during the site audits.

- 3.5.2 Particular observations during the site inspections are described below:

#### ***Air Quality***

- 3.5.3 Dust was observed during excavation, the Contractor was reminded to spray water or dust suppression chemical before, during and immediately after the operation so as to maintain the entire surface wet. (Reminder)
- 3.5.4 Dark smoke emission from plant/equipment and vessels and from an excavator were observed, the Contractor was reminded that dark smoke emission from plant/equipment shall be avoided. Emission of dark smoke was no longer observed in subsequent site inspection in the reporting quarterly. The Contractor was reminded to ensure proper implementation of air quality mitigation measures and smoke emission from plant/equipment shall be avoided. (Closed)
- 3.5.5 Dust was observed during the operation of excavator for road finishing works. The Contractor was reminded to provide effective dust suppression mechanism. No dust was observed near excavator at the concerned area from photo record provided by the Contractor. (Closed)
- 3.5.6 Dust was observed on 30 Mar 2017 during the transport of dusty materials. The Contractor was reminded to spray water or other dust suppression chemical prior to loading, unloading or transport of dusty materials. The Contractor subsequently sprayed water to the dusty materials. (Closed)
- 3.5.7 It was observed that a discolored NRMM labels was affixed on the side of a drilling rig machines, excavator and boring machines. The Contractor was reminded to affix appropriate NRMM labels on the machines. The Contractor subsequently provided NRMM label to the machine. (Closed)

#### ***Noise***

- 3.5.8 Acoustic mat was not provided to generator placed on ship deck of Mytilus, the Contractor was reminded to provide appropriate acoustic decoupling measures. The Contractor subsequently rectified the situation by providing acoustic decoupling measures to the concerned generator. (Closed)

#### ***Water Quality***

- 3.5.9 It was observed that silt curtain near Portion E2 was disconnected. The Contractor was reminded to reinstall silt curtain at the concerned area and provide maintenance regularly. (Reminder)

#### ***Chemical and Waste Management***

- 3.5.10 Chemical containers were placed on bare ground or on the edge of drip tray, the Contractor was reminded to place all chemical containers on drip tray properly to retain leakage, if any. The Contractor subsequently remove the chemical containers from the location. The Contractor was reminded chemical containers should be put inside drip trays as a preventive measure. (Closed)
- 3.5.11 Chemical containers were placed on ship deck of Chun Ming 98, 83 and 18, the Contractor was reminded to place all chemical containers on drip tray properly to retain leakage, if any. The Contractor subsequently remove the oil drum from the area. The Contractor was reminded chemical



containers should be put inside drip trays as a preventive measure. (Pending for Contractor's rectification)

- 3.5.12 The Contractor was reminded to provide drip tray to equipment that use petrol or other chemical as fuel to avoid leakage, if any. (Reminder)
- 3.5.13 The Contractor was reminded to clear leaked water on ground and replace the flawed drip tray to prevent leakage, if any. (Reminder)
- 3.5.14 Oil Spillage was observed from derrick lighter along the pathway on ship deck of Chun Ming 68, the Contractor was reminded to clear all leaked oil as chemical waste, provide adequate spill kits and repair derrick lighter at once before using. The Contractor subsequently rectified the situation. (Closed)
- 3.5.15 Oil Spillage were observed on ship deck of Chun Ming 18 on 27 Apr 2017 and leaking from a generator at Portion E2 on 11 May 2017, the Contractor was reminded to clear all leaked oil as chemical waste and dispose of as chemical waste. The Contractor subsequently cleaned the leaked oil with spill kit provided on barge and removed the generator from concerned area respectively. (Closed)
- 3.5.16 The Contractor was reminded to clear spilled oil or chemical retained on drip tray to prevent chemical leakage. (Reminder)
- 3.5.17 The Contractor was reminded to clear water retained on drip tray after rainfall to prevent spillage, if any. (Reminder)
- 3.5.18 The Contractor was reminded to clear leaked oil on the lid of containers and water retained on drip tray of drilling rig (Lam D90) to prevent spillage or mixing with general site runoff. (Reminder)

#### ***Landscape and Visual Impact***

- 3.5.19 No relevant adverse impact was observed in the reporting quarter.

#### ***Others***

- 3.5.20 Rectifications of remaining identified items are undergoing by the Contractor. Follow-up inspections on the status on provision of mitigation measures will be conducted to ensure all identified items are mitigated properly.

## **4 ADVICE ON THE SOLID AND LIQUID WASTE MANAGEMENT STATUS**

### **4.1 Summary of Solid and Liquid Waste Management**

- 4.1.1 The Contractor registered as a chemical waste producer for this project. Sufficient numbers of receptacles were available for general refuse collection and sorting.
- 4.1.2 As advised by the Contractor, 63,124.6m<sup>3</sup> of inert C&D Materials generated and reused in other Projects; 231,560.5m<sup>3</sup> of surplus surcharge exported to Macau; 82,992.7m<sup>3</sup> of Imported fill; 448kg paper/cardboard packaging, 136.5 m<sup>3</sup> other C&D waste such as general refuse were generated and disposed of in the reporting period. Monthly summary of waste flow table is detailed in Appendix I.
- 4.1.3 The Contractor is advised to properly maintain on site C&D materials and wastes collection, sorting and recording system, dispose of C&D materials and wastes at designated ground and maximize reuse / recycle of C&D materials and wastes. The Contractor is reminded to properly maintain the site tidiness and dispose of the wastes accumulated on site regularly and properly.
- 4.1.4 The Contractor is reminded that chemical waste containers should be properly treated and stored temporarily in designated chemical waste storage area on site in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.
- 4.1.5 The treated marine sediment and/or treated excavated filling material specified by Contract no. HY/2013/01 has been received as public fill for Contract no. HY/2010/02's reclamation filling works since January 2015. As informed by the Contractor in the last reporting quarter, such site arrangement has been discontinued since 24 February 2016.
- 4.1.6 After checking with the Contractor, surcharge material was removed off site to Macau from 27 April 2016 and it is continued in the reporting quarter. Surplus surcharge was exported to Macau during the reporting quarter. The Contractor was reminded to ensure consistency in quantities in case of any C&D material disposed off-site and/or no surcharge material removed off site.

## 5 IMPLEMENTATION STATUS OF ENVIRONMENTAL MITIGATION MEASURES

### 5.1 Implementation Status of Environmental Mitigation Measures

- 5.1.1 In response to the site audit findings, the Contractors carried out corrective actions.
- 5.1.2 A summary of the Implementation Schedule of Environmental Mitigation Measures (EMIS) is presented in Appendix C. Most of the recommended mitigation measures are being upheld. Moreover, regular review and checking on the construction methodologies, working processes and plants were carried out to ensure the environmental impacts were kept minimal and recommended environmental mitigation measures were implemented effectively.
- 5.1.3 Training of marine travel route for marine vessels operator was given to relevant staff and relevant records were kept properly.
- 5.1.4 Regarding the implementation of dolphin monitoring and protection measures (i.e. implementation of Dolphin Watching Plan, Dolphin Exclusion Zone and Silt Curtain integrity Check), regular checks were conducted by experienced MMOs within the works area to ensure that no dolphins were trapped by the silt curtain area. There were no dolphins spotted within the silt curtain during this quarter. The relevant procedures were followed and all measures were well implemented. The silt curtains were also inspected in accordance to the submitted plan.
- 5.1.5 Acoustic decoupling measures on noisy plants on construction vessels were checked regularly and the Contractor was reminded to ensure provision of ongoing maintenance to noisy plants and to carry out improvement work once insufficient acoustic decoupling measures were found.
- 5.1.6 Frequency of watering per day on exposed soil was checked; with reference to the record provided by the Contract, watering was conducted at least 8 times per day on reclaimed land. The frequency of watering is the mainly refer to water truck. Sprinklers are only served to strengthen dust control measure for busy traffic at the entrance of Portion D. As informed by the Contractor, during the malfunction period of sprinkler, water truck will enhance watering at such area. The Contractor was reminded to ensure provision of watering of at least 8 times per day on all exposed soil within the reporting period.
- 5.1.7 As informed by the Contractor, the perimeter silt curtain near Portion B of HKBCF has been arranged on 3 February 2016. A notification on the concerned site arrangement of the perimeter silt curtain of Contract HY/2010/02 was sent to IEC/ENPO by the ET for their review on 8 March 2016, IEC/ENPO issued comments on 10 March 2016 and the notification of realignment of perimeter silt curtain is under ET's further review in the reporting quarter. The concerned notification on the concerned site arrangement of the perimeter silt curtain of Contract HY/2010/02 will be sent to the Authority once the review is completed.
- 5.1.8 Further to our letter (ET's letter's ref.: 60249820/rmky16033001) dated 30/3/2016 regarding the notification of silt curtain removal programme and arrangement, as informed by RSS on 18 May 2016, the Contractor provided an updated programme on 31 October 2016 to indicate the current site situation. According to CHEC's latest removal programme during the reporting quarter, stage 2 (east side of the perimeter silt curtain removal work has been completed and dates for the subsequent stages have also been updated, while the overall phasing arrangement has not changed. A notification email has been sent to IEC/ENPO to inform them that the completion of removal of perimeter silt curtain of Stages 2 and the tentative date for silt curtain removal work of stage 3, 4 and 5. With referred to previous IEC/ENPO comment received on 7 June 2016 if update of proposal was mainly on time schedule and they have no objection in principle. However prior to IEC/ENPO's reply to confirm ET's updated proposal, ET was requested to provide site photos to show ET's checking of the current site condition with respect to the reminders given in their previous letter (Ref.: HYDZHMBEEM00\_0\_4102L.16 dated 22 April 2016).
- 5.1.9 With respect to the commencement of marine work of the Expansion of Hong Kong International Airport into a Three-Runway System (3RS Project), large portion works site boundary are established at the northern part of the existing airport Island. The works area of 3RS project affected several water quality monitoring stations and dolphin monitoring transect lines which are being

used for conducting monitoring under Contract No. HY/2010/02 and therefore, the EM&A Programme for this Contract is affected. As a result, the “Proposal for Alteration of Transect Line of Dolphin Monitoring and Alternative Monitoring Location for Impact Water Quality Monitoring (IWQM) Stations” was prepared by ET in September 2016 in accordance with condition 5.1 of EP-353/2009/K and condition 4.1 of EP-354/2009/D, to relocate water quality monitoring stations from SR5, IS10, CS(Mf)3 and alternate the transect lines of dolphin monitoring 2, 3, 4, 5, 6 and 7. Comment was subsequently received from IEC/ENPO. A revised proposal has been updated and sent to IEC/ENPO for their further review on 24 March 2017 and IEC/ENPO verified the revised proposal on the same date. The revised proposal has been sent to authority by project team for review and approval on 3 April 2017. The authority subsequently approved the proposal on 12 May 2017. Relocation of water quality monitoring stations from SR5, IS10, CS(Mf)3 to SR5(N), IS10(N), CS(Mf)3(N) and alternation of transect lines of dolphin monitoring 2, 3, 4, 5, 6, 7 and 24 are adopted starting from 15 May 2017 and 17 May 2017 respectively.

- 5.1.10 After review, no floating grout production was in operation at any time in reporting period for Contract No.HY/2010/02. Condition 3.26A of EP-353/2009/K for Contract No.HY/2010/02 is complied with during the reporting month.

## **6 SUMMARY OF EXCEEDANCES OF THE ENVIRONMENTAL QUALITY PERFORMANCE LIMIT**

### **6.1 Summary of Exceedances of the Environmental Quality Performance Limit**

- 6.1.1 All 1-Hour TSP and 24-Hour TSP results were below the Action and Limit Level in the reporting quarter.
- 6.1.2 For construction noise, no exceedance was recorded at all monitoring stations in the reporting quarter.
- 6.1.3 For water quality monitoring, In March 2017, 1 action level exceedance of turbidity were recorded at both SR4(N) and IS8 during flood tide on 24 March 2017; 1 action level exceedance and 1 limit level exceedance of suspended solids were recorded at SR4(N) and IS8 respectively during flood tide on 24 March 2017; 1 action level exceedance of suspended solids were recorded at both SR4(N) and IS8 during ebb tide on 24 March 2017. The exceedances were considered unrelated to this Contract's activities after investigation. No other exceedance was recorded at all monitoring stations in the March 2017; In April 2017, 1 action level exceedance of suspended solids was recorded at IS(Mf)11 during flood tide on 28 April 2017. The exceedance was considered unrelated to this Contract's activities after investigation; No other exceedance was recorded at all monitoring stations in the April 2017.
- 6.1.4 For dolphin monitoring, One (1) Limit Level exceedance of dolphin monitoring was recorded in the reporting quarter. After investigation, it was concluded that the HZMB works is one of the contributing factors affecting the dolphins. It was also concluded the contribution of impacts due to the HZMB works as a whole (or individual marine contracts) cannot be quantified nor separate from the other stress factors. Event Action Plan for Impact Dolphin Monitoring was triggered. For detail of investigation, please refer to appendix L.
- 6.1.5 Cumulative statistics on exceedances is provided in Appendix J.

## **7 SUMMARY OF COMPLAINTS, NOTIFICATION OF SUMMONS AND SUCCESSFUL PROSECUTIONS**

### **7.1 Summary of Environmental Complaints, Notification of Summons and Successful Prosecutions**

- 7.1.1 The Environmental Complaint Handling Procedure is annexed in Figure 5.
- 7.1.2 One environmental complaint was received on 27 March 2017, and the complainant complained that a very loud sound was intermittently heard by the Complainant since 10pm on 26 March and such loud sound was heard by the complainant until midnight. It was suspected that the sound came from the Hong Kong-Zhuhai-Macao Bridge (HZMB) construction works near the artificial island. In addition, a large area of pollution was observed on sea in the morning of the day the complainant made the complaint. It was suspected that was caused by the HZMB construction works. After investigation, there is no adequate information to conclude the complaint is related to this Contract. Nevertheless, the Contractor was reminded to continue to fully maintain all noise and water quality mitigation measures.
- 7.1.3 One environmental complaint was received on 17 April 2017, the organization which made the complaint, Green Sense, complained that “muddy water was observed at area surrounding the Hong Kong-Zhuhai-Macao Bridge (HZMB) artificial island, it is suspected that there were overflow muddy water from the artificial island. Tam Hoi-pong of Green Sense stated that there should not be too much muddy water if reclamation was conducted according to the EIA report. He suspected that there are problems of reclamation works, silt curtain have not effectively screen out the mud and sand, the construction works is not ideal and unable to ensure water quality. After investigation, there is no adequate information to conclude the complaint is related to this Contract. Nevertheless, the Contractor was reminded to continue to fully maintain all water quality mitigation measures.
- 7.1.4 No notification of summons or prosecution was received in the reporting period
- 7.1.5 Statistics on complaints, notifications of summons and successful prosecutions are summarized in Appendix J.

## 8 COMMENTS, RECOMMENDATIONS AND CONCLUSIONS

### 8.1 Comments on mitigation measures

8.1.1 According to the environmental site inspections performed in the reporting quarter, the following recommendations were provided:

#### ***Air Quality Impact***

- All working plants and vessels on site should be regularly inspected and properly maintained to avoid dark smoke emission.
- All vehicles should be washed to remove any dusty materials before leaving the site.
- Haul roads should be sufficiently dampened to minimize fugitive dust generation.
- Wheel washing facilities should be properly maintained and reviewed to ensure properly functioning.
- Temporary exposed slopes and open stockpiles should be properly covered.
- Enclosure should be erected for cement debagging, batching and mixing operations.
- Water spraying should be provided to suppress fugitive dust for any dusty construction activity.
- Regular review and provide maintenance to dust control measures such as sprinkler system.

#### ***Construction Noise Impact***

- Quieter powered mechanical equipment should be used as far as possible.
- Noisy operations should be oriented to a direction away from sensitive receivers as far as possible.
- Proper and effective noise control measures for operating equipment and machinery on-site should be provided, such as erection of movable noise barriers or enclosure for noisy plants. Closely check and replace the sound insulation materials regularly
- Vessels and equipment operating should be checked regularly and properly maintained.
- Noise Emission Label (NEL) shall be affixed to the air compressor and hand-held breaker operating within works area.
- Acoustic decoupling measures should be properly implemented for all existing and incoming construction vessels with continuous and regularly checking to ensure effective implementation of acoustic decoupling measures.

#### ***Water Quality Impact***

- Regular review and maintenance of silt curtain systems, drainage systems and desilting facilities in order to make sure they are functioning effectively.
- Construction of seawall should be completed as early as possible.
- Regular inspect and review the loading process from barges to avoid splashing of material.
- Silt, debris and leaves accumulated at public drains, wheel washing bays and perimeter u-channels and desilting facilities should be cleaned up regularly.
- Silty effluent should be treated/ desilted before discharged. Untreated effluent should be prevented from entering public drain channel.

- Proper drainage channels/bunds should be provided at the site boundaries to collect/intercept the surface run-off from works areas.
- Exposed slopes and stockpiles should be covered up properly during rainstorm.

#### ***Chemical and Waste Management***

- All types of wastes, both on land and floating in the sea, should be collected and sorted properly and disposed of timely and properly. They should be properly stored in designated areas within works areas temporarily.
- All chemical containers and oil drums should be properly stored and labelled.
- All plants and vehicles on site should be properly maintained to prevent oil leakage.
- All kinds of maintenance works should be carried out within roofed, paved and confined areas.
- All drain holes of the drip trays utilized within works areas should be properly plugged to avoid any oil and chemical waste leakage.
- Oil stains on soil surface and empty chemical containers should be cleared and disposed of as chemical waste.
- Regular review should be conducted for working barges and patrol boats to ensure sufficient measures and spill control kits were provided on working barges and patrol boats to avoid any spreading of leaked oil/chemicals.

#### ***Landscape and Visual Impact***

- All existing, retained/transplanted trees at the works areas should be properly fenced off and regularly inspected.
- Control night-time lighting and glare by hooding all lights.

### **8.2 Recommendations on EM&A Programme**

- 8.2.1 The impact monitoring programme for air quality, noise, water quality and dolphin ensured that any deterioration in environmental condition was readily detected and timely actions taken to rectify any non-compliance. Assessment and analysis of monitoring results collected demonstrated the environmental impacts of the Project. With implementation of recommended effective environmental mitigation measures, the Project's environmental impacts were considered as environmentally acceptable. The weekly environmental site inspections ensured that all the environmental mitigation measures recommended were effectively implemented.
- 8.2.2 The recommended environmental mitigation measures, as included in the EM&A programme, effectively minimize the potential environmental impacts from the Project. Also, the EM&A programme effectively monitored the environmental impacts from the construction activities and ensure the proper implementation of mitigation measures. No particular recommendation was advised for the improvement of the programme.

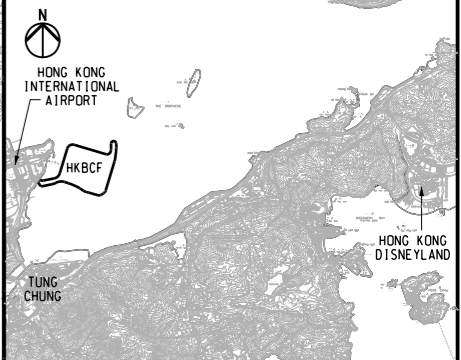


### 8.3 Conclusions

- 8.3.1 The construction phase and EM&A programme of the Project commenced on 12 March 2012.
- 8.3.2 All 1-Hour TSP and 24-Hour TSP results were below the Action and Limit Level in the reporting quarter.
- 8.3.3 For construction noise, no exceedance was recorded at all monitoring stations in the reporting quarter.
- 8.3.4 For water quality monitoring:
- 8.3.4.1 In March 2017, 1 action level exceedance of turbidity were recorded at both SR4(N) and IS8 during flood tide on 24 March 2017; 1 action level exceedance and 1 limit level exceedance of suspended solids were recorded at SR4(N) and IS8 respectively during flood tide on 24 March 2017; 1 action level exceedance of suspended solids were recorded at both SR4(N) and IS8 during ebb tide on 24 March 2017. The exceedances were considered unrelated to this Contract's activities after investigation. No other exceedance was recorded at all monitoring stations in the March 2017.
- 8.3.4.2 In April 2017, 1 action level exceedance of suspended solids was recorded at IS(Mf)11 during flood tide on 28 April 2017. The exceedance was considered unrelated to this Contract's activities after investigation; No other exceedance was recorded at all monitoring stations in the April 2017.
- 8.3.5 One (1) Limit Level exceedance of dolphin monitoring was recorded in the reporting quarter. After investigation, it was concluded that the HZMB works is one of the contributing factors affecting the dolphins. It was also concluded the contribution of impacts due to the HZMB works as a whole (or individual marine contracts) cannot be quantified nor separate from the other stress factors. Event Action Plan for Impact Dolphin Monitoring was triggered. For detail of investigation, please refer to appendix L.
- 8.3.6 Environmental site inspection was carried out 13 times in the reporting quarter. Recommendations on remedial actions were given to the Contractors for the deficiencies identified during the site audits.
- 8.3.7 One environmental complaint was received on 27 March 2017, and the complainant complained that a very loud sound was intermittently heard by the Complainant since 10pm on 26 March and such loud sound was heard by the complainant until midnight. It was suspected that the sound came from the Hong Kong-Zhuhai-Macao Bridge (HZMB) construction works near the artificial island. In addition, a large area of pollution was observed on sea in the morning of the day the complainant made the complaint. It was suspected that was caused by the HZMB construction works. After investigation, there is no adequate information to conclude the complaint is related to this Contract. Nevertheless, the Contractor was reminded to continue to fully maintain all noise and water quality mitigation measures.
- 8.3.8 One environmental complaint was received on 17 April 2017, the organization which made the complaint, Green Sense, complained that "muddy water was observed at area surrounding the Hong Kong-Zhuhai-Macao Bridge (HZMB) artificial island, it is suspected that there were overflow muddy water from the artificial island. Tam Hoi-pong of Green Sense stated that there should not be too much muddy water if reclamation was conducted according to the EIA report. He suspected that there are problems of reclamation works, silt curtain have not effectively screen out the mud and sand, the construction works is not ideal and unable to ensure water quality. After investigation, there is no adequate information to conclude the complaint is related to this Contract. Nevertheless, the Contractor was reminded to continue to fully maintain all water quality mitigation measures.
- 8.3.9 No notification of summons or prosecution was received in the reporting quarter.
- 8.3.10 Apart from the above mentioned monitoring, most of the recommended mitigation measures, as included in the EM&A programme, were implemented properly in the reporting quarter.

- 8.3.11 The recommended environmental mitigation measures effectively minimize the potential environmental impacts from the Contract. The EM&A programme effectively monitored the environmental impacts from the construction activities and ensure the proper implementation of mitigation measures. No particular recommendation was advised for the improvement of the programme.
- 8.3.12 Moreover, regular review and checking on the construction methodologies, working processes and plants were carried out to ensure the environmental impacts were kept minimal and recommended environmental mitigation measures were implemented effectively.

DO NOT SCALE DRAWING. CHECK ALL DIMENSIONS ON-SITE.  
ALL RIGHTS RESERVED.  
© OVE ARUP & PARTNERS HONG KONG LIMITED.



**KEY PLAN**

- NOTES**
1. ALL COORDINATES ARE RELATED TO HONG KONG 1980 GRID.
  2. ALL LEVELS ARE IN METRES ABOVE HONG KONG PRINCIPAL DATUM (mPD).
  3. REFER TO DRG NO. 211036/SL/1002 FOR THE DEFINITION OF SETTING OUT LINE (SOL) FOR THE HONG KONG BOUNDARY CROSSING FACILITIES (HKBCF) RECLAMATION SITE.
  4. REFER TO DRG NO. 211036/SL/1004 FOR DETAILS OF SITE BOUNDARY.
  5. FOR EXTENT OF SORTING FACILITIES AT FILL BANK AT TSEUNG KWAN O AREA 137 REFER TO DRG NO. 211036/SL/1015.

- LEGEND**
- - - - - SITE BOUNDARY
  - - - - - SETTING OUT LINE (SOL)
  - - - - - WORKS AREA BOUNDARY

Rev	Description	By	Date
-	FOR CONSTRUCTION	HYJL	11/11

Consultant

**ARUP** 奧雅納工程顧問  
Ove Arup & Partners Hong Kong Limited

Supported By :

- Ecosystems Ltd.
- EDA Marine Ltd.
- Geotechnical Consulting Group (Asia) Ltd.
- Hong Kong Cetacean Research Project
- IntelBuild Technyx Asia Limited
- Tony Gee and Partners LLP

Contract No. and Title:  
**Contract No. HY/2010/02**  
**Hong Kong-Zhuhai-Macao Bridge**  
**Hong Kong Boundary Crossing Facilities**  
**- Reclamation Works**

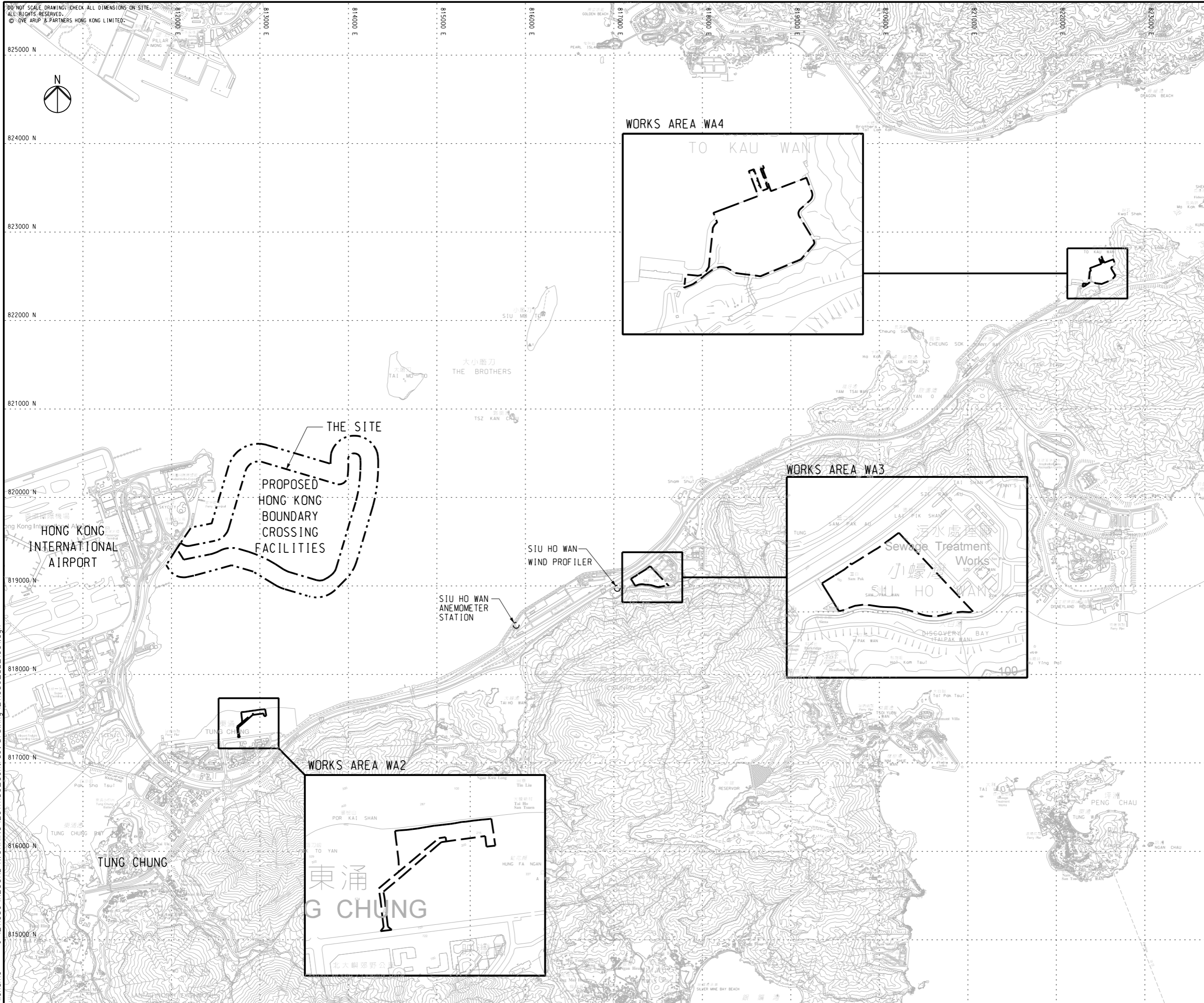
Drawing title  
**KEY PLAN**

Drawing no. <b>211036/SL/1001</b>		Rev. -	
Drawn RL	Date 11/09	Checked KKY	Approved DML
Scale 1:20000 @A1 1:40000 @A3		Status	<b>WORKING</b>

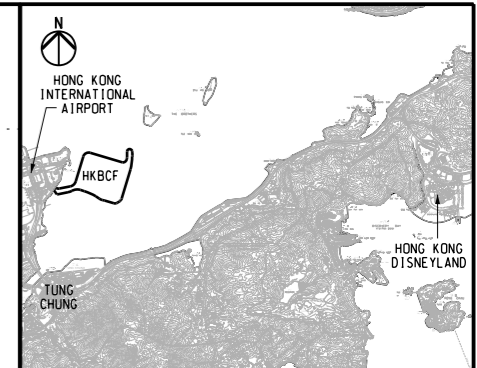
COPYRIGHT RESERVED

**路政署 HIGHWAYS DEPARTMENT**  
港珠澳大橋香港工程管理局  
Hong Kong - Zhuhai - Macao Bridge  
Hong Kong Project Management Office

Printed by : 12/17/2011  
Filename : J:\211036\RECORD\WORKING\20111130\_Contract Drawing\_211036\_SL\_1001.dgn



DO NOT SCALE DRAWING. CHECK ALL DIMENSIONS ON SITE.  
ALL RIGHTS RESERVED.  
© OVE ARUP & PARTNERS HONG KONG LIMITED.



KEY PLAN

NOTES

- FOR LEGENDS AND NOTES FOR CHAIN LINK FENCE AND GATE REFER TO DRG NO. 211036/SL/1013.
- THE ERECTION OF CHAIN LINK FENCE AND GATES SHALL BE COMPLETED BY THE HANDOVER DATE OF EACH PORTION OF SITE, OR AS INSTRUCTED BY THE ENGINEER.
- FOR SETTING OUT COORDINATES OF DIFFERENT PORTIONS OF SITE REFER TO DRG NO. 211036/SL/1003.
- ACCESS POINTS BETWEEN PORTIONS SHALL BE PROVIDED BY THE CONTRACTOR, AND THE LOCATIONS SHALL BE AGREED WITH THE ENGINEER ON SITE.
- FOR HOARDING AND FENCE AT FILL BANK AT TSEUNG KWAN O AREA 137 REFER TO DRG NO. 211036/SL/1015.

LEGEND

- SETTING OUT LINE (SOL)
- WORKS AREA BOUNDARY
- PORTIONS BOUNDARY LINE

Rev	Description	By	Date
-	FOR CONSTRUCTION	HYJL	11/11

Consultant	
<b>ARUP</b>	奧雅納工程顧問 Ove Arup & Partners Hong Kong Limited
Supported By :	<ul style="list-style-type: none"> <li>Ecosystems Ltd. <input type="radio"/></li> <li>EDA Marine Ltd. <input type="radio"/></li> <li>Geotechnical Consulting Group (Asia) Ltd. <input type="radio"/></li> <li>Hong Kong Cetacean Research Project <input type="radio"/></li> <li>Intel:Build Technyx Asia Limited <input type="radio"/></li> <li>Tony Gee and Partners LLP <input type="radio"/></li> </ul>

Contract No. and Title:  
**Contract No. HY/2010/02**  
**Hong Kong-Zhuhai-Macao Bridge**  
**Hong Kong Boundary Crossing Facilities**  
**- Reclamation Works**

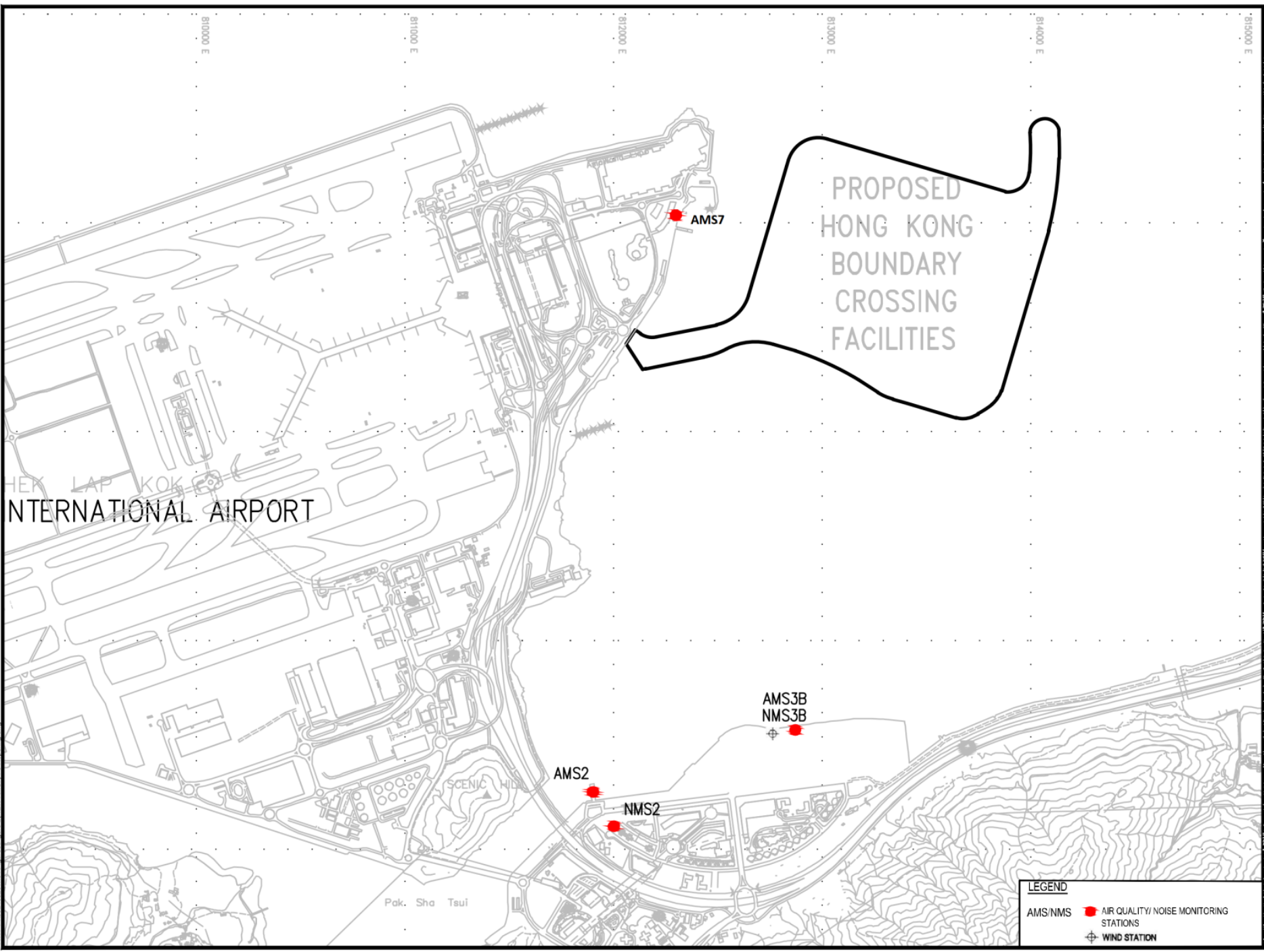
Drawing title  
**WORKS AREA LAYOUT**  
**AND HOARDING PLAN**  
**(SHEET 2 OF 3)**

Drawing no. <b>211036/SL/1014</b>		Rev. -	
Drawn RL	Date 06/10	Checked KKY	Approved DML
Scale 1:5000 @A1 1:10000 @A3		Status <b>WORKING</b>	

COPYRIGHT RESERVED

**路政署**  
**HIGHWAYS DEPARTMENT**  
 港珠澳大橋香港工程管理局  
 Hong Kong - Zhuhai - Macao Bridge  
 Hong Kong Project Management Office

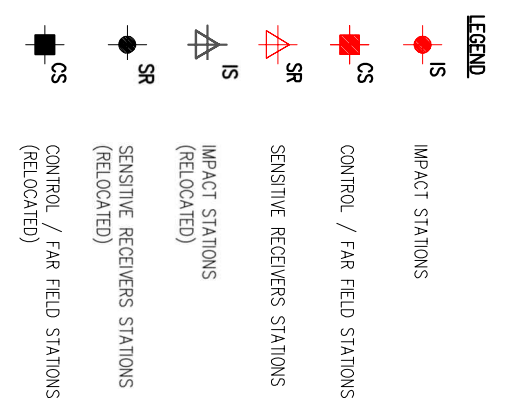
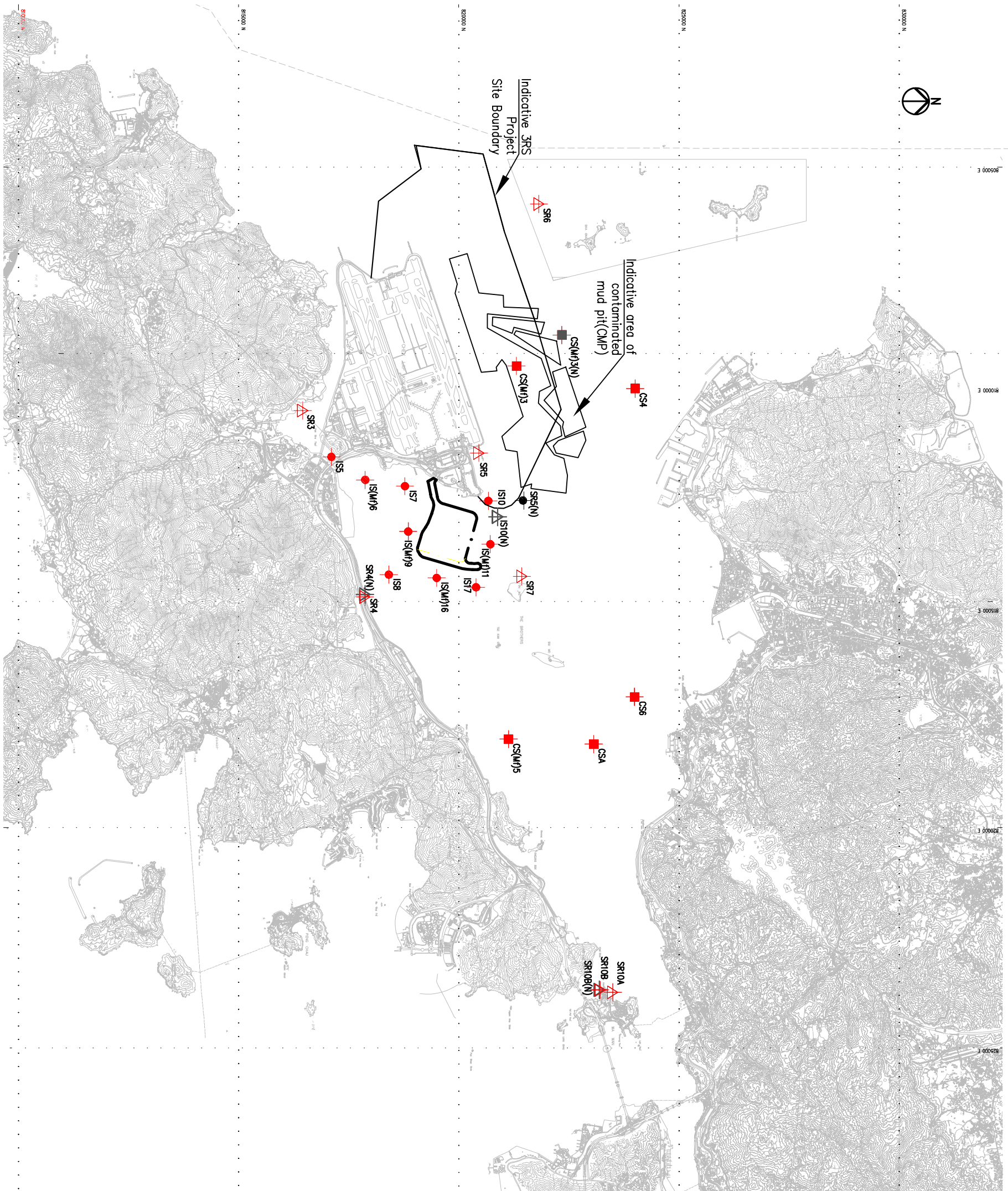
Printed by : 12/17/2011  
 Filename : J:\211036\RECORD\WORKING\20111130\_Contract Drawing\_211036\_SL\_1014.dgn



**LEGEND**

AMS/NMS ● AIR QUALITY/ NOISE MONITORING STATIONS

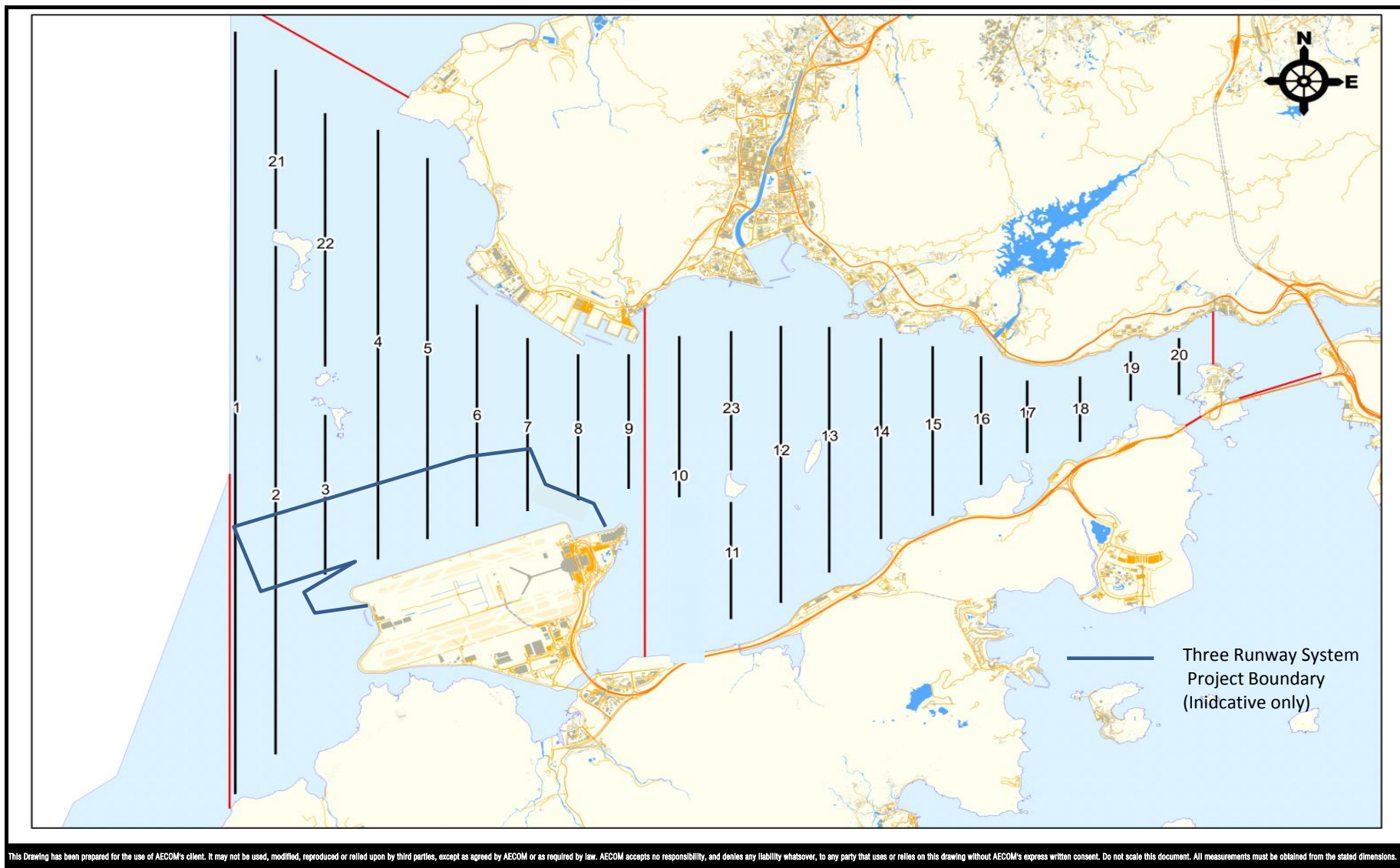
+ WIND STATION



**SETTING OUT SCHEDULE**

MONITORING STATIONS	CO-ORDINATES	
	EASTING	NORTHING
IS5	811579	817106
IS(Mf)6	812101	817873
IS7	812244	818777
IS8	814251	818412
IS(Mf)9	813273	818850
SR5(N)	812589	821475
IS(Mf)11	813562	820716
IS(Mf)16	814328	819497
IS17	814539	820391
SR3	810525	816456
SR4(N)	814705	817859
IS10(N)	812942	820881
SR6	805837	821818
SR7	814233	821431
SR10A	823741	823495
SR10B(N)	823683	823187
CS(Mf)3(N)	808814	822355
CS(Mf)5	817990	821129
CS4	810025	824004
CS6	817028	823992
CSA	818103	823064
IS10	812577	820670
SR5	811489	820455
CS(Mf)3	809989	821117

This drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

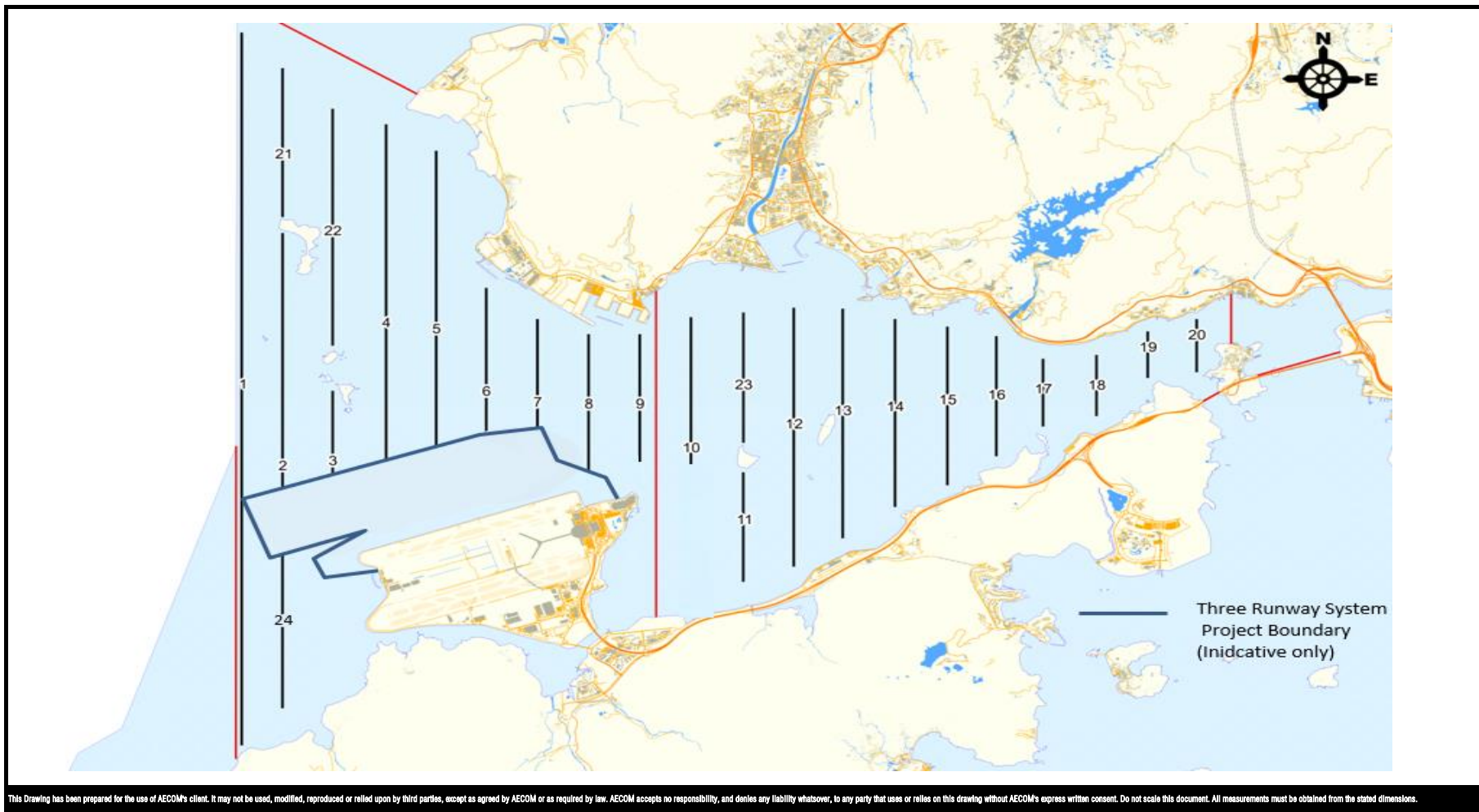


**Remarks:**

\*Transect 10 is now 3.6km in length due to the HKBCF construction site.

^Coordinates for transect lines 1, 2, 7, 8, 9 and 11 have been updated in respect to the Proposal for Alteration of Transect Line for Dolphin Monitoring approved by EPD on 19 August 2015. The total transect length for both NEL and NWL combined is 108km.

# New projects, large number of barges/vessels were anchored densely at north of Three Runway System project boundary, access to the transect area on lines 1, 2, 3, 4, 6 and 8 were blocked or affected in May 2017.



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

**Remarks:**

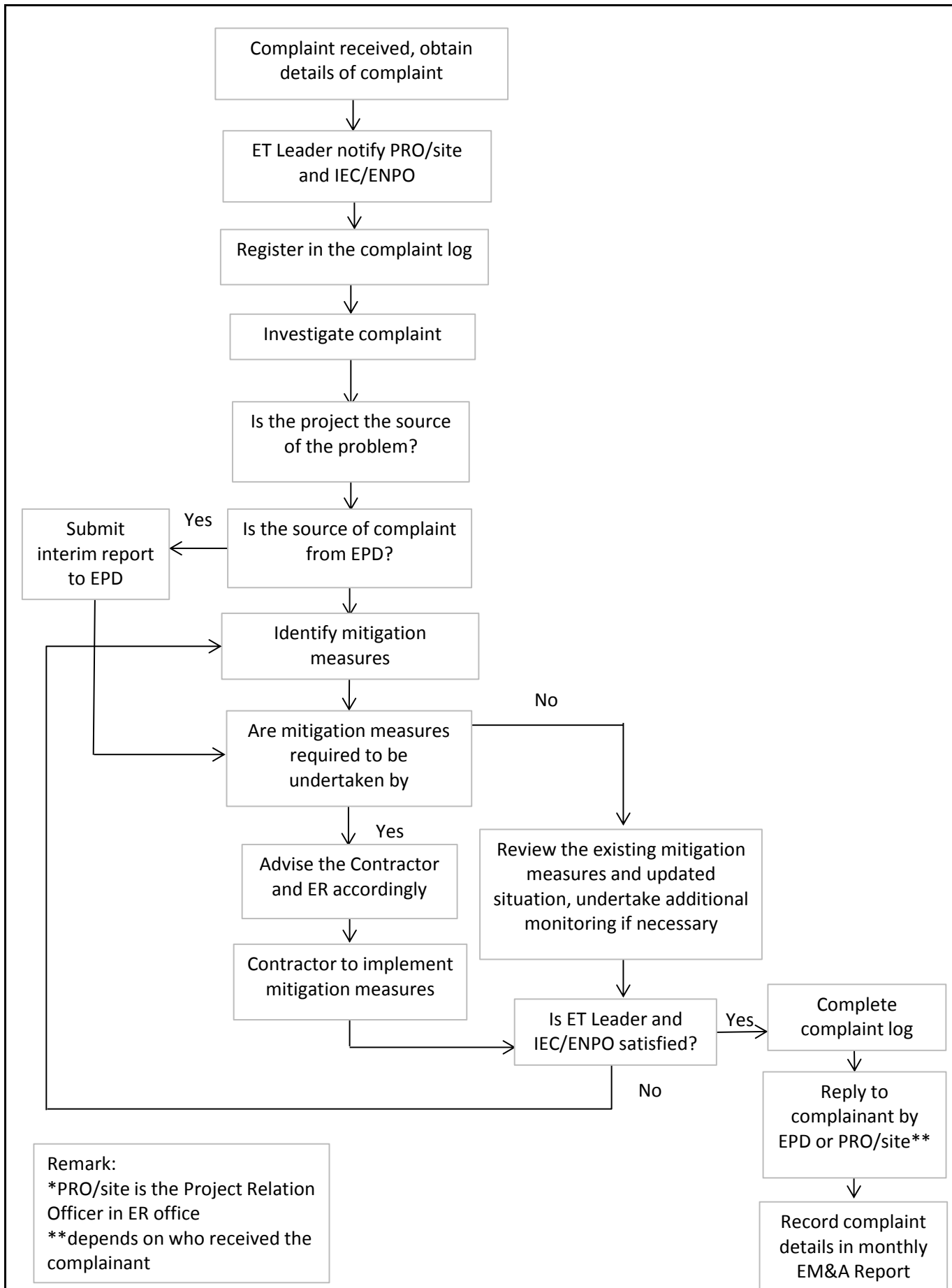
\*Transect 10 is now 3.6km in length due to the HKBCF construction site.

^Coordinates for transect lines 1, 2, 7, 8, 9 and 11 have been updated in respect to the Proposal for Alteration of Transect Line for Dolphin Monitoring approved by EPD on 19 August 2015. The total transect length for both NEL and NWL combined is 108km.

# New projects, large number of barges/vessels were anchored densely at north of Three Runway System project boundary, access to the transect area on lines 1, 2, 3, 4, 6 and 8 were blocked or affected in May 2017.

>Coordinates for transect lines 2, 3, 4, 5, 6 and 7 have been updated in respect to the Proposal for Alteration of Transect Line of Dolphin Monitoring and Alternative Monitoring Location for Impact Water Quality Monitoring (IWQM) Stations due to Commencement of Third Runway (3RS) Project which was approved by EPD on 12 May 2017. Original transect line 2 was separated into two different transect lines because 3RS works area overlapped the area of original transect line 2. While the numbering of northern part of original line number 2 remained unchanged, the southern part of original line number 2 is now renamed as transect line 24. The total transect length for both NEL and NWL combined is 99km.

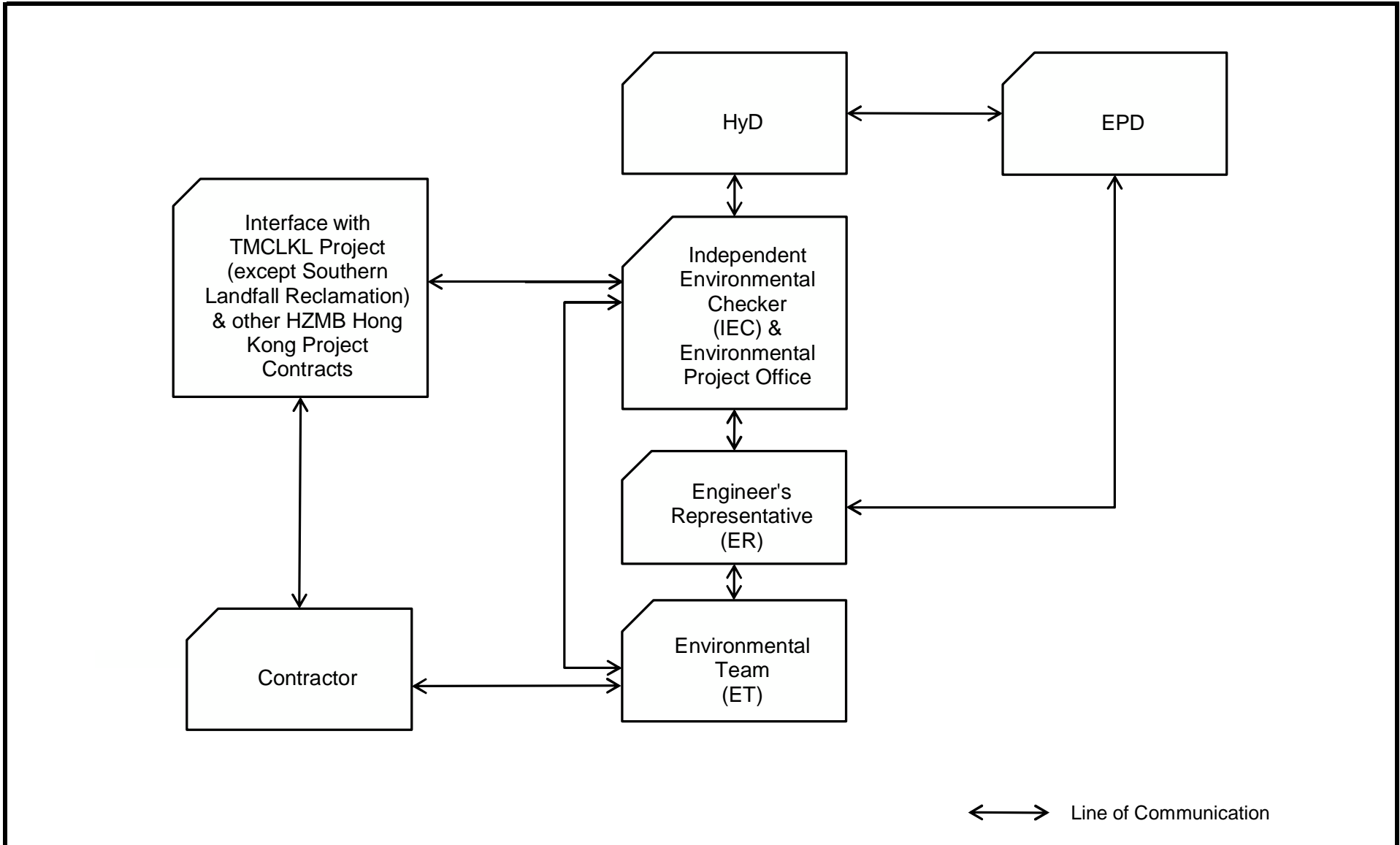




Remark:  
 \*PRO/site is the Project Relation Officer in ER office  
 \*\*depends on who received the complainant

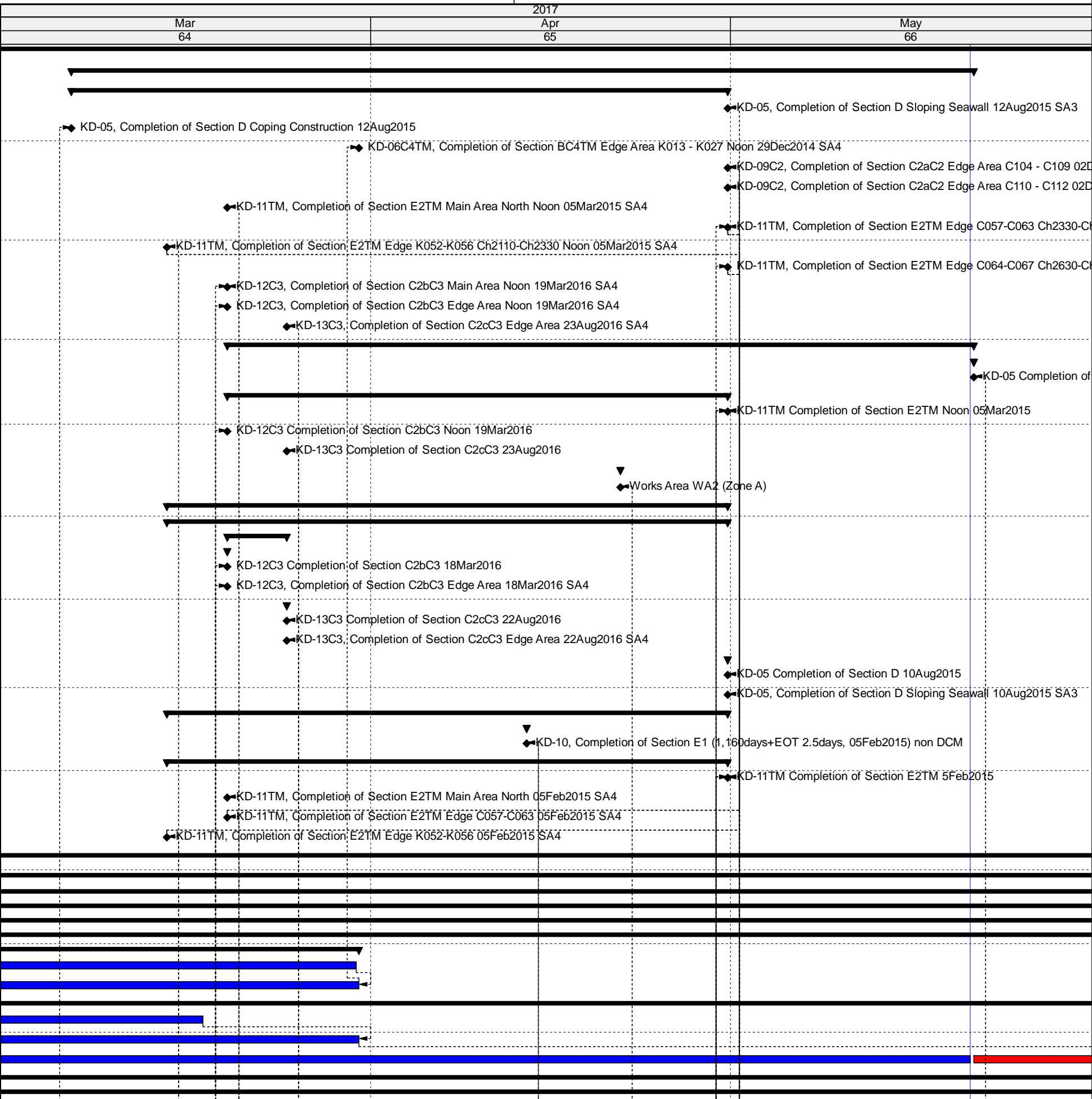
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.



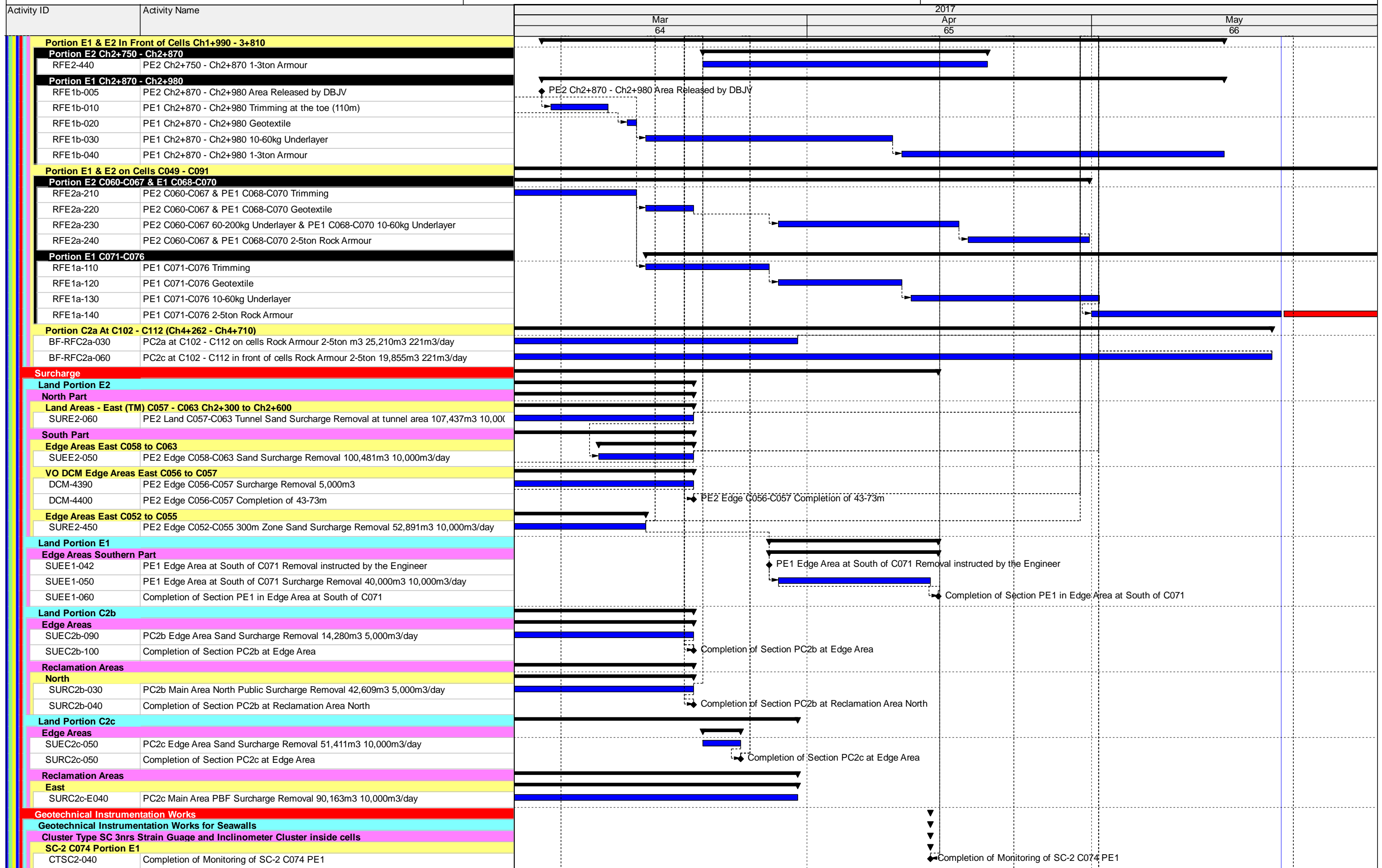


This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent. Do not scale this document. All measurements must be obtained from the stated dimensions.

Activity ID	Activity Name
<b>66th Monthly Progress Report Status as on 21May2017</b>	
<b>Contract Key Dates</b>	
<b>Key Dates for achievement of Stages and completion of Sections</b>	
G1076	KD-05, Completion of Section D Sloping Seawall 12Aug2015 SA3
G1078	KD-05, Completion of Section D Coping Construction 12Aug2015
G1082	KD-06C4TM, Completion of Section BC4TM Edge Area K013 - K027 Noon 29Dec2014 S
G1111	KD-09C2, Completion of Section C2aC2 Edge Area C104 - C109 02Dec2015 SA3 43-73M
G1118	KD-09C2, Completion of Section C2aC2 Edge Area C110 - C112 02Dec2015 SA3 23-73n
G1130	KD-11TM, Completion of Section E2TM Main Area North Noon 05Mar2015 SA4
G1134	KD-11TM, Completion of Section E2TM Edge C057-C063 Ch2330-Ch2630 Noon 05Mar2
G1135	KD-11TM, Completion of Section E2TM Edge K052-K056 Ch2110-Ch2330 Noon 05Mar2
G1136	KD-11TM, Completion of Section E2TM Edge C064-C067 Ch2630-Ch2790 Noon 05Mar2
G1140	KD-12C3, Completion of Section C2bC3 Main Area Noon 19Mar2016 SA4
G1142	KD-12C3, Completion of Section C2bC3 Edge Area Noon 19Mar2016 SA4
G1152	KD-13C3, Completion of Section C2cC3 Edge Area 23Aug2016 SA4
<b>Supplementary Agreement</b>	
<b>SA3</b>	
SA3-KD05-010	KD-05 Completion of Section D 12Aug2015
<b>SA4</b>	
SA4-KD11-040	KD-11TM Completion of Section E2TM Noon 05Mar2015
SA4-KD12-010	KD-12C3 Completion of Section C2bC3 Noon 19Mar2016
SA4-KD13-010	KD-13C3 Completion of Section C2cC3 23Aug2016
<b>Vacation of Site</b>	
G1280	Works Area WA2 (Zone A)
<b>Summary Programme</b>	
<b>Portion Summary</b>	
<b>Portion C</b>	
<b>Portion C2b</b>	
SSA4-KD12-010	KD-12C3 Completion of Section C2bC3 18Mar2016
SSC2b-1142	KD-12C3, Completion of Section C2bC3 Edge Area 18Mar2016 SA4
<b>Portion C2c</b>	
SSA4-KD13-010	KD-13C3 Completion of Section C2cC3 22Aug2016
SSC2c-1152	KD-13C3, Completion of Section C2cC3 Edge Area 22Aug2016 SA4
<b>Portion D</b>	
SSA3-KD05-010	KD-05 Completion of Section D 10Aug2015
SSD-1076	KD-05, Completion of Section D Sloping Seawall 10Aug2015 SA3
<b>Portion E</b>	
<b>Portion E1</b>	
SSE1-1120	KD-10, Completion of Section E1 (1,160days+EOT 2.5days, 05Feb2015) non DCM
<b>Portion E2</b>	
SSA4-KD11-040	KD-11TM Completion of Section E2TM 5Feb2015
SSE2-1130	KD-11TM, Completion of Section E2TM Main Area North 05Feb2015 SA4
SSE2-1134	KD-11TM, Completion of Section E2TM Edge C057-C063 05Feb2015 SA4
SSE2-1135	KD-11TM, Completion of Section E2TM Edge K052-K056 05Feb2015 SA4
<b>Work Zone, as defined in PS Clause 1.03(6)</b>	
<b>Portion A, B, C &amp; E</b>	
<b>Seawall</b>	
<b>Optimizing Rubble Mound Seawalls</b>	
<b>Rock Armour</b>	
<b>Seawall Portion B K013-K027 Ch0+450 - Ch1+100</b>	
RFB0-030	PB at K013 - K027 Underlayer (200-500kg) 16,832m3 1000m3/day
RFB0-040	PB at K013 - K027 Rock Armour (0.3-1 ton 33904m3 244m3/day)
<b>Seawall Portion C2a C113-C119 Ch4+710 - Ch5+050</b>	
RFC2a010	PC2a at C113 - C117 Removal of Temporary Rockfill (190,000m3, 1,500m3/day)
RFC2a030	PC2a at C113 - C117 Underlayer 21,600m3 1000m3/day
RFC2a040	PC2a at C113 - C117 Rock Armour (2-5 ton 43,272m3 305m3/day)
<b>Conforming Sloping Seawalls</b>	
<b>Rock Armour - Before Surcharge Period</b>	



█ Remaining Level of Effort    █ Remaining Work    ▶ Summary  
█ Actual Level of Effort    █ Critical Remaining Work  
█ Actual Work    ◆ Milestone



Activity ID	Activity Name	2017		
		Mar 64	Apr 65	May 66
<b>Portion D</b>				
<b>Site Construction</b>				
<b>C1 to C4</b>				
<b>Construction of Permanent Seawall</b>				
<b>Vertical Seawall Type V2 6+136 to 5+650</b>				
<b>Reclamation upto +5.5mPD</b>				
PD-V2-0380	PD C1 West - Coping backfill with compaction upto +5.5mPD VSOP22-20			
PD-V2-0420	PD C4 East - Coping backfill with compaction upto +5.5mPD VSOP05-01			
PD-V2-0430	PD Completion of Coping before end June 2017			
<b>Sloping Seawall Type S1 0+000 to 0+420</b>				
<b>S1 Rockfill Type 1</b>				
PD-S1-1030	PD C2/3 - Sloping Seawall Type S1 Reconstruction			
PD-S1-1040	PD C3/4 - Sloping Seawall Type S1 Reconstruction			
PD-S1-1045	PD C4 East - Sloping Seawall Type S1 Reconstruction			
PD-S1-1050	Completion of Southern Sloping Seawall			
<b>Works Area WA2 (Tung Chung)</b>				
<b>Zone A</b>				
A1880	Maintenance of Engineer's Accommodation (28Feb2017)			

**Appendix C - Implementation Schedule of Environmental Mitigation Measures**

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
<b>Air Quality</b>				
S5.5.6.1 of HKBCFEIA	A1	The contractor shall follow the procedures and requirements given in the Air Pollution Control (Construction Dust) Regulation	All construction sites	V
S5.5.6.2 of HKBCFEIA and S4.8.1 of TKCLKLEIA	A2	Proper watering of exposed spoil should be undertaken throughout the construction phase: <ul style="list-style-type: none"> <li>• Any excavated or stockpile of dusty material should be covered entirely by impervious sheeting or sprayed with water to maintain the entire surface wet and then removed or backfilled or reinstated where practicable within 24 hours of the excavation or unloading;</li> <li>• Any dusty materials remaining after a stockpile is removed should be wetted with water and cleared from the surface of roads;</li> <li>• A stockpile of dusty material should not be extend beyond the pedestrian barriers, fencing or traffic cones.</li> <li>• Where practicable, vehicle washing facilities with high pressure water jet should be provided at every discernible or designated vehicle exit point. The area where vehicle washing takes place and the road section between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores;</li> <li>• When there are open excavation and reinstatement works, hoarding of not less than 2.4m high should be provided as far as practicable along the site boundary</li> </ul>	All construction sites	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<p>with provision for public crossing. Good site practice shall also be adopted by the Contractor to ensure the conditions of the hoardings are properly maintained throughout the construction period;</p> <ul style="list-style-type: none"> <li>• The portion of any road leading only to construction site that is within 30m of a vehicle entrance or exit should be kept clear of dusty materials;</li> <li>• Surfaces where any pneumatic or power-driven drilling, cutting, polishing or other mechanical breaking operation takes place should be sprayed with water or a dust suppression chemical continuously;</li> <li>• Any area that involves demolition activities should be sprayed with water or a dust suppression chemical immediately prior to, during and immediately after the activities so as to maintain the entire surface wet;</li> <li>• Where a scaffolding is erected around the perimeter of a building under construction, effective dust screens, sheeting or netting should be provided to enclose the scaffolding from the ground floor level of the building, or a canopy should be provided from the first floor level up to the highest level of the scaffolding;</li> <li>• Any skip hoist for material transport should be totally enclosed by impervious sheeting;</li> <li>• Every stock of more than 20 bags of cement or dry pulverised fuel ash (PFA) should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3 sides;</li> <li>• Cement or dry PFA delivered in bulk should be stored in a closed silo fitted with an</li> </ul>		

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<p>audible high level alarm which is interlocked with the material filling line and no overfilling is allowed;</p> <ul style="list-style-type: none"> <li>• All unpaved roads/exposed area shall be watered which results in dust suppression by forming moist cohesive films among the discrete grains of road surface material.</li> <li>• No burning of debris or other materials on the works areas is allowed;</li> <li>• Water spray shall be used during the handling of fill material at the site and at active cuts, excavation and fill sites where dust is likely to be created;</li> <li>• Open dropping heights for excavated materials shall be controlled to a maximum height of 2m to minimise the fugitive dust arising from unloading;</li> <li>• During transportation by truck, materials shall not be loaded to a level higher than the side and tail boards, and shall be dampened or covered before transport. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be covered by a clean tarpaulin. The tarpaulin shall be properly secured and shall extend at least 300mm over the edges of the side and tail boards;</li> <li>• Loading, unloading, transfer, handling or storage of bulk cement or dry PFA should be carried out in a totally enclosed system or facility, and any vent or exhaust should be fitted with an effective fabric filter or equivalent air pollution control system; and</li> <li>• Exposed earth should be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shotcrete or other suitable</li> </ul>		



EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		surface stabiliser within six months after the last construction activity on the construction site or part of the construction site where the exposed earth lies.		
S5.5.6.3 of HKBCFEIA and S4.8.1 of TKCLKLEIA	A3	The Contractor should undertake proper watering on all exposed spoil and associated work areas (with at least 8 times per day) throughout the construction phase.	All construction sites	V
S5.5.6.4 of HKBCFEIA and S4.11 of TKCLKLEIA	A4	Implement regular dust monitoring under EM&A programme during the construction stage.	Selected representative dust monitoring station	V
S5.5.7.1 of HKBCFEIA	A5	The following mitigation measures should be adopted to prevent fugitive dust emissions for concrete batching plant: <ul style="list-style-type: none"> <li>• Loading, unloading, handling, transfer or storage of any dusty materials should be carried out in totally enclosed system;</li> <li>• All dust-laden air or waste gas generated by the process operations should be properly extracted and vented to fabric filtering system to meet the emission limits for TSP;</li> <li>• Vents for all silos and cement/ pulverised fuel ash (PFA) weighing scale should be fitted with fabric filtering system;</li> <li>• The materials which may generate airborne dusty emissions should be wetted by water spray system;</li> </ul>	All construction sites	N/A

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<ul style="list-style-type: none"> <li>• All receiving hoppers should be enclosed on three sides up to 3m above unloading point;</li> <li>• All conveyor transfer points should be totally enclosed;</li> <li>• All access and route roads within the premises should be paved and wetted; and</li> <li>• Vehicle cleaning facilities should be provided and used by all concrete trucks before leaving the premises to wash off any dust on the wheels and/or body.</li> </ul>		
S5.5.2.7 of HKBCFEIA	A6	The following mitigation measures should be adopted to prevent fugitive dust emissions at barging point: <ul style="list-style-type: none"> <li>• All road surface within the barging facilities will be paved;</li> <li>• Dust enclosures will be provided for the loading ramp;</li> <li>• Vehicles will be required to pass through designated wheels wash facilities; and</li> <li>• Continuous water spray at the loading points.</li> </ul>	All construction sites	N/A (Construction in process)
<b>Construction Noise (Air borne)</b>				
S6.4.10 of HKBCFEIA	N1	Use of good site practices to limit noise emissions by considering the following: <ul style="list-style-type: none"> <li>• only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;</li> <li>• machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;</li> <li>• plant known to emit noise strongly in one direction, where possible, be orientated</li> </ul>	All construction sites	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		so that the noise is directed away from nearby NSRs; <ul style="list-style-type: none"> <li>• silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works;</li> <li>• mobile plant should be sited as far away from NSRs as possible and practicable;</li> <li>• material stockpiles, mobile container site officer and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.</li> </ul>		
S6.4.11 of HKBCFEIA	N2	Install temporary hoarding located on the site boundaries between noisy construction activities and NSRs. The conditions of the hoardings shall be properly maintained throughout the construction period.	All construction sites	V
S6.4.12 of HKBCFEIA	N3	Install movable noise barriers (typically density @14kg/m <sup>2</sup> ), acoustic mat or full enclosure close to noisy plants including air compressor, generators, saw.	For plant items listed in Appendix 6D of the EIA report at all construction sites	N/A
S6.4.13 of HKBCFEIA	N4	Select “Quiet plants” which comply with the BS 5228 Part 1 or TM standards.	For plant items listed in Appendix 6D of the EIA report at all construction sites	V
S6.4.14 of HKBCFEIA	N5	Sequencing operation of construction plants where practicable.	All construction sites where practicable	V
S5.1 of	N6	Implement a noise monitoring under EM&A programme.	Selected	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
TMCLKLEIA			representative noise monitoring station	
<b>Waste Management (Construction Waste)</b>				
S12.6 of TMCLKLEIA	WM1	The Contractor shall identify a coordinator for the management of waste.	All construction sites	V
S12.6 of TMCLKLEIA	WM2	The Contractor shall apply for and obtain the appropriate licenses for the disposal of public fill, chemical waste and effluent discharges.	All construction sites	V
S12.6 of TMCLKLEIA	WM3	EM&A of waste handling, storage, transportation, disposal procedures and documentation through the site audit programme shall be undertaken.	All construction sites	V
S8.3.8 of HKBCFEIA and S12.6 of TMCLKLEIA	WM4	<p><u>Construction and Demolition Material</u></p> <p>The following mitigation measures should be implemented in handling the waste:</p> <ul style="list-style-type: none"> <li>• Maintain temporary stockpiles and reuse excavated fill material for backfilling and reinstatement;</li> <li>• Carry out on-site sorting;</li> <li>• Make provisions in the Contract documents to allow and promote the use of recycled aggregates where appropriate;</li> <li>• Adopt ‘Selective Demolition’ technique to demolish the existing structures and facilities with a view to recovering broken concrete effectively for recycling purpose, where possible;</li> </ul>	All construction sites	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<ul style="list-style-type: none"> <li>• Implement a trip-ticket system for each works contract to ensure that the disposal of C&amp;D materials are properly documented and verified;</li> <li>• Implement an enhanced Waste Management Plan similar to ETWBTC (Works) No. 19/2005 – “Environmental Management on Construction Sites” to encourage on-site sorting of C&amp;D materials and to minimize their generation during the course of construction;</li> <li>• In addition, disposal of the C&amp;D materials onto any sensitive locations such as agricultural lands, etc. should be avoided. The Contractor shall propose the final disposal sites to the Project Proponent and get its approval before implementation; and</li> <li>• The surplus surcharge should be transferred to a fill bank.</li> </ul>		
S8.3.9- S8.3.11 of HKBCFEIA and S12.6 of TMCLKLEIA	WM5	<p><u>C&amp;D Waste</u></p> <ul style="list-style-type: none"> <li>• Standard formwork or pre-fabrication should be used as far as practicable in order to minimise the arising of C&amp;D materials. The use of more durable formwork or plastic facing for the construction works should be considered. Use of wooden hoardings should not be used, as in other projects. Metal hoarding and falsework should be used to enhance the possibility of recycling. The purchasing of construction materials will be carefully planned in order to avoid over ordering and wastage.</li> <li>• The Contractor should recycle as much of the C&amp;D materials as possible on-site. Public fill and C&amp;D waste should be segregated and stored in different containers</li> </ul>	All construction sites	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<p>or skips to enhance reuse or recycling of materials and their proper disposal. Where practicable, concrete and masonry can be crushed and used as fill. Steel reinforcement bar can be used by scrap steel mills. Different areas of the sites should be considered for such segregation and storage.</p>		
<p>S8.2.12- S8.3.15 of HKBCFEIA and S12.6 of TMCLKLEIA</p>	<p>WM6</p>	<p><u>Chemical Waste</u></p> <ul style="list-style-type: none"> <li>• Chemical waste that is produced, as defined by Schedule 1 of the Waste Disposal (Chemical Waste) (General) Regulation, should be handled in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.</li> <li>• Containers used for the storage of chemical wastes should be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed; have a capacity of less than 450 liters unless the specification has been approved by the EPD; and display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the regulation.</li> <li>• The storage area for chemical wastes should be clearly labelled and used solely for the storage of chemical waste; enclosed on at least 3 sides; have an impermeable floor and bunding of sufficient capacity to accommodate 110% of the volume of the largest container or 20 % of the total volume of waste stored in that area, whichever is the greatest; have adequate ventilation; covered to prevent rainfall entering; and arranged so that incompatible materials are adequately separated.</li> <li>• Disposal of chemical waste should be via a licensed waste collector; be to a facility licensed to receive chemical waste, such as the Chemical Waste Treatment Centre</li> </ul>	<p>All construction sites</p>	<p>V</p>

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		which also offers a chemical waste collection service and can supply the necessary storage containers; or be to a reuser of the waste, under approval from the EPD.		
S8.3.16 of HKBCFEIA and S12.6 of TMCLKLEIA	WM7	<p><u>Sewage</u></p> <ul style="list-style-type: none"> <li>Adequate numbers of portable toilets should be provided for the workers. The portable toilets should be maintained in a state, which will not deter the workers from utilizing these portable toilets. Night soil should be collected by licensed collectors regularly.</li> </ul>	All construction sites	V
S8.3.17 of HKBCFEIA and S12.6 of TMCLKLEIA	WM8	<p><u>General Refuse</u></p> <ul style="list-style-type: none"> <li>The site and surroundings shall be kept tidy and litter free. General refuse generated on-site should be stored in enclosed bins or compaction units separately from construction and chemical wastes.</li> <li>A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily basis to minimize odour, pest and litter impacts. Burning of refuse on construction sites is prohibited by law.</li> <li>Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated and made easily accessible. Separate labelled bins for their deposit should be provided if feasible.</li> <li>Office wastes can be reduced through the recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be</li> </ul>	All construction sites	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<p>considered by the Contractor. In addition, waste separation facilities for paper, aluminum cans, plastic bottles etc., should be provided.</p> <ul style="list-style-type: none"> <li>• Training should be provided to workers about the concepts of site cleanliness and appropriate waste management procedure, including reduction, reuse and recycling of wastes.</li> <li>• Sufficient dustbins shall be provided for storage of waste as required under the Public Cleansing and Prevention of Nuisances By-laws. In addition, general refuse shall be cleared daily and shall be disposed of to the nearest licensed landfill or refuse transfer station.</li> <li>• All waste containers shall be in a secure area on hardstanding.</li> </ul>		
<b>Water Quality (Construction Phase)</b>				
	W1	<p>Mitigation during the marine works to reduce impacts to within acceptable levels have been recommended and will comprise a series of measures that restrict the method and sequencing of backfilling, as well as protection measures. Details of the measures are provided below:</p>	During filling	V



EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<ul style="list-style-type: none"> <li>• Reclamation filling for the Project shall not proceed until at least 200m of leading seawall at the reclamation area formed above +2.2mPD, unless otherwise agreement was obtained from EPD, except for the 300m gaps for marine access. All underwater filling works shall be carried out behind seawalls to avoid dispersion of suspended solids outside the Project limit;</li> <li>• Except for the filling of the cellular structures, not more than 15% public fill shall be used for reclamation filling below +2.5mPD during construction of the seawall;</li> <li>• After the seawall is completed except for the 300m marine access as indicated in the EPs, not more than 30% public fill shall be used for reclamation filling below +2.5mPD, unless otherwise agreement from EPD was obtained;</li> <li>• Upon completion of 200m leading seawall, no more than a total of 60 filling barge trips per day shall be made with a cumulative maximum daily filling rate of 60,000 m<sup>3</sup> for HKBCF and TMCLKL southern landfall reclamation during the filling operation; and</li> <li>• Upon completion of the whole section of seawall except for the 300m marine access as indicated in the EPs, no more than a total of 190 filling barge trips per day shall be made with a cumulative maximum daily filling rate of 190,000 m<sup>3</sup> for the remaining filling operations for HKBCF and TMCLKL southern landfall reclamation.</li> <li>• Floating type perimeter silt curtains shall be around the HKBCF site before the commencement of marine works. Staggered layers of silt curtain shall be provided</li> </ul>		

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<p>to prevent sediment loss at navigation accesses. The length of each staggered layers shall be at least 200m;</p> <ul style="list-style-type: none"> <li>• Single layer silt curtain to be applied around the North-east airport water intake;</li> <li>• The silt-curtains should be maintained in good condition to ensure the sediment plume generated from filling be confined effectively within the site boundary;</li> <li>• The filling works shall be scheduled to spread the works evenly over a working day;</li> <li>• Cellular structure shall be used for seawall construction;</li> <li>• A layer of geotextile shall be placed on top of the seabed before any filling activities take place inside the cellular structures to form the seawall;</li> <li>• The conveyor belts shall be fitted with windboards and conveyor release points shall be covered with curtain to prevent any spillage of filling materials onto the surrounding waters; and</li> <li>• An additional layer of silt curtain shall be installed near the active stone column installation points. A layer of geotextile with stone blanket on top shall be placed on the seabed prior to stone column installation works.</li> </ul>		
S9.11.1.3 of HKBCFEIA and S6.10 of	W2	<p><u>Land Works</u></p> <p>General construction activities on land should also be governed by standard good working practice. Specific measures to be written into the works contracts should include:</p>	All land-based construction sites	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
TMCLKLEIA		<ul style="list-style-type: none"> <li>• wastewater from temporary site facilities should be controlled to prevent direct discharge to surface or marine waters;</li> <li>• sewage effluent and discharges from on-site kitchen facilities shall be directed to Government sewer in accordance with the requirements of the WPCO or collected for disposal offsite. The use of soakaways shall be avoided;</li> <li>• storm drainage shall be directed to storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Channels, earth bunds or sand bag barriers should be provided on site to properly direct stormwater to such silt removal facilities. Catchpits and perimeter channels should be constructed in advance of site formation works and earthworks;</li> <li>• silt removal facilities, channels and manholes shall be maintained and any deposited silt and grit shall be removed regularly, including specifically at the onset of and after each rainstorm;</li> <li>• temporary access roads should be surfaced with crushed stone or gravel;</li> <li>• rainwater pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities;</li> <li>• measures should be taken to prevent the washout of construction materials, soil, silt or debris into any drainage system;</li> <li>• open stockpiles of construction materials (e.g. aggregates and sand) on site</li> </ul>		

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<p>should be covered with tarpaulin or similar fabric during rainstorms;</p> <ul style="list-style-type: none"> <li>• manholes (including any newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers;</li> <li>• discharges of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system;</li> <li>• all vehicles and plant should be cleaned before they leave the construction site to ensure that no earth, mud or debris is deposited by them on roads. A wheel washing bay should be provided at every site exit;</li> <li>• wheel wash overflow shall be directed to silt removal facilities before being discharged to the storm drain;</li> <li>• the section of construction road between the wheel washing bay and the public road should be surfaced with crushed stone or coarse gravel;</li> <li>• wastewater generated from concreting, plastering, internal decoration, cleaning work and other similar activities, shall be screened to remove large objects;</li> <li>• vehicle and plant servicing areas, vehicle wash bays and lubrication facilities shall be located under roofed areas. The drainage in these covered areas shall be connected to foul sewers via a petrol interceptor in accordance with the requirements of the WPCO or collected for offsite disposal;</li> </ul>		

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<ul style="list-style-type: none"> <li>• the contractors shall prepare an oil / chemical cleanup plan and ensure that leakages or spillages are contained and cleaned up immediately;</li> <li>• waste oil should be collected and stored for recycling or disposal, in accordance with the Waste Disposal Ordinance;</li> <li>• all fuel tanks and chemical storage areas should be provided with locks and be sited on sealed areas. The storage areas should be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank; and</li> <li>• surface run-off from bunded areas should pass through oil/grease traps prior to discharge to the storm water system..</li> </ul>		
S9.14 of HKBCFEIA and S6.10 of TMCLKLEIA	W3	Implement a water quality monitoring programme	At identified monitoring location	V
S6.10 of TMCLKLEIA	W4	All construction works shall be subject to routine audit to ensure implementation of all EIA recommendations and good working practice.	All construction site areas	V
<b>Ecology (Construction Phase)</b>				
S10.7 of HKBCFEIA and S8.14 of TMCLKLEIA	E1	<ul style="list-style-type: none"> <li>• Install silt curtain during the construction</li> <li>• Limit works fronts</li> <li>• Construct seawall prior to reclamation filling where practicable</li> </ul>	Seawall, reclamation area	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		<ul style="list-style-type: none"> <li>• Good site practices</li> <li>• Strict enforcement of no marine dumping</li> <li>• Site runoff control</li> <li>• Spill response plan</li> </ul>		
S10.7 of HKBCFEIA	E2	<ul style="list-style-type: none"> <li>• Watering to reduce dust generation; prevention of siltation of freshwater habitats; Site runoff should be desilted, to reduce the potential for suspended sediments, organics and other contaminants to enter streams and standing freshwater.</li> </ul>	Land-based works areas	V
S10.7 of HKBCFEIA and S8.14 of TMCLKLEIA	E3	<ul style="list-style-type: none"> <li>• Good site practices, including strictly following the permitted works hours, using quieter machines where practicable, and avoiding excessive lightings during night time.</li> </ul>	Land-based works areas	V
S10.7 of HKBCFEIA and S8.14 of TMCLKLEIA	E4	<ul style="list-style-type: none"> <li>• Dolphin Exclusion Zone</li> <li>• Dolphin watching plan</li> </ul>	Marine works	V
S10.7 of HKBCFEIA and S8.14 of TMCLKLEIA	E5	<ul style="list-style-type: none"> <li>• Decouple compressors and other equipment on working vessels</li> <li>• Proposal on design and implementation of acoustic decoupling measures applied during reclamation works</li> <li>• Avoidance of percussive piling</li> </ul>	Marine works	V
S10.7 of	E6	<ul style="list-style-type: none"> <li>• Control vessel speed</li> </ul>	Marine traffic	V

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
HKBCFEIA and S8.14 of TMCLKLEIA		<ul style="list-style-type: none"> <li>• Skipper training</li> <li>• Predefined and regular routes for working vessels; avoid Brothers Islands</li> </ul>		
S10.10 of HKBCFEIA and S8.14 of TMCLKLEIA	E7	<ul style="list-style-type: none"> <li>• Vessel based dolphin monitoring</li> </ul>	Northeast and Northwest Lantau	V
<b>Fisheries</b>				
S11.7 of HKBCFEIA	F1	<ul style="list-style-type: none"> <li>• Reduce re-suspension of sediments</li> <li>• Limit works fronts</li> <li>• Good site practices</li> <li>• Strict enforcement of no marine dumping</li> <li>• Spill response plan</li> </ul>	Seawall, reclamation area	V
S11.7 of HKBCFEIA	F2	<ul style="list-style-type: none"> <li>• Install silt-grease trap in the drainage system collecting surface runoff</li> </ul>	Reclamation area	V
<b>Landscape &amp; Visual (Construction Phase)</b>				
S14.3.3. 3 of HKBCFEIA and S10.9 of TMCLKLEIA	LV1	<p><u>Mitigate Landscape Impacts</u></p> <p>G1/CM4 Grass-hydroseed or sheeting bare soil surface and stock pile areas.</p> <p>G9 Reserve of loose natural granite rocks for re-use. Provide new coastline to adopt “natural-look” by means of using armour rocks in the form of natural</p>	All construction site areas	N/A

EIA Ref.	EM&A Log Ref	Environmental Mitigation Measures	Location	Implementation Status
		rock materials and planting strip area accommodating screen buffer to enhance “natural-look” of new coastline.		
S10.9 of TMCLKLEIA	LV2	<u>Mitigate Landscape Impacts</u> CM7 Ensure no run-off into water body adjacent to the Project Area.	All construction site areas	V
S14.3.3. 3 of HKBCFEIA	LV4	<u>Mitigate Visual Impacts</u> V1 Minimize time for construction activities during construction period.	All construction site areas	V
S10.9 of TMCLKLEIA	LV5	<u>Mitigate Visual Impacts</u> CM6 Control night-time lighting and glare by hooding all lights.	All construction site areas	V
<b>EM&amp;A</b>				
S15.2.2 of HKBCFEIA	EM1	An Independent Environmental Checker needs to be employed as per the EM&A Manual.	All construction site areas	V
S15.5 - S15.6 of HKBCFEIA	EM2	<ul style="list-style-type: none"> <li>An Environmental Team needs to be employed as per the EM&amp;A Manual.</li> <li>Prepare a systematic Environmental Management Plan to ensure effective implementation of the mitigation measures.</li> <li>An environmental impact monitoring needs to be implementing by the Environmental Team to ensure all the requirements given in the EM&amp;A Manual are fully complied with.</li> </ul>	All construction site areas	V

Legend: V = implemented;

x = not implemented;

N/A = not applicable



## Appendix D - Summary of Action and Limit Levels

Table 1 – Action and Limit Levels for 1-hour TSP

Location	Action Level	Limit Level
AMS2	374 µg/m <sup>3</sup>	500 µg/m <sup>3</sup>
AMS3B*	368 µg/m <sup>3</sup>	500 µg/m <sup>3</sup>
AMS6	360 µg/m <sup>3</sup>	500 µg/m <sup>3</sup>
AMS7	370 µg/m <sup>3</sup>	500 µg/m <sup>3</sup>

Remarks: \* Action Level set out at AMS3 Ho Yu College is adopted.

Table 2 – Action and Limit Levels for 24-hour TSP

Location	Action Level	Limit Level
AMS2	176 µg/m <sup>3</sup>	260 µg/m <sup>3</sup>
AMS3B*	167 µg/m <sup>3</sup>	260 µg/m <sup>3</sup>
AMS6	173 µg/m <sup>3</sup>	260 µg/m <sup>3</sup>
AMS7	183 µg/m <sup>3</sup>	260 µg/m <sup>3</sup>

Remarks: \* Action Level set out at AMS3 Ho Yu College is adopted.

Table 3 – Action and Limit Levels for Construction Noise (0700-1900 hrs of normal weekdays)

Location	Action Level	Limit Level
NMS2	When one documented complaint, related to 0700 – 1900 hours on normal weekdays, is received from any one of the sensitive receivers	75 dB(A)
NMS3B		*65 / 70 dB(A)

\*Daytime noise Limit Level of 70 dB(A) applies to education institutions, while 65dB(A) applies during school examination period.

Table 4 – Action and Limit Levels for Water Quality

Parameters	Action	Limit
DO in mg L <sup>-1</sup> (Surface, Middle & Bottom)	<u>Surface and Middle</u> 5.0 <u>Bottom</u> 4.7	<u>Surface and Middle</u> 4.2 (except 5 mg/L for FCZ) <u>Bottom</u> 3.6
SS in mg L <sup>-1</sup> (depth-averaged)	23.5 and 120% of upstream control station's SS at the same tide of the same day	34.4 and 130% of upstream control station's SS at the same tide of the same day and 10mg/L for WSD Seawater intakes
Turbidity in NTU (depth-averaged)	27.5 and 120% of upstream control station's turbidity at the same tide of the same day	47.0 and 130% of upstream control station's turbidity at the same tide of the same day

Notes:

- "depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.
- For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
- For turbidity, SS, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.

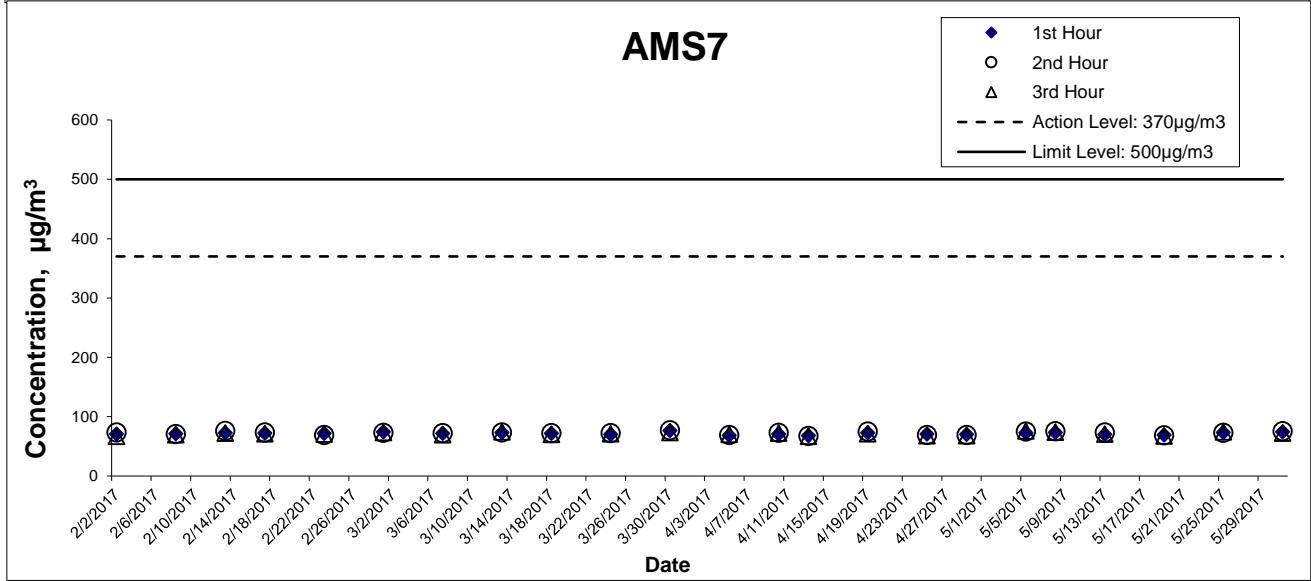
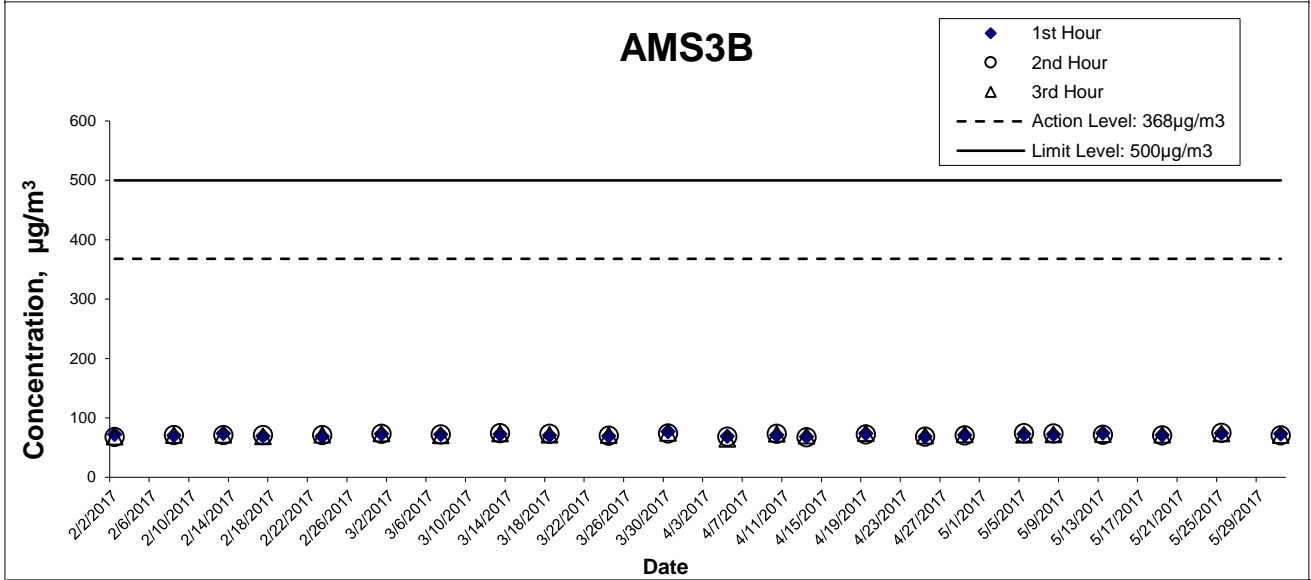
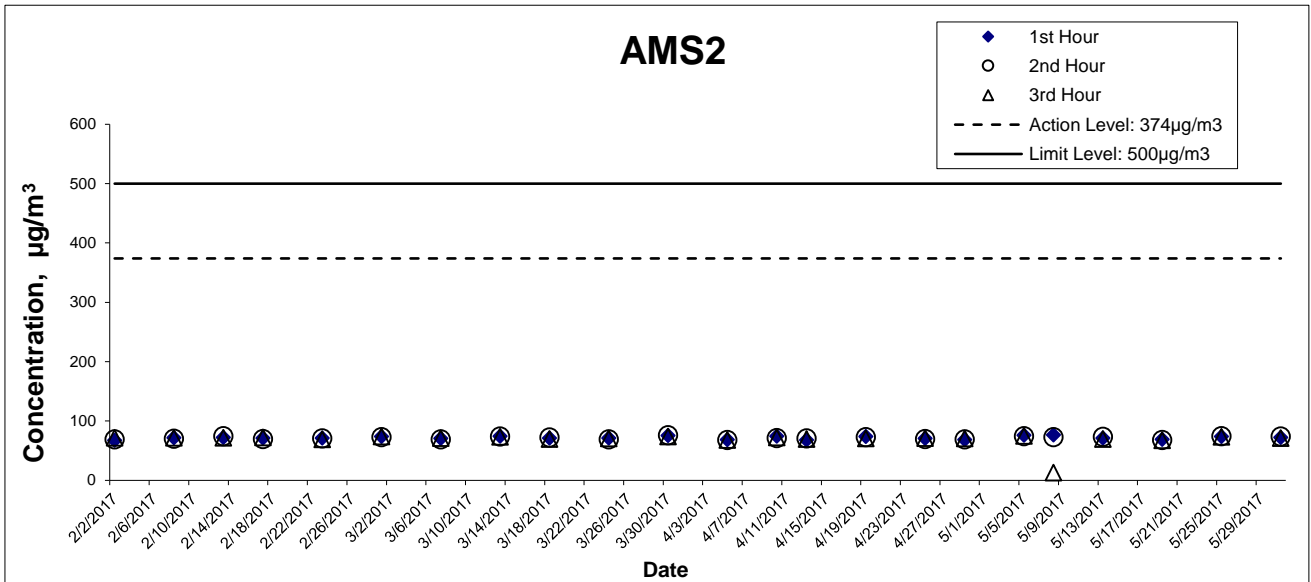
Table 5(a) Action and Limit Levels for Chinese White Dolphin Monitoring - Approach to Define Action Level (AL) and Limit Level (LL):

	<b>North Lantau Social Cluster</b>	
	<b>NEL</b>	<b>NWL</b>
Action Level	(STG < 70% of baseline) & (ANI < 70% of baseline)	(STG < 70% of baseline) & (ANI < 70% of baseline)
Limit Level	[(STG < 40% of baseline) & (ANI < 40% of baseline)] AND [ (STG < 40% of baseline) & (ANI < 40% of baseline)]	

For North Lantau Social Cluster, action level will be trigger if either NEL **or** NWL fall below the criteria; limit level will be triggered if both NEL **and** NWL fall below the criteria.

Table 5(b) Derived Value of Action Level (AL) and Limit Level (LL) for Chinese White Dolphin Monitoring

	<b>North Lantau Social Cluster</b>	
	<b>NEL</b>	<b>NWL</b>
Action Level	(STG < 4.2) & (ANI < 15.5 )	(STG < 6.9) & (ANI < 31.3)
Limit Level	[(STG < 2.4) & (ANI <8.9)] AND [ (STG < 3.9)& (ANI < 17.9)]	

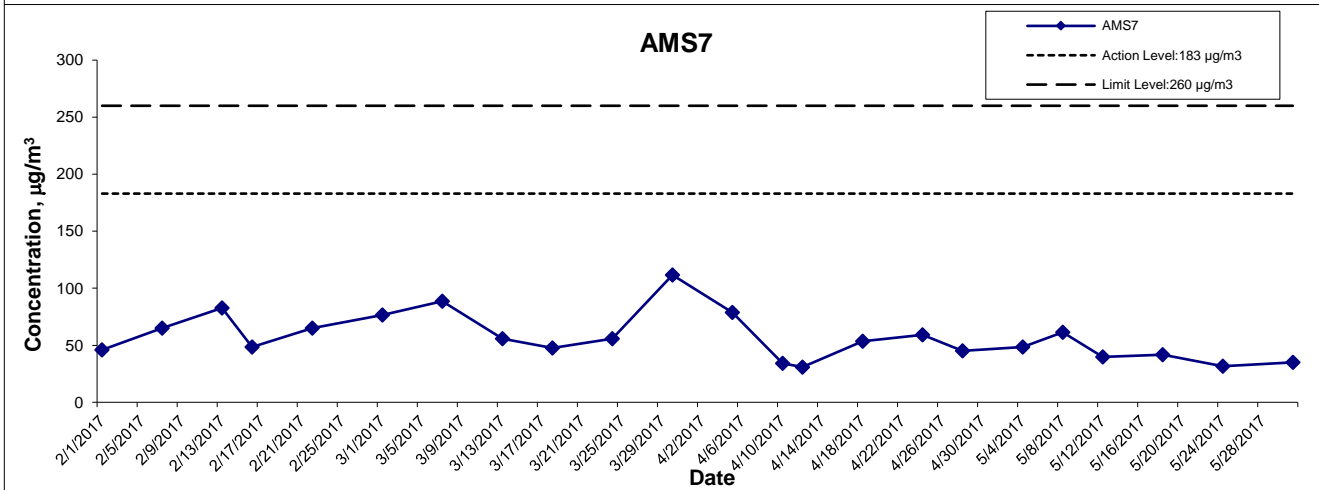
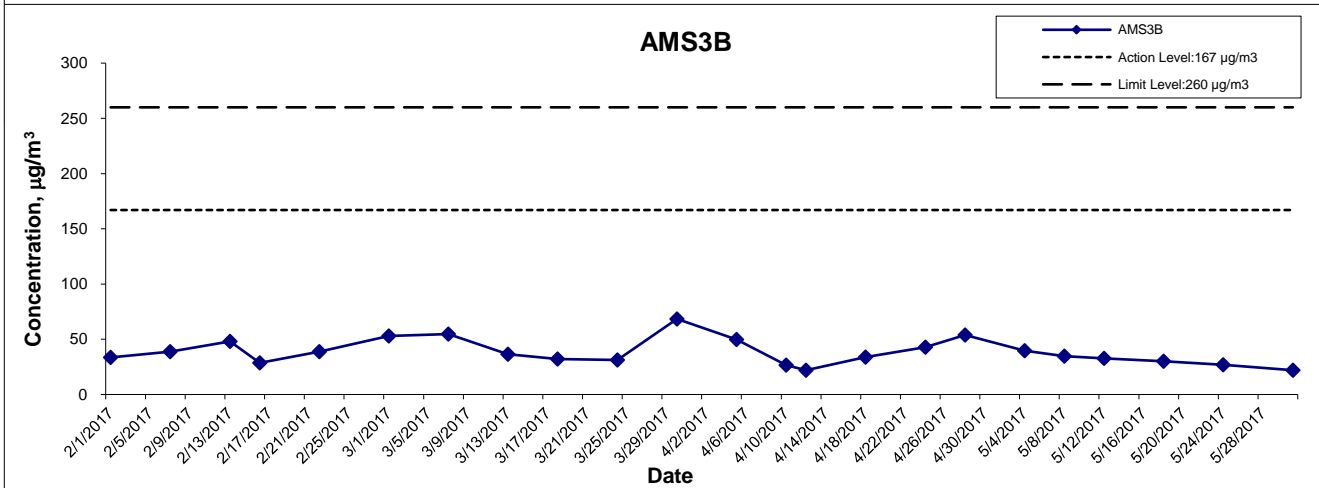
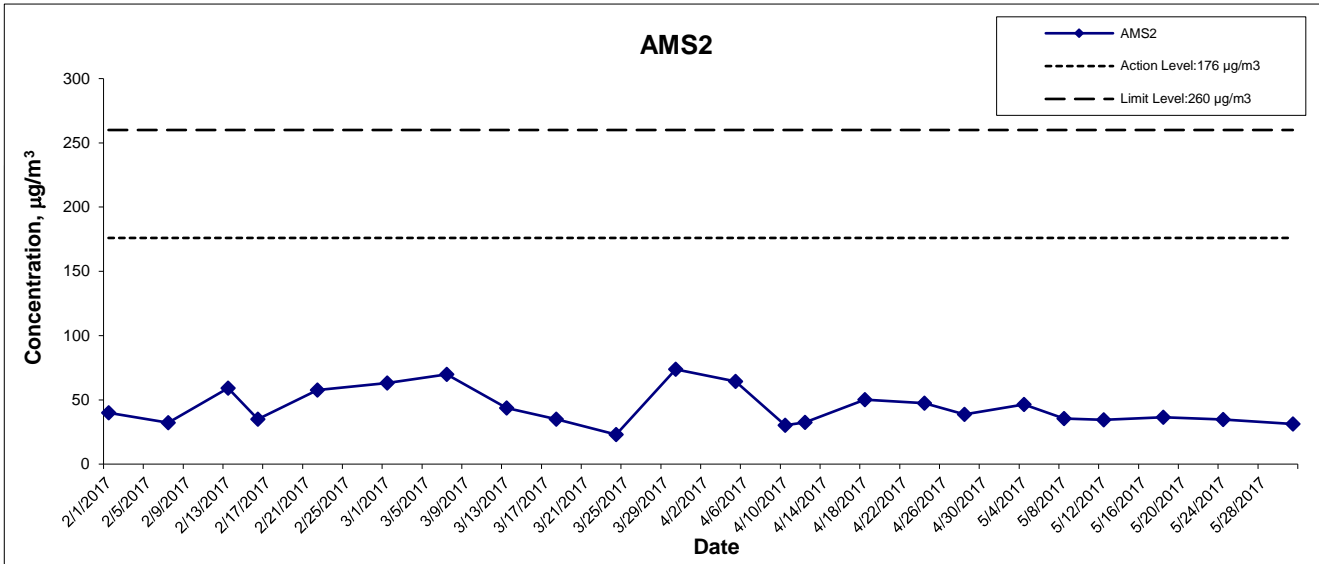


This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

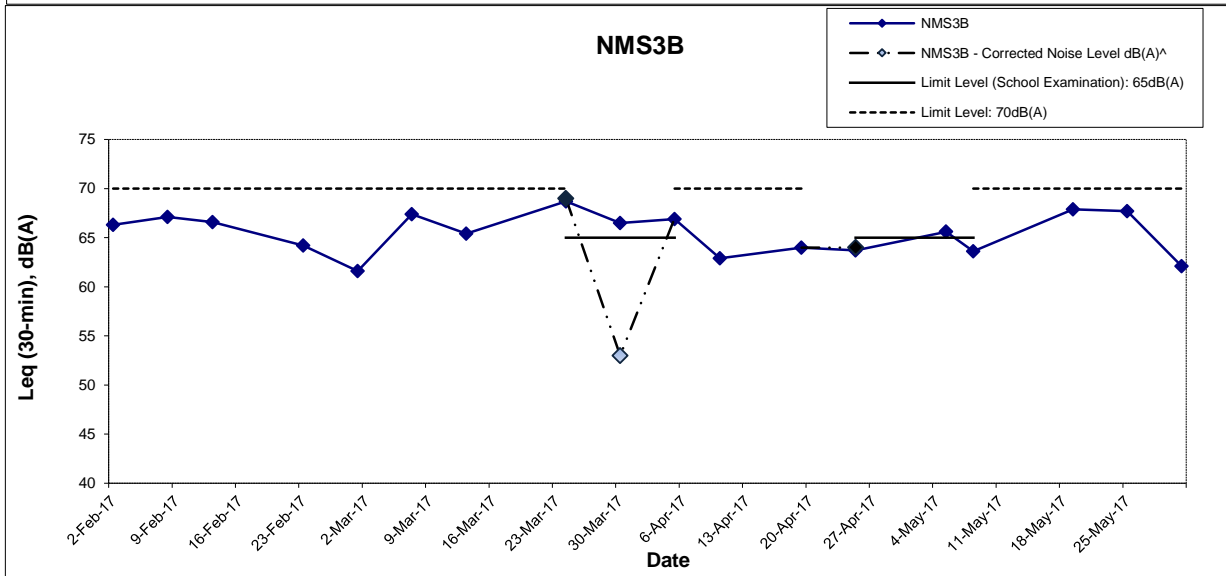
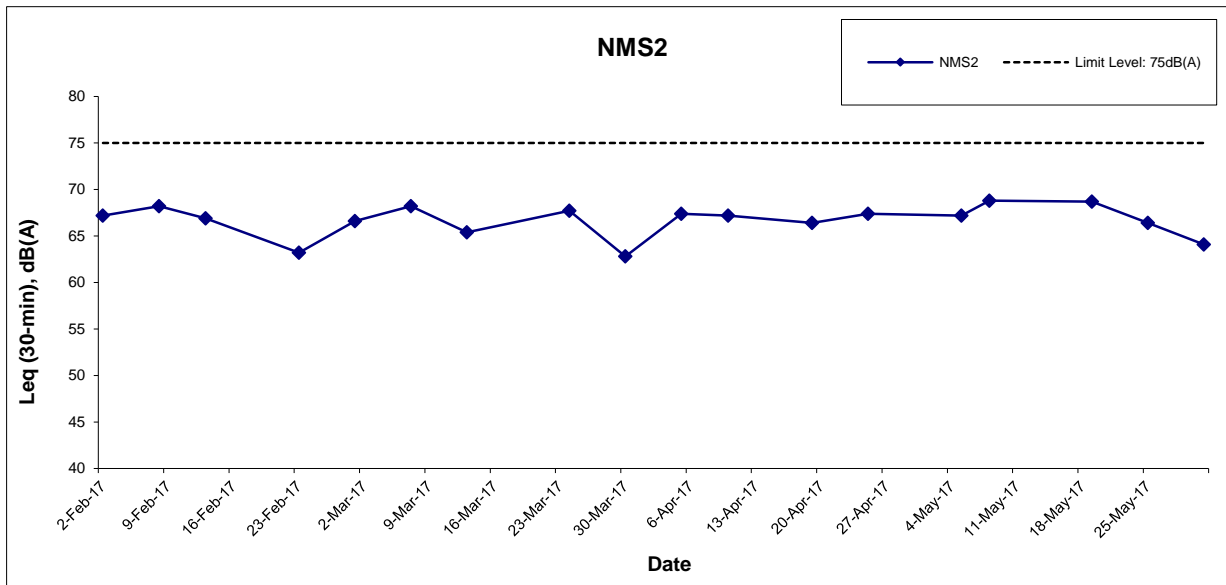
HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

**Graphical Presentation of Impact 1-hour TSP  
 Monitoring Results**





This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.



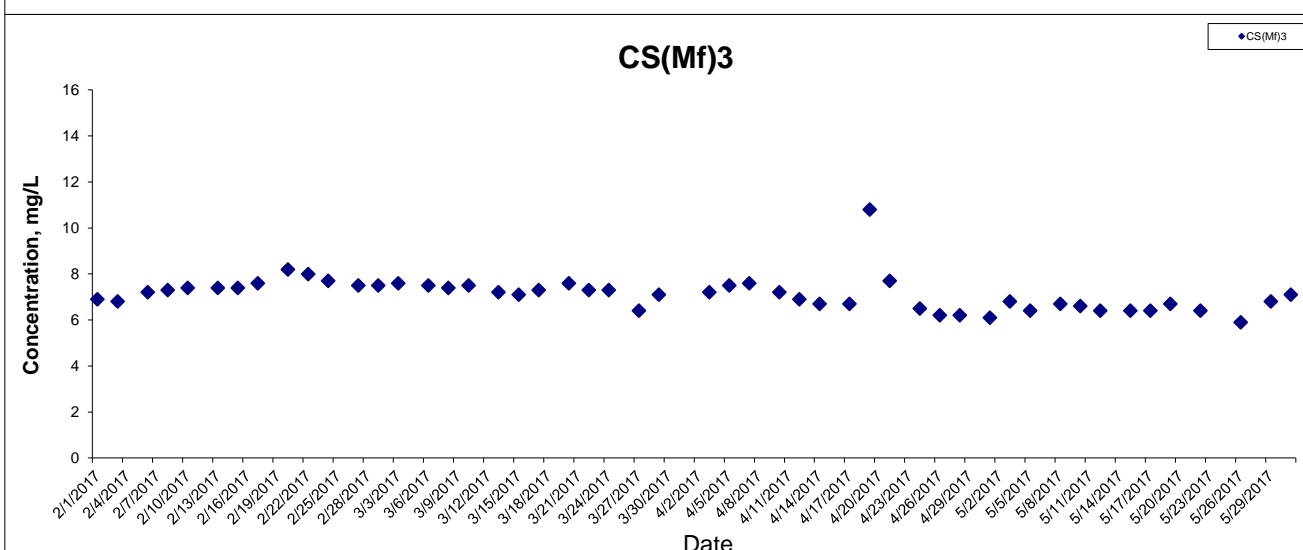
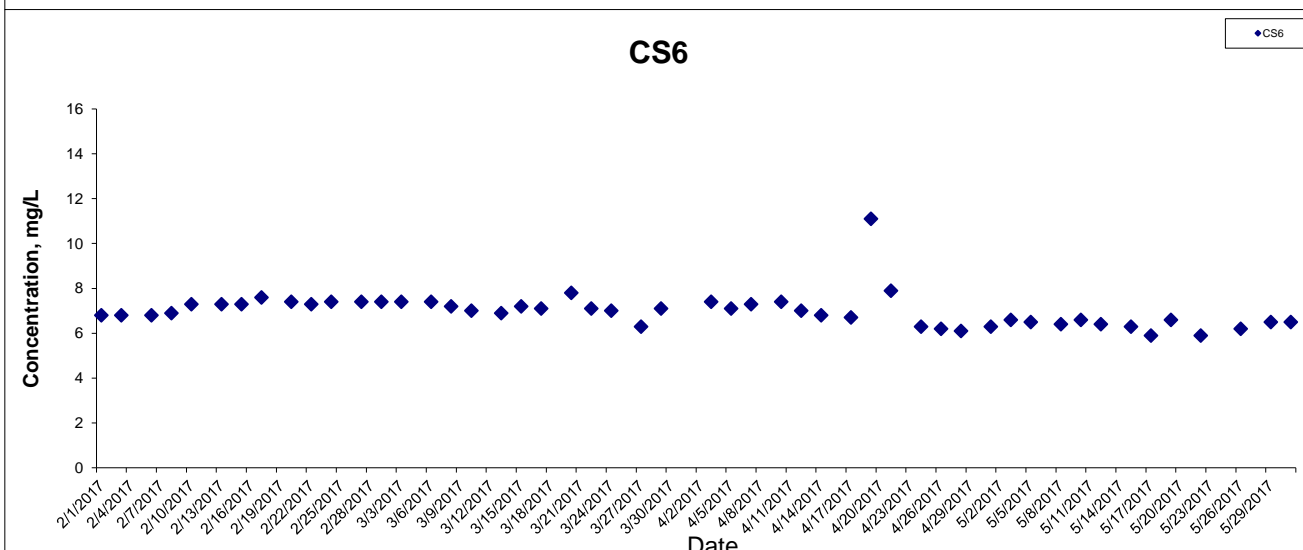
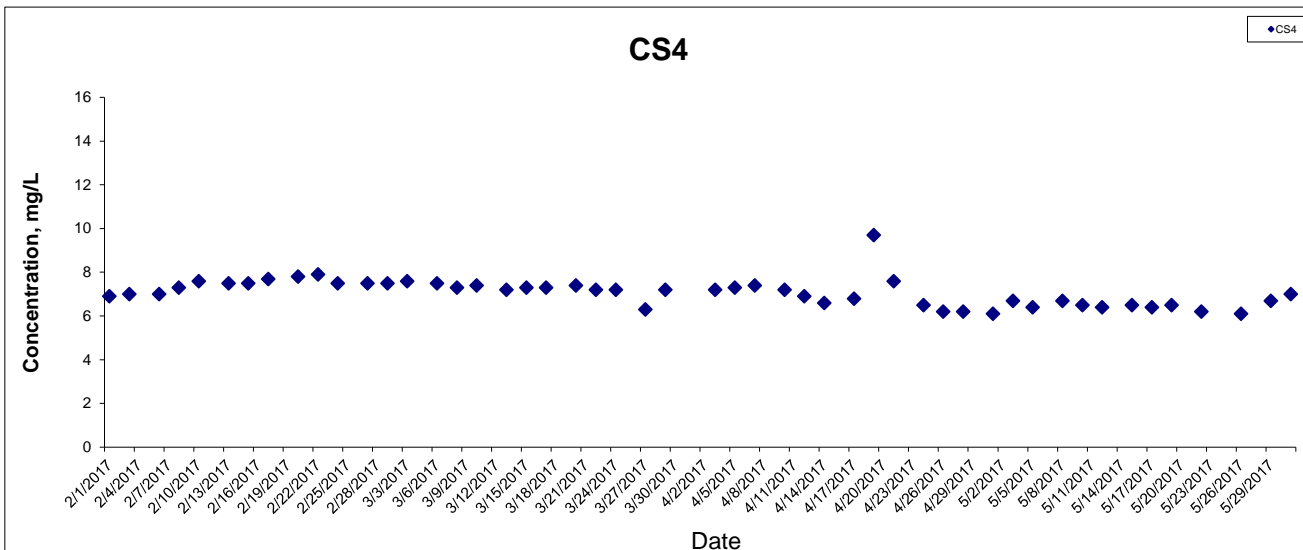
Remarks: Effective from July 2012, the Limit Level at NMS3A was revised to 70dB(A). Daytime noise Limit Level of 70 dB(A) applies to education institutions, while 65dB(A) applies during school examination period.

\* The measured noise level on 30 Mar 2017 at NMS3B exceeded the noise level of 65dB(A) during examination period but it is higher than the baseline level. Therefore, baseline correction was carried out and the corrected noise level which solely represent the noise level of Construction works 53 dB(A) respectively which is lower than the exceedance level of 65dB(A) . As such the EAP was not triggered.

>The measured noise level on 5 May 2017 at NMS3B exceeded the noise level of 65dB(A) during examination period but it was below the baseline level. Therefore, it is not considered as an exceedance. As such the EAP was not triggered.

This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Surface & Middle) at Mid-Ebb Tide



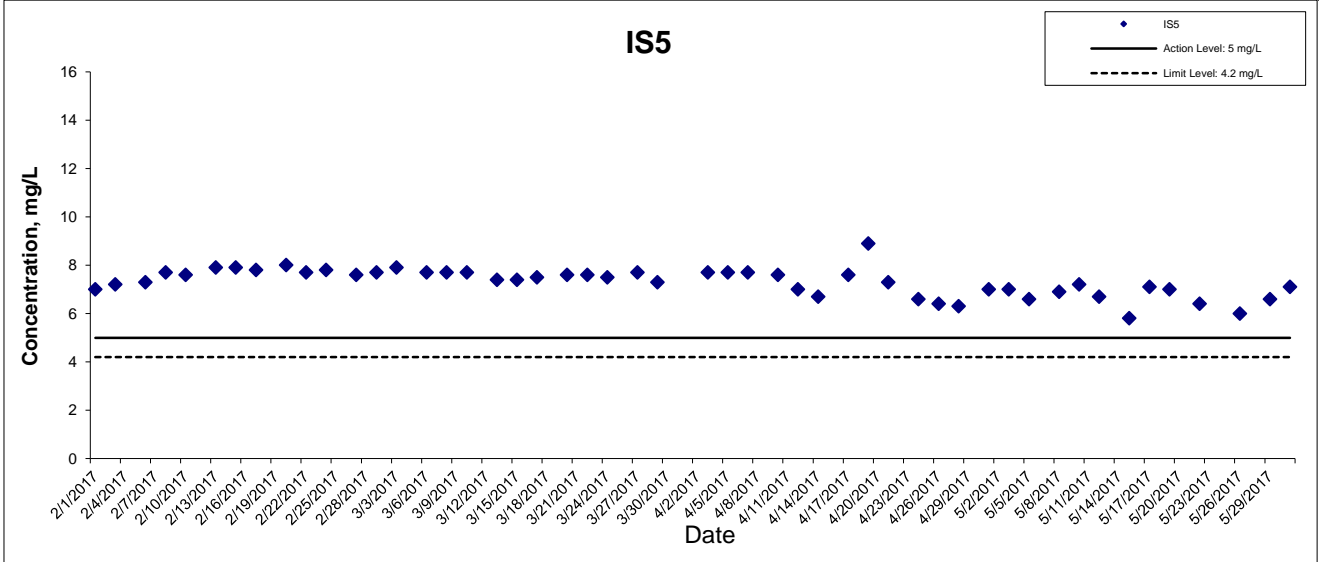
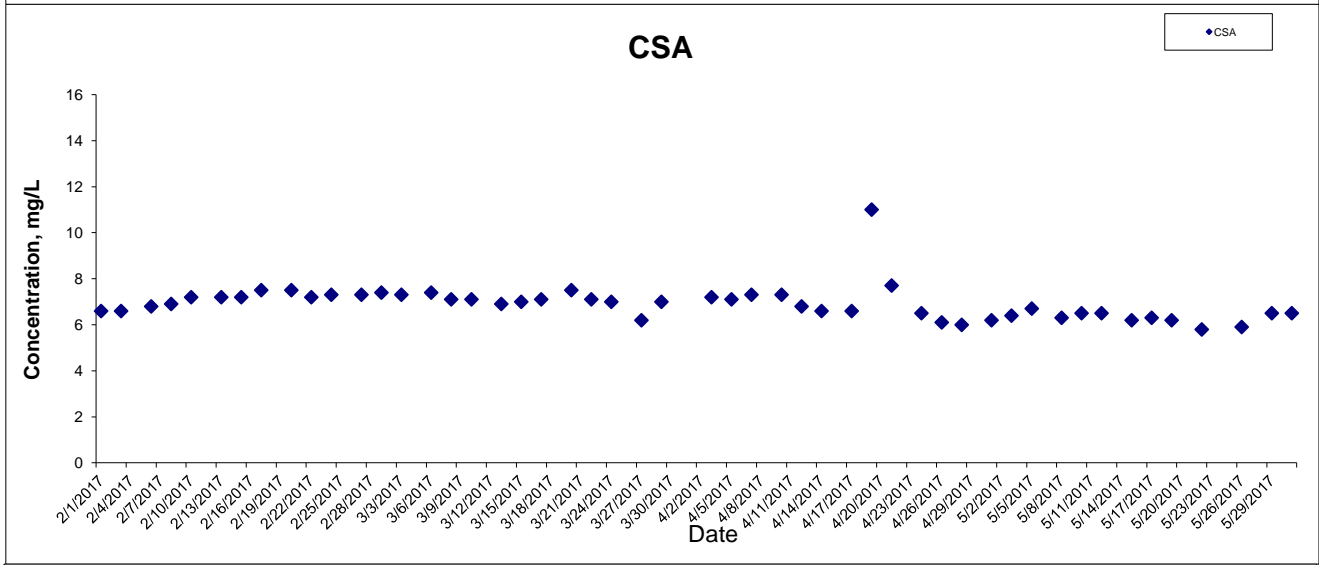
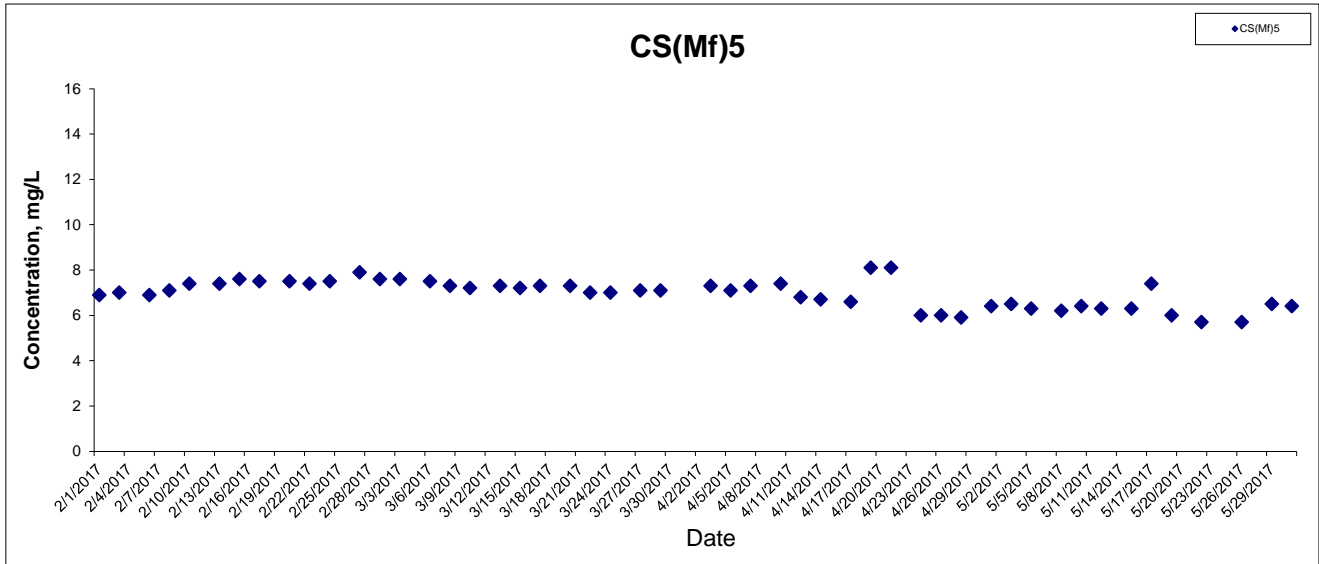
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results



## Dissolved Oxygen (Surface & Middle) at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

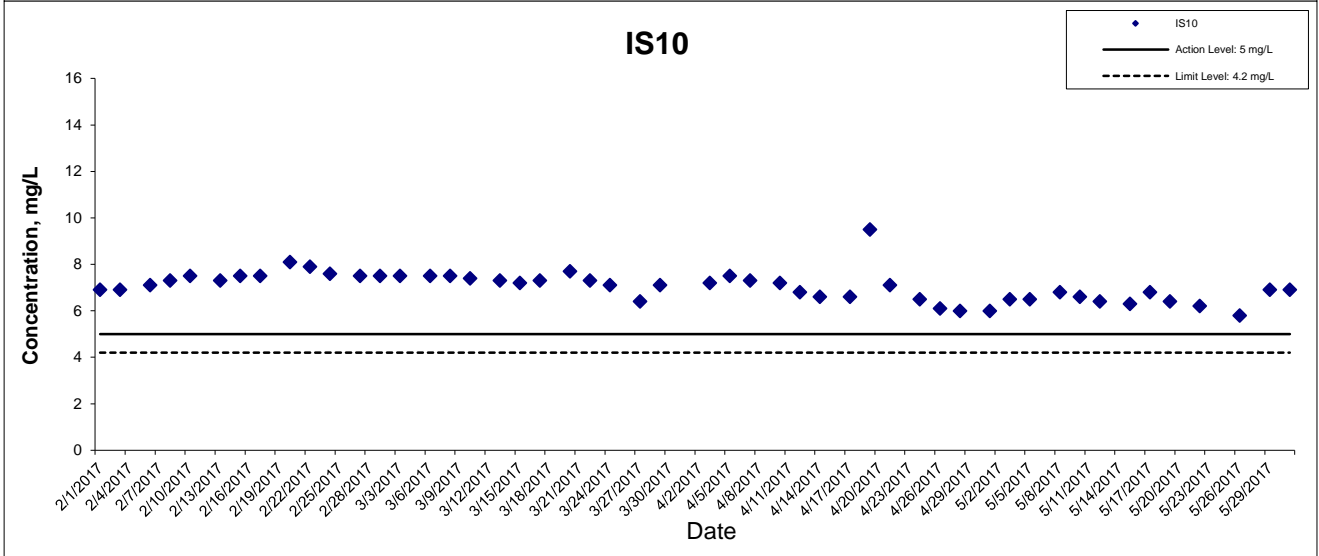
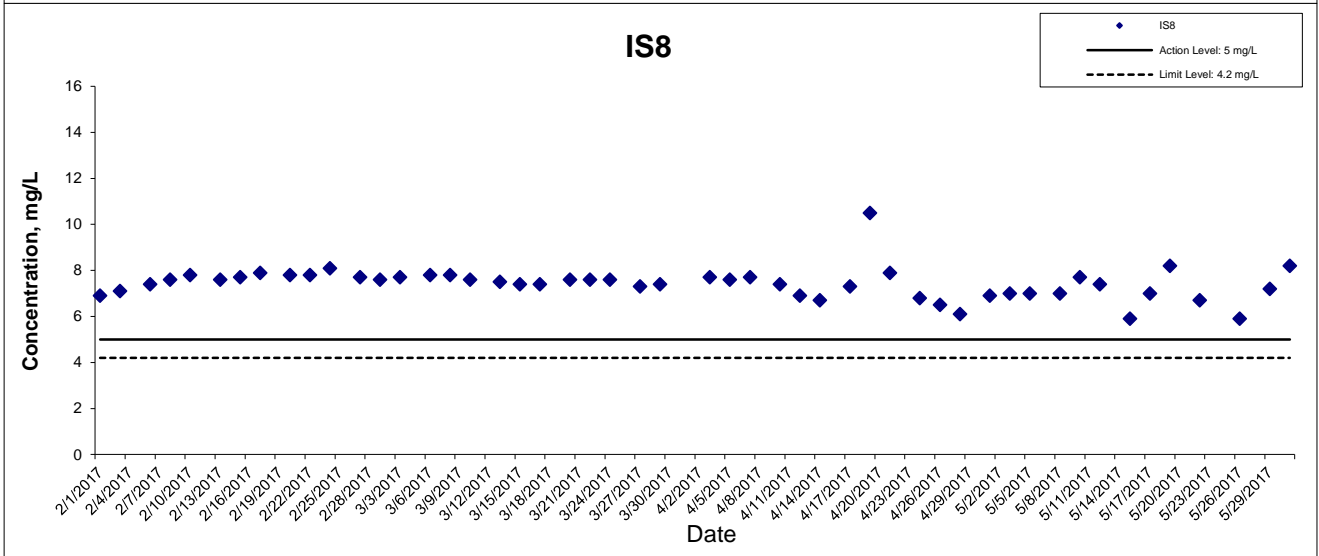
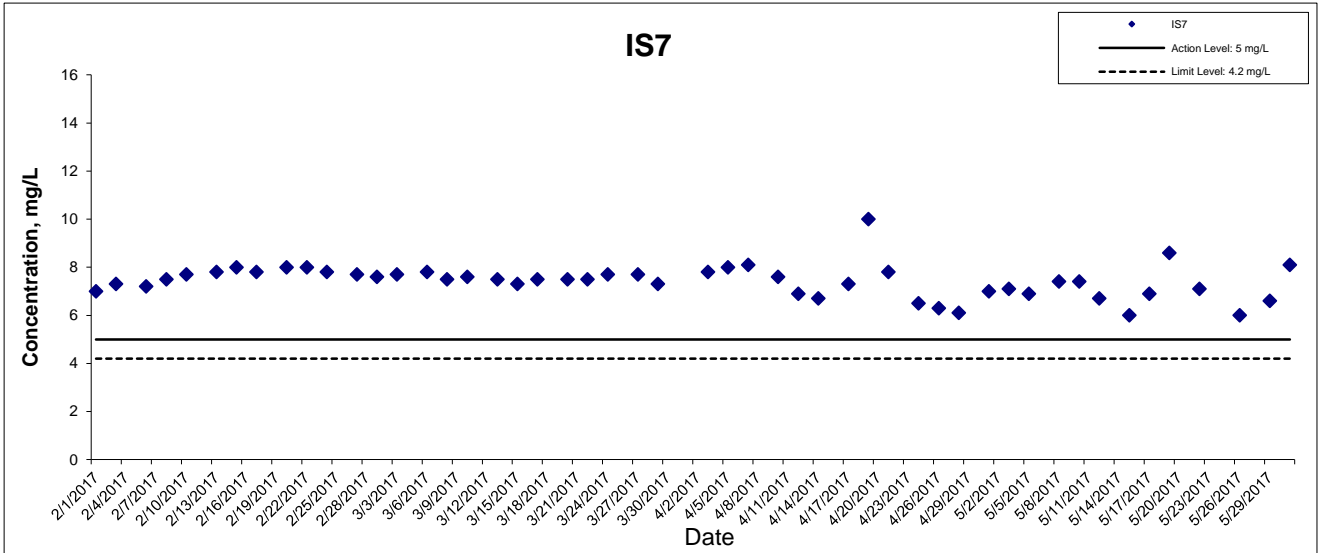
HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results



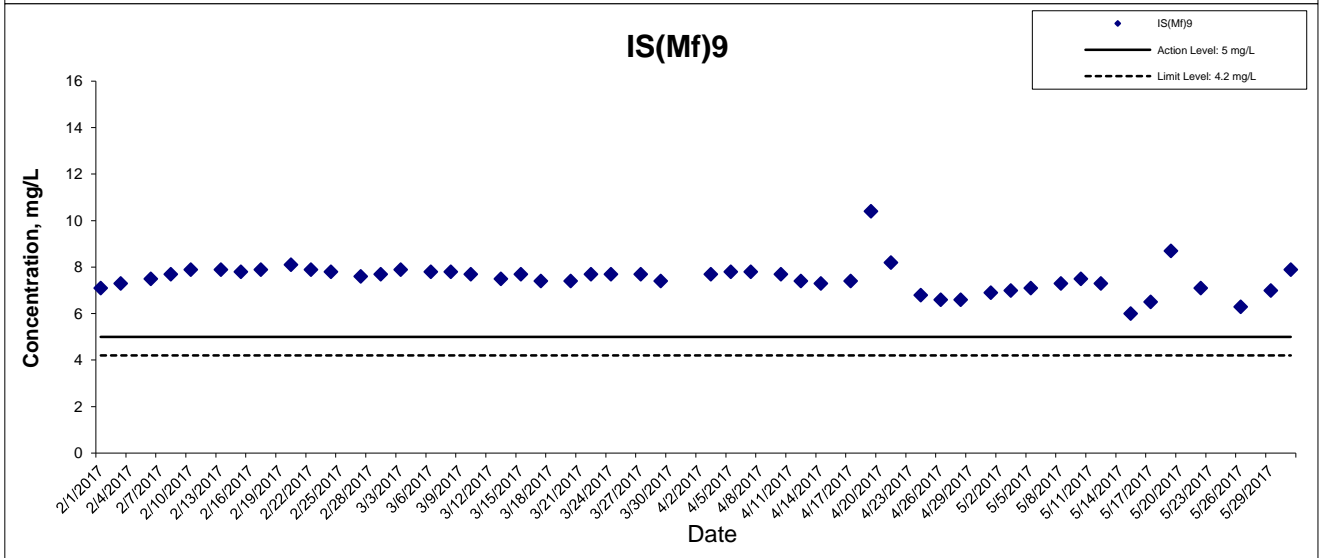
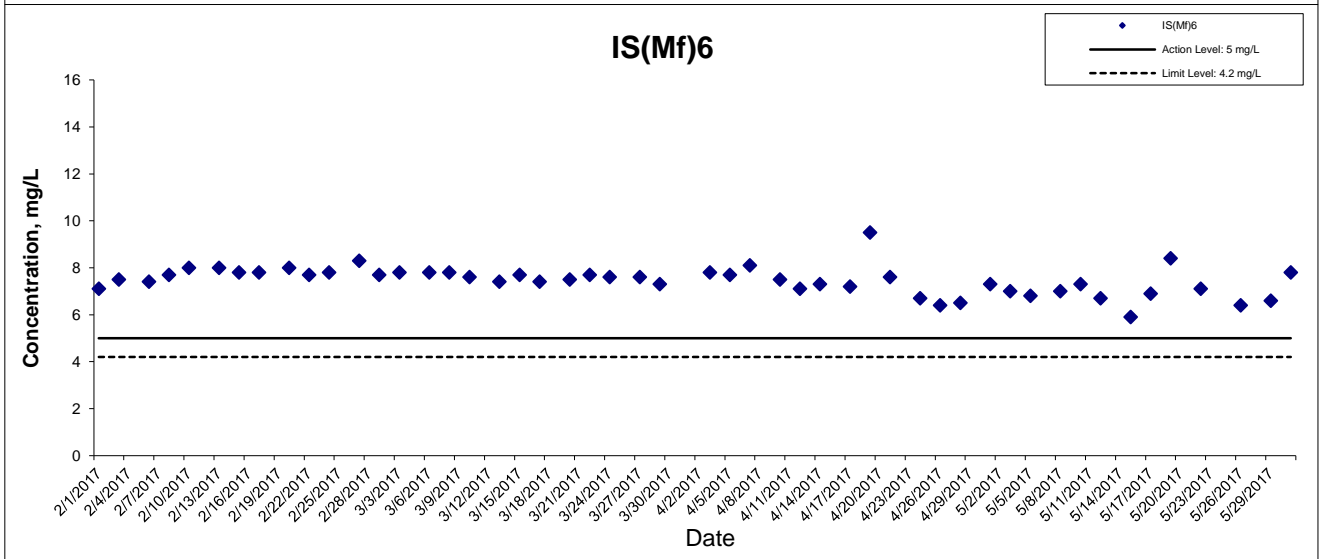
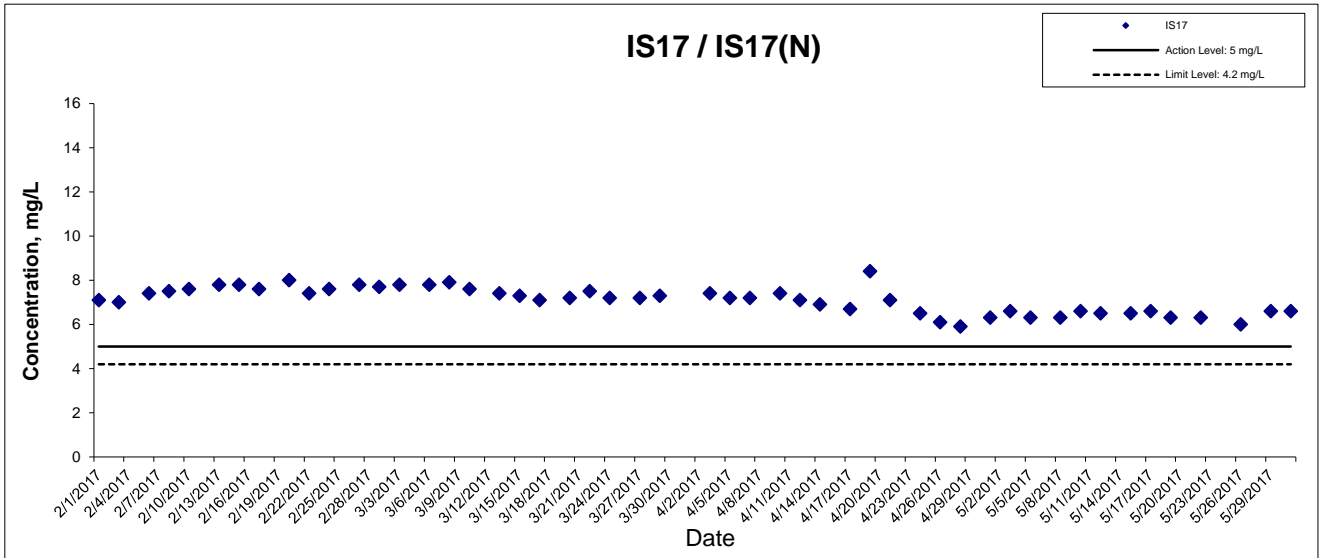


## Dissolved Oxygen (Surface & Middle) at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Surface & Middle) at Mid-Ebb Tide

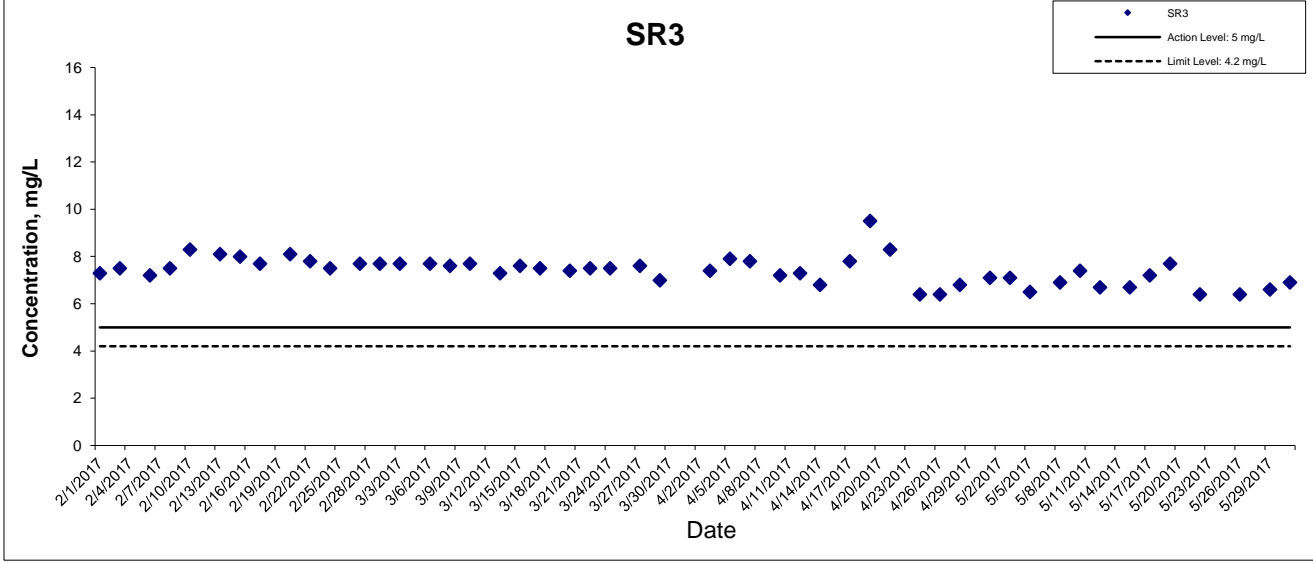
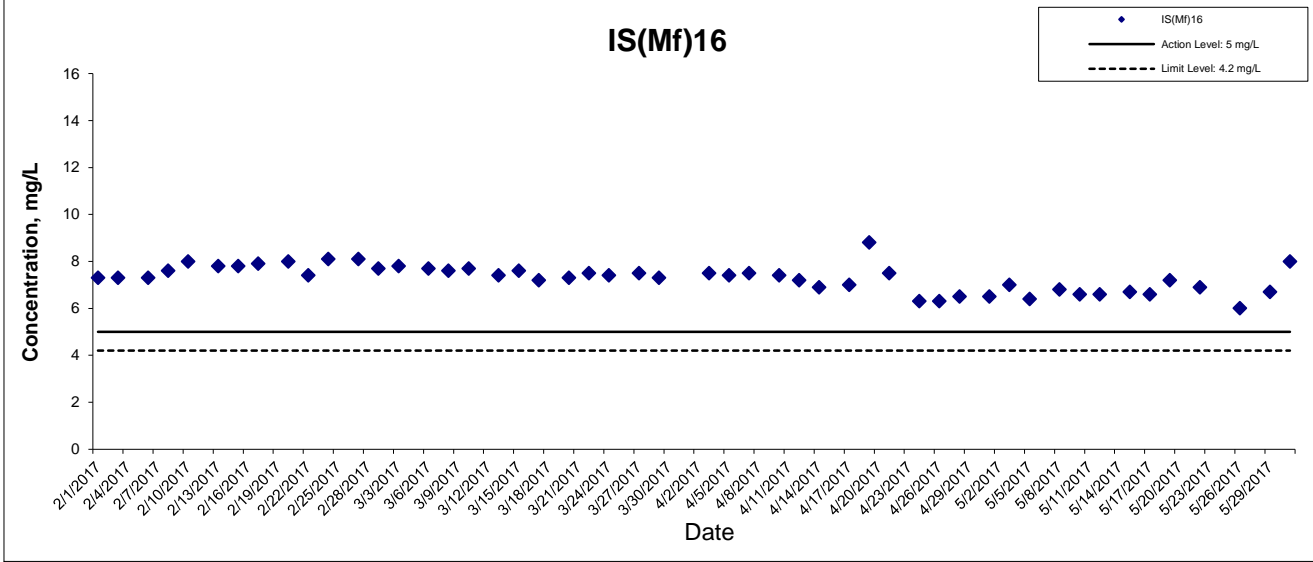
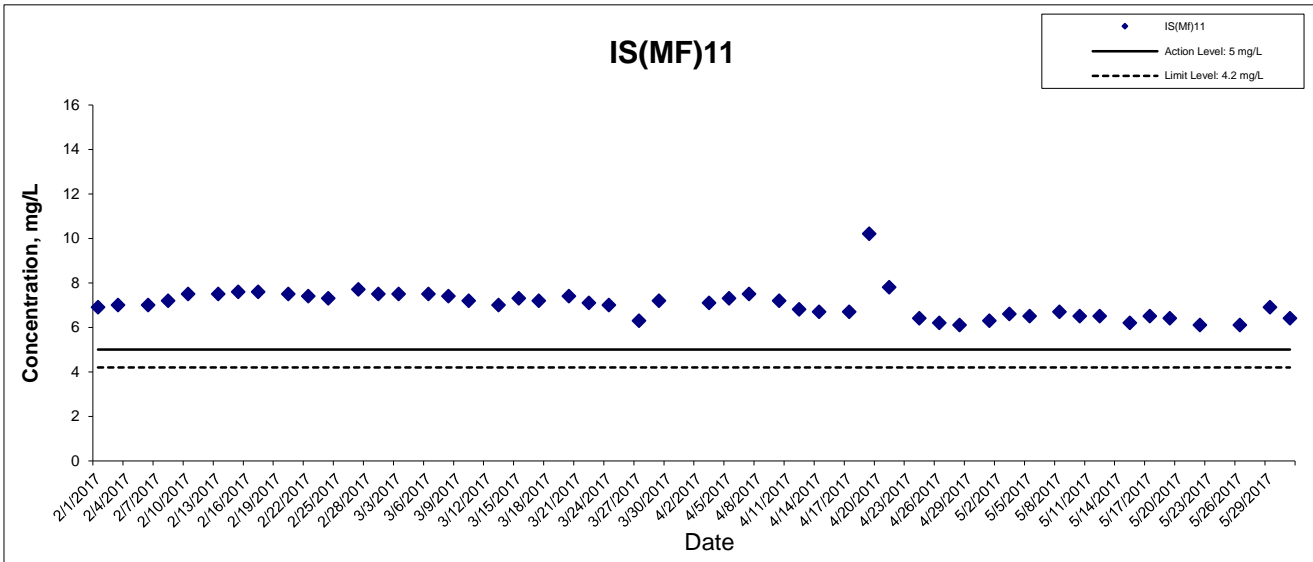


This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

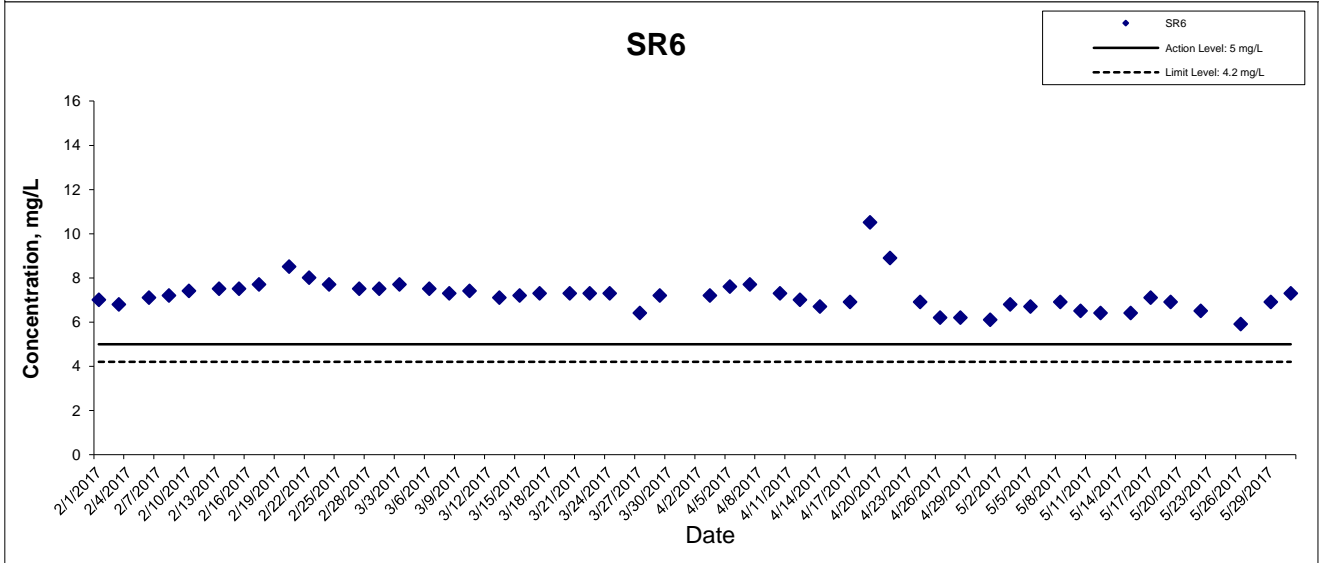
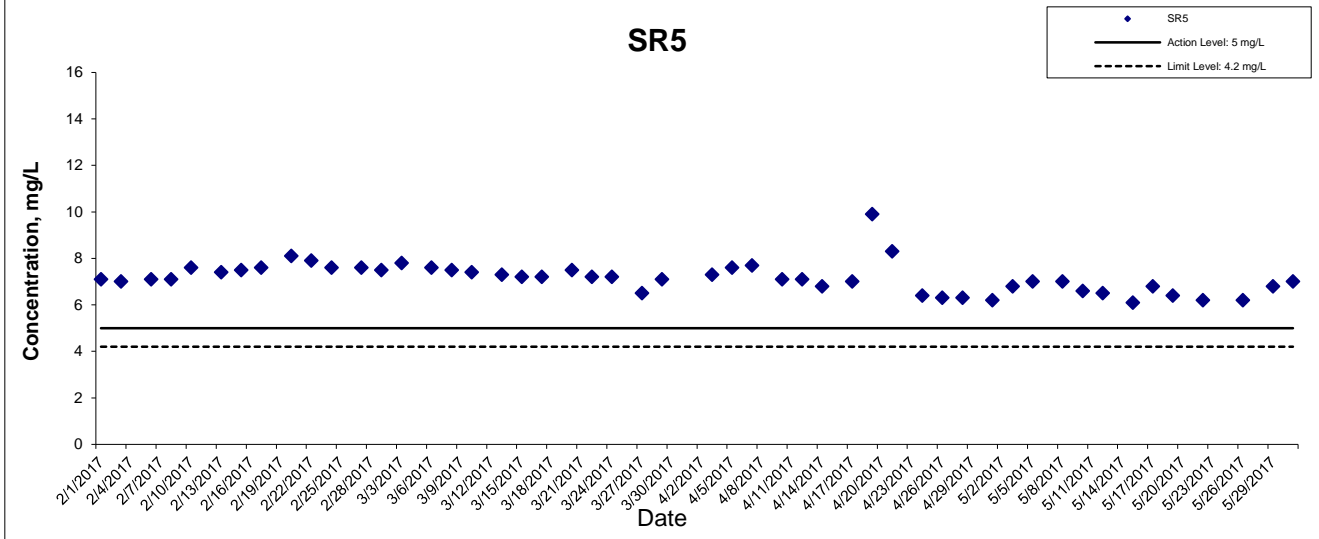
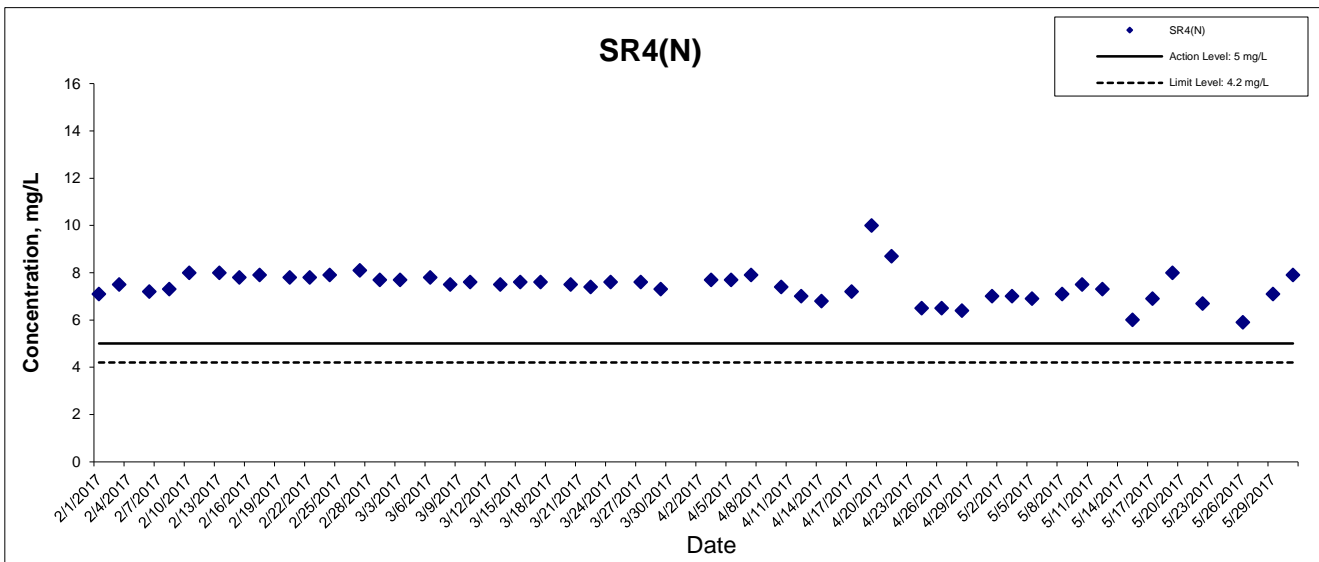
Graphical Presentation of Impact Water Quality  
 Monitoring Results





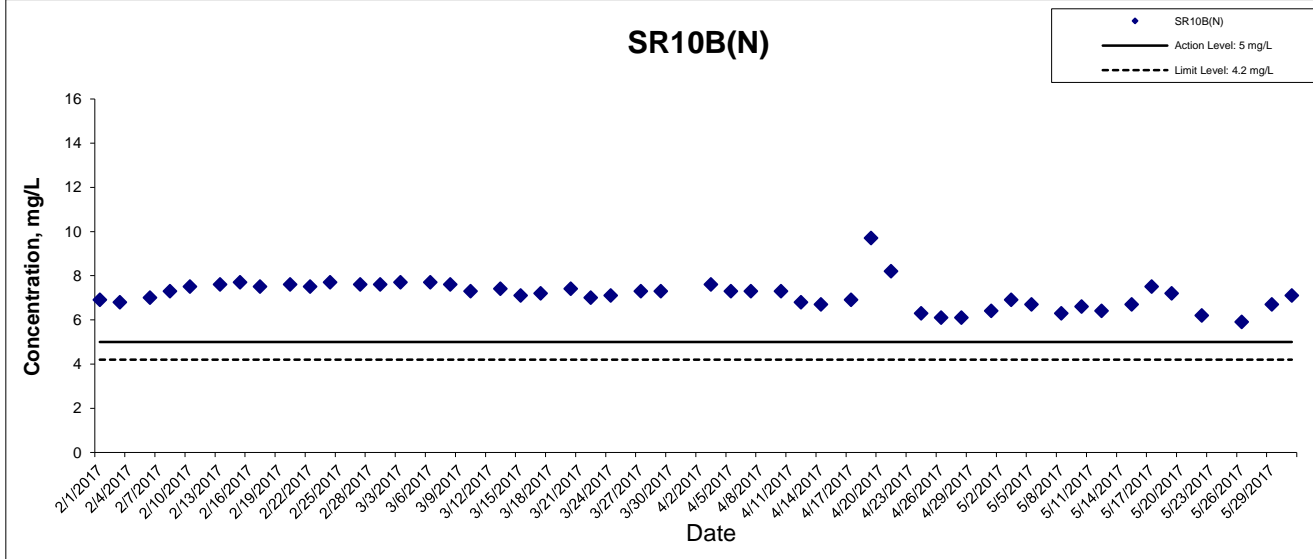
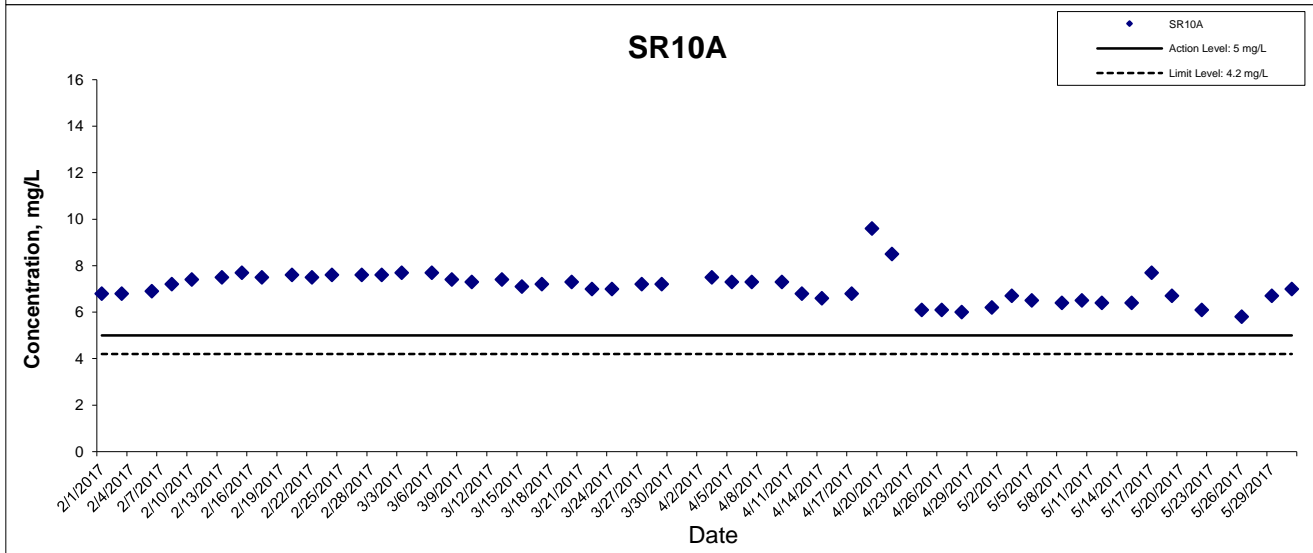
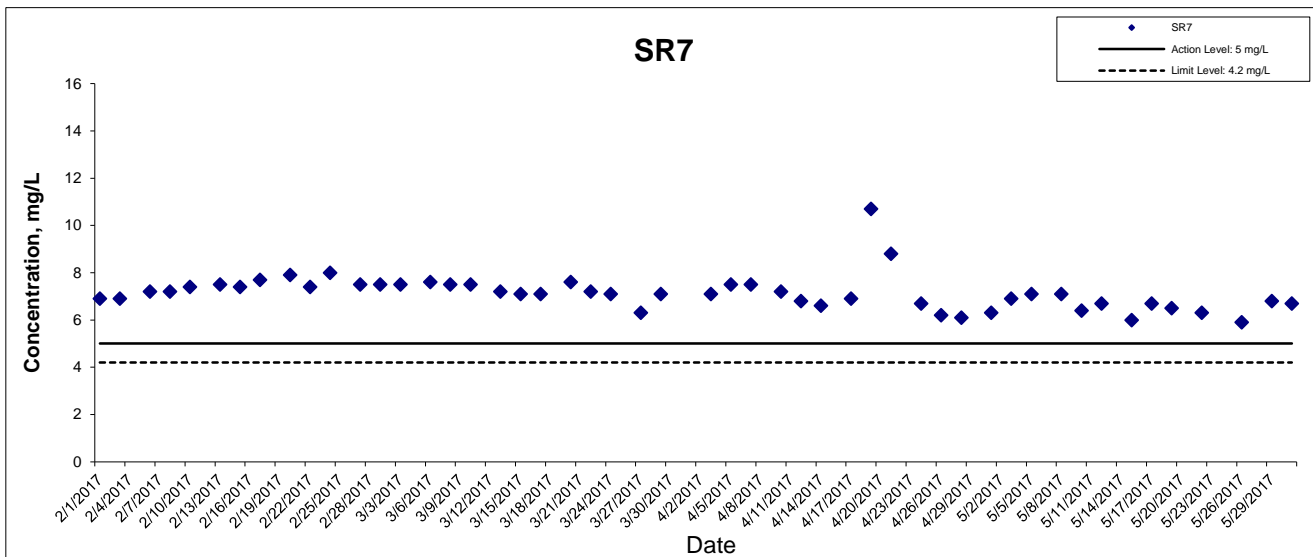
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.





This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

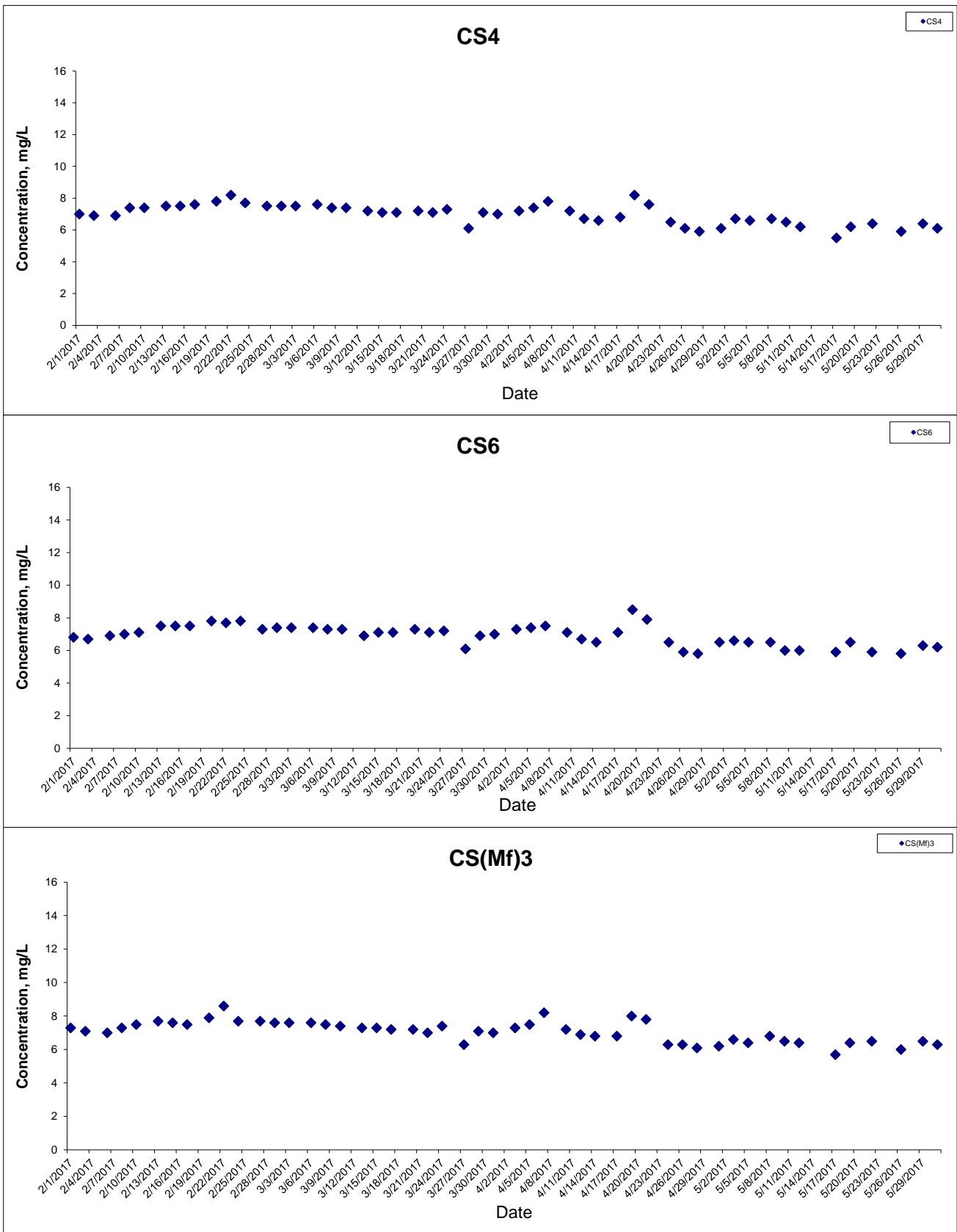




This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.



## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



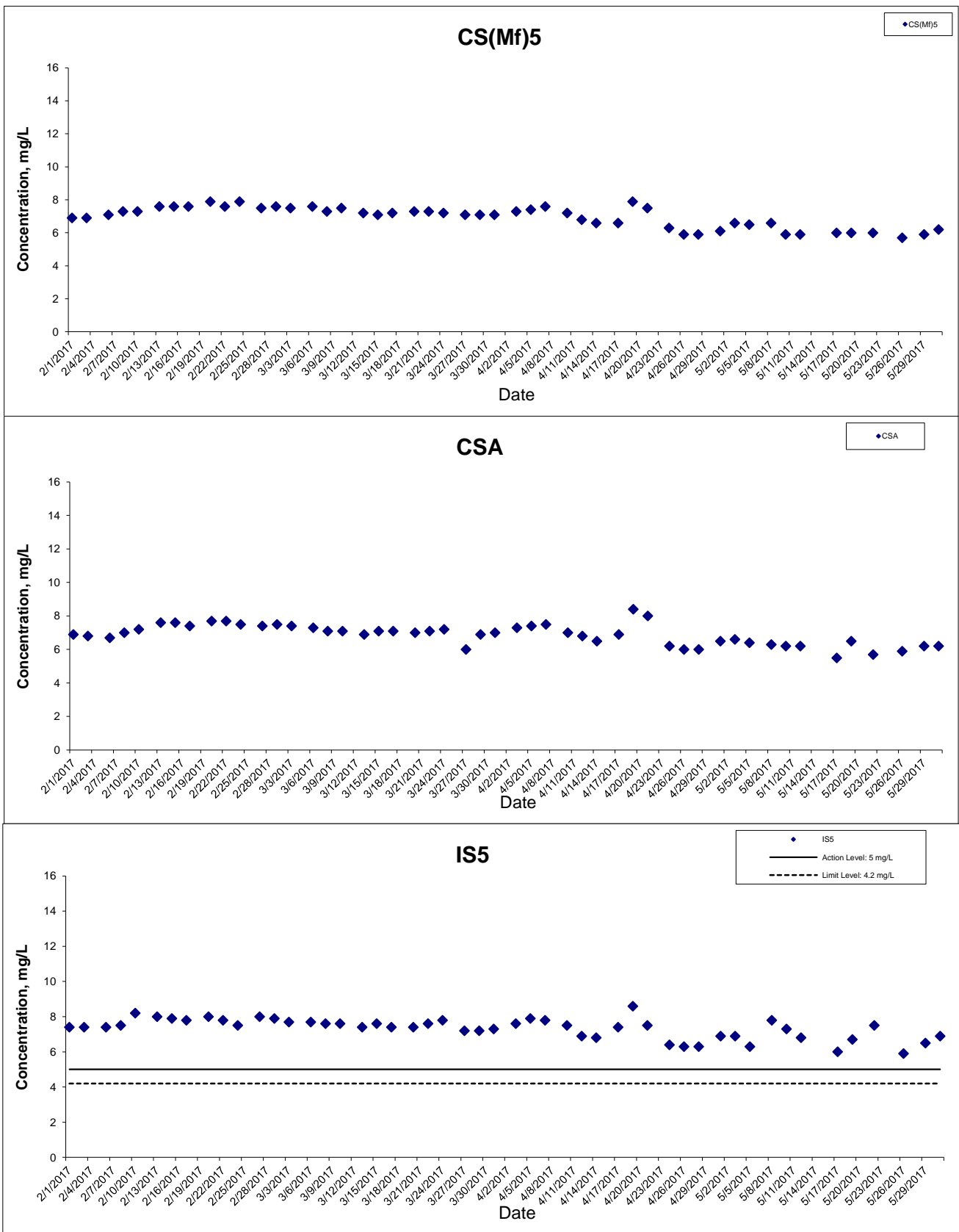
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results



## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



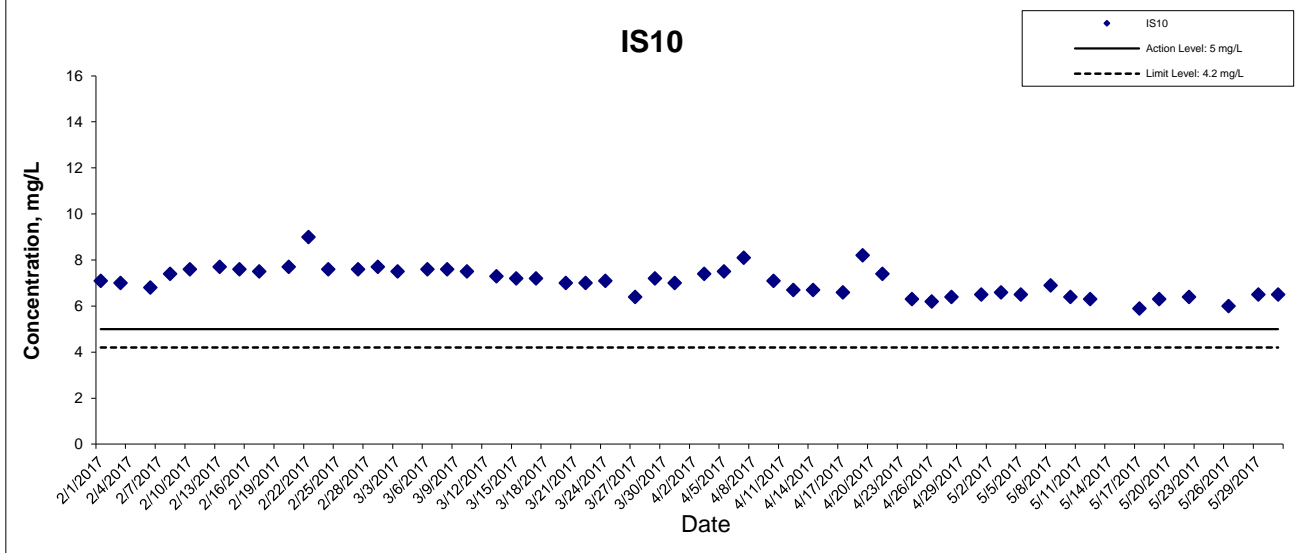
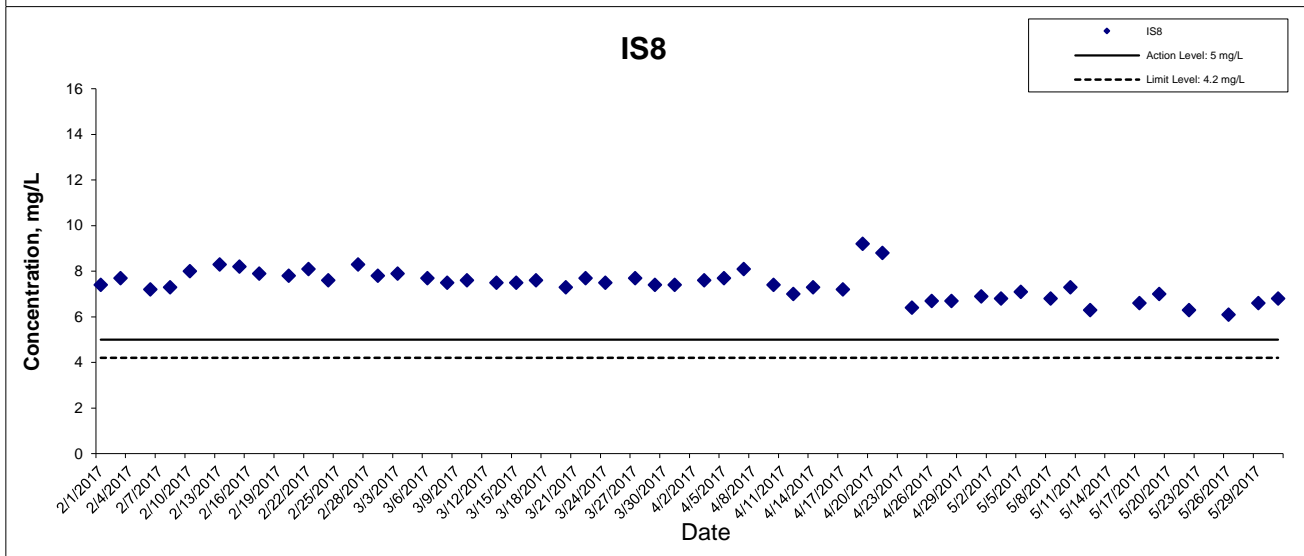
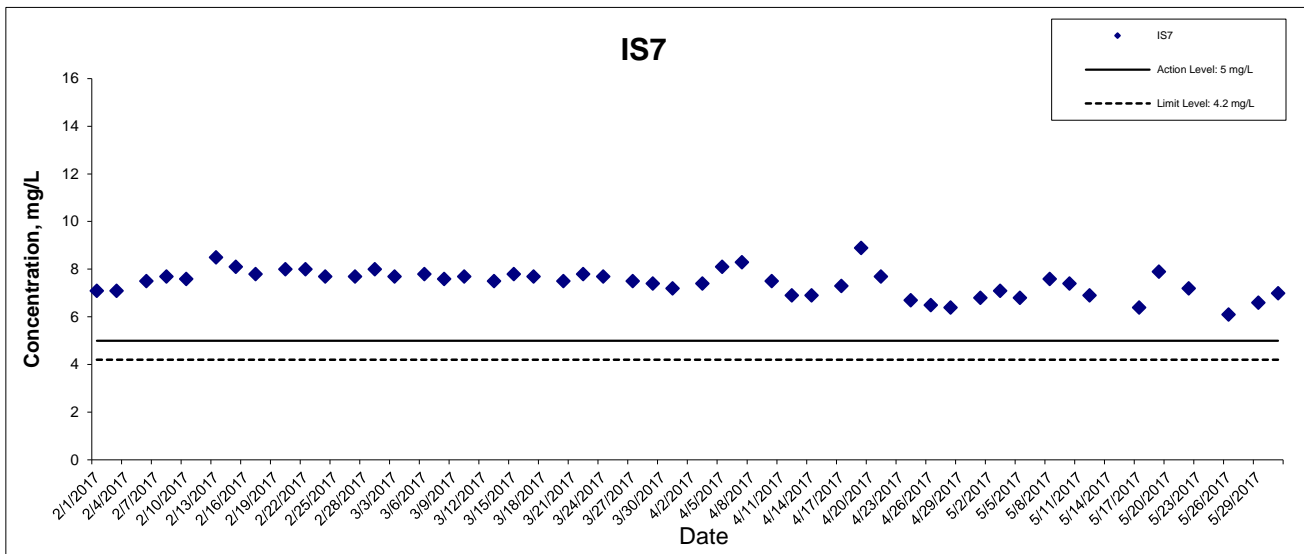
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results



## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

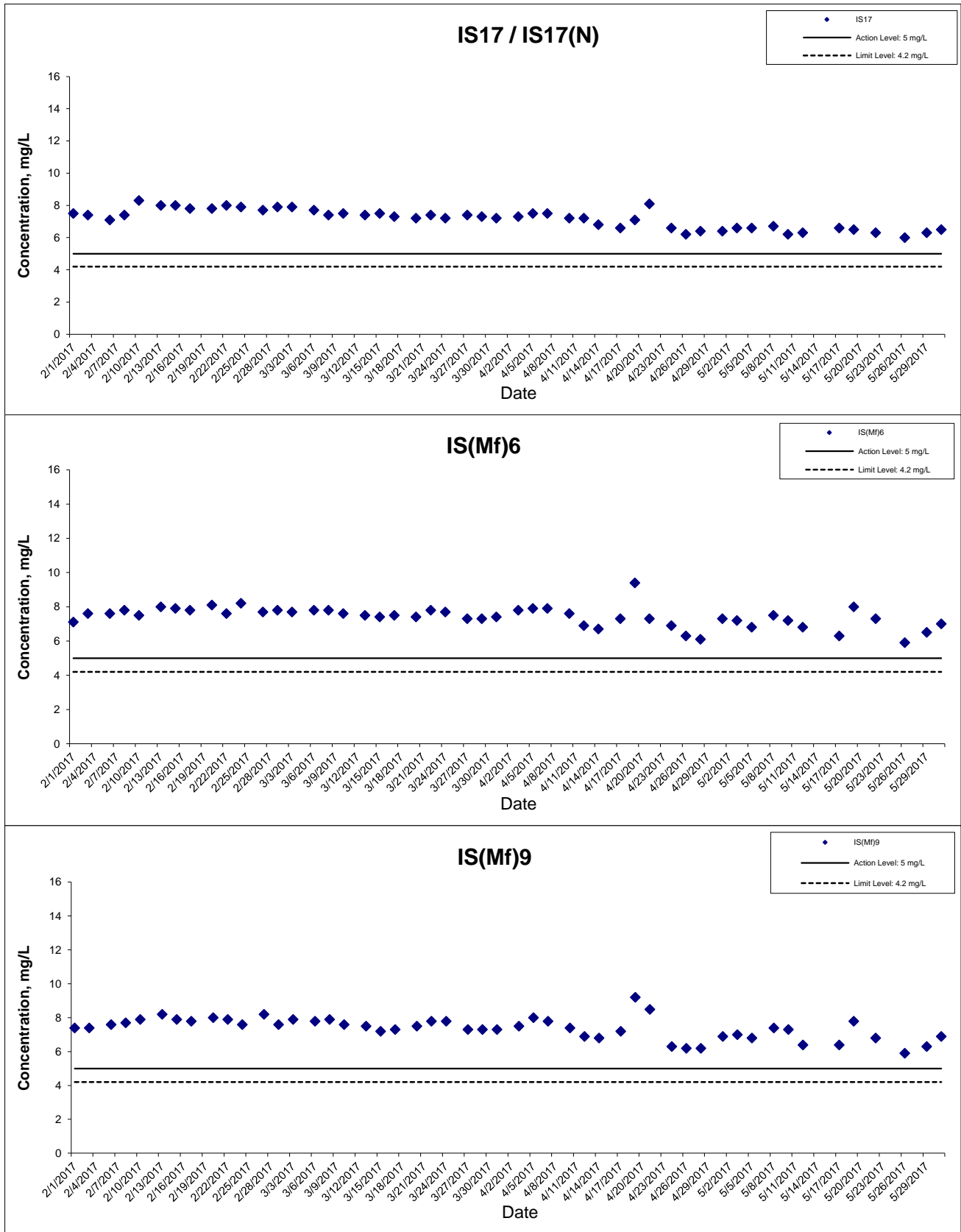
HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results



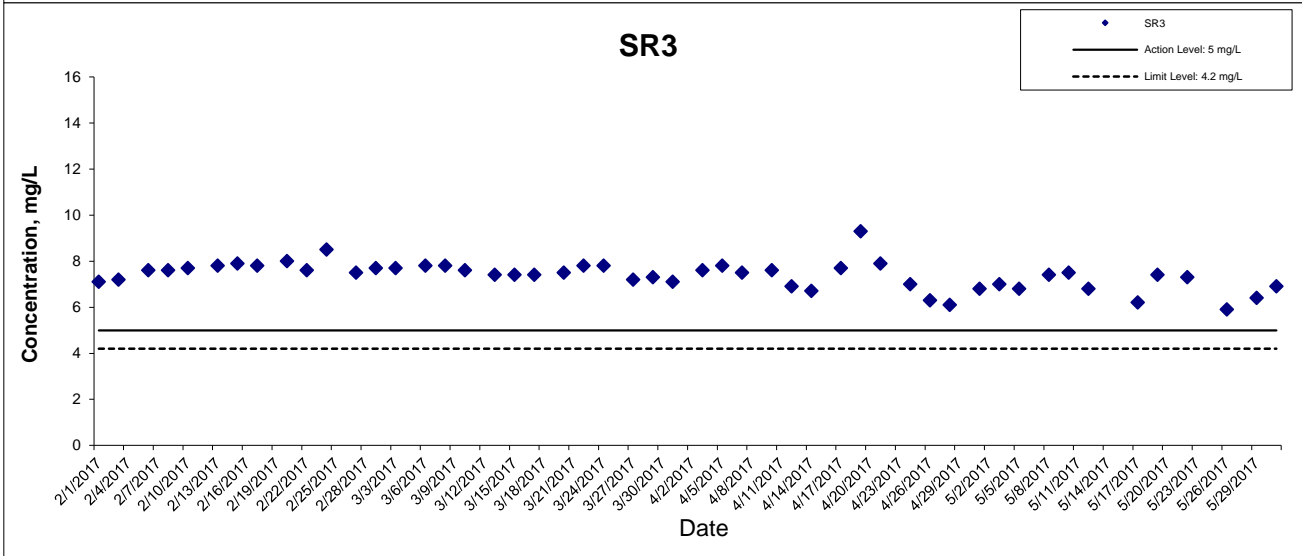
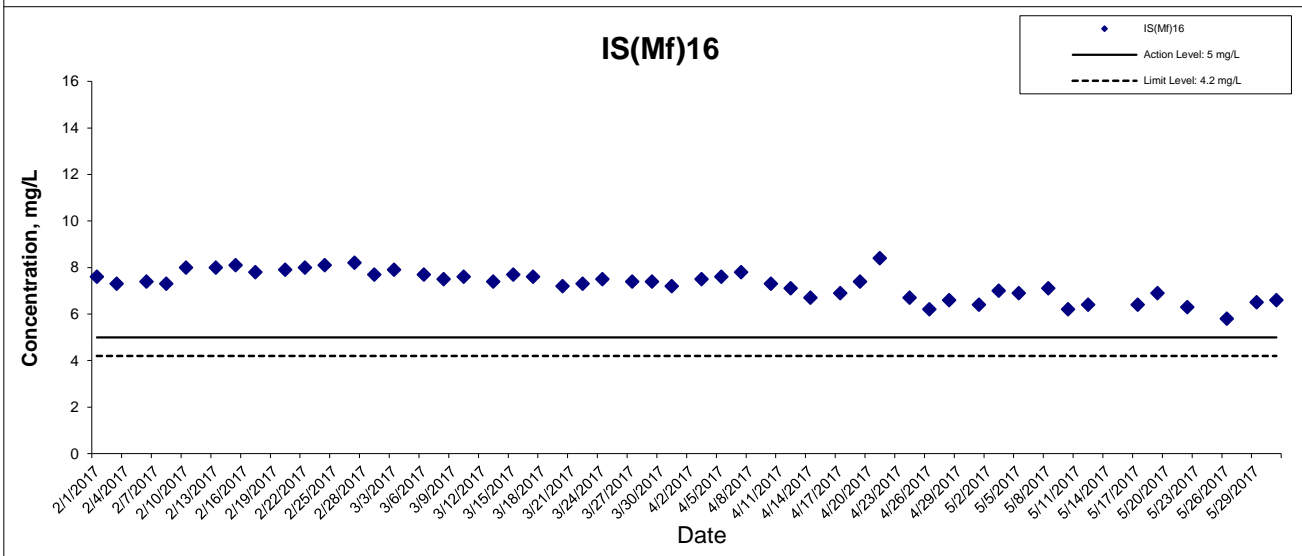
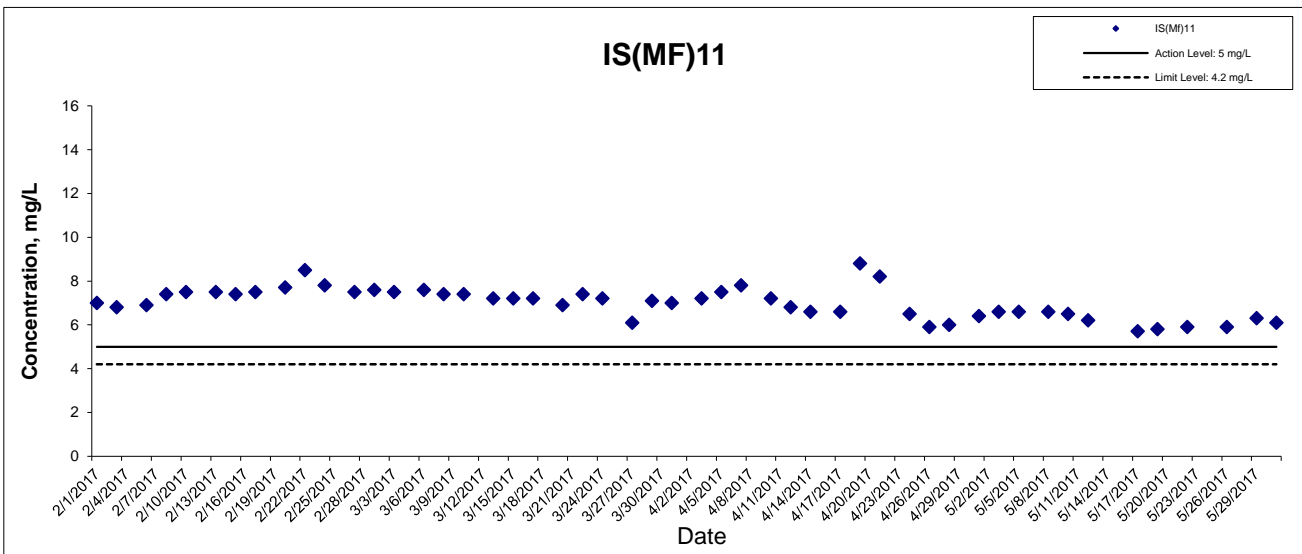


## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



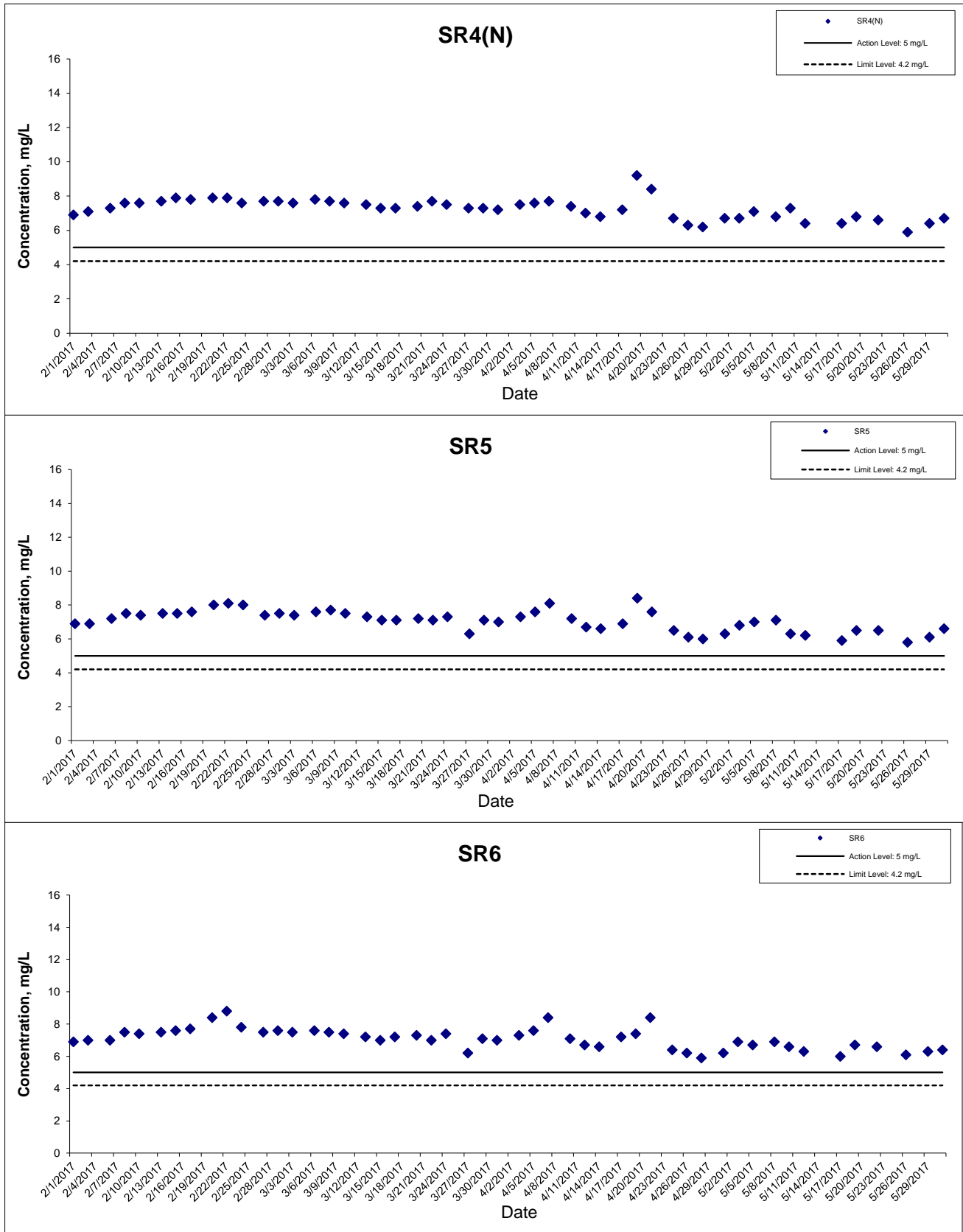
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results

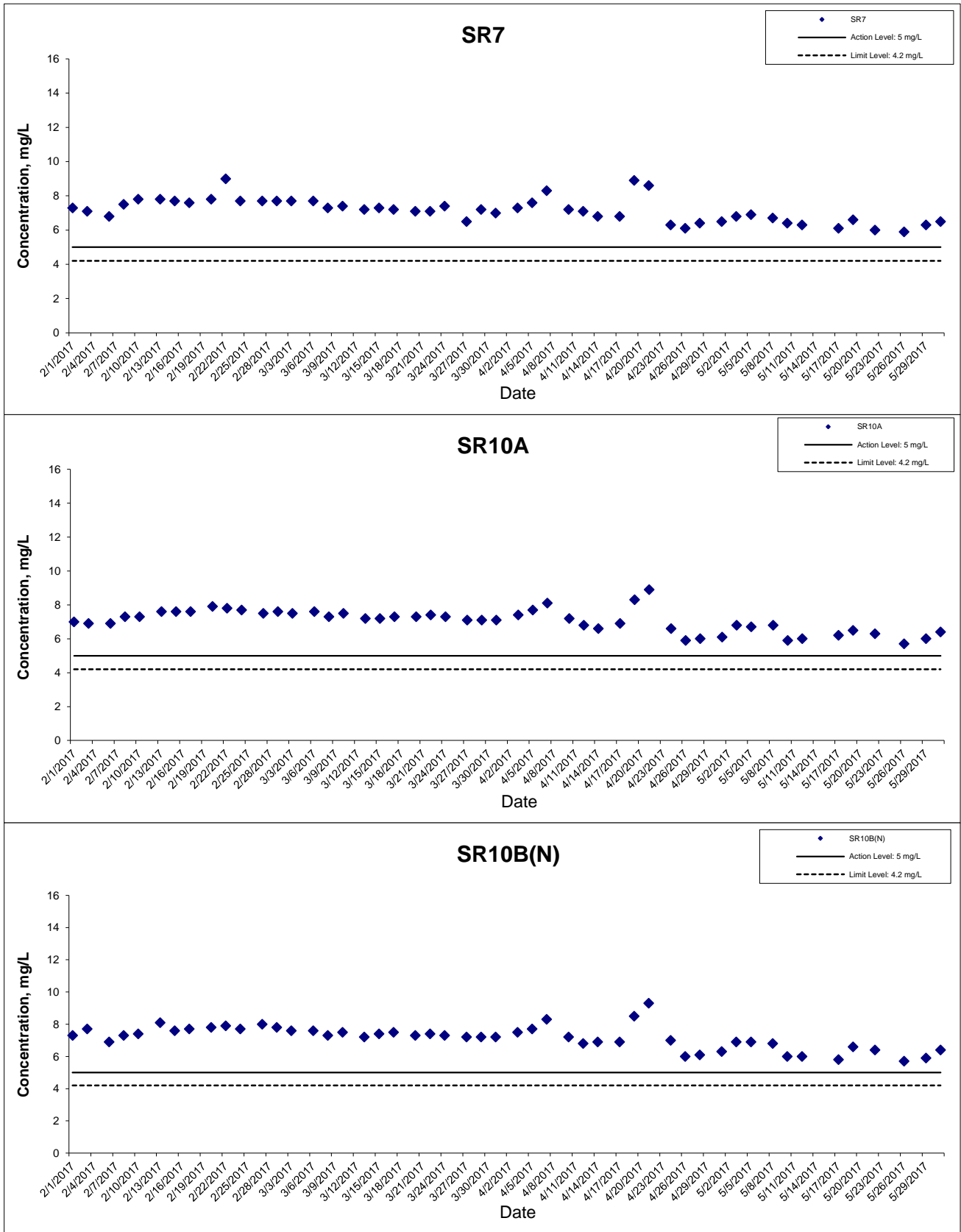


## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



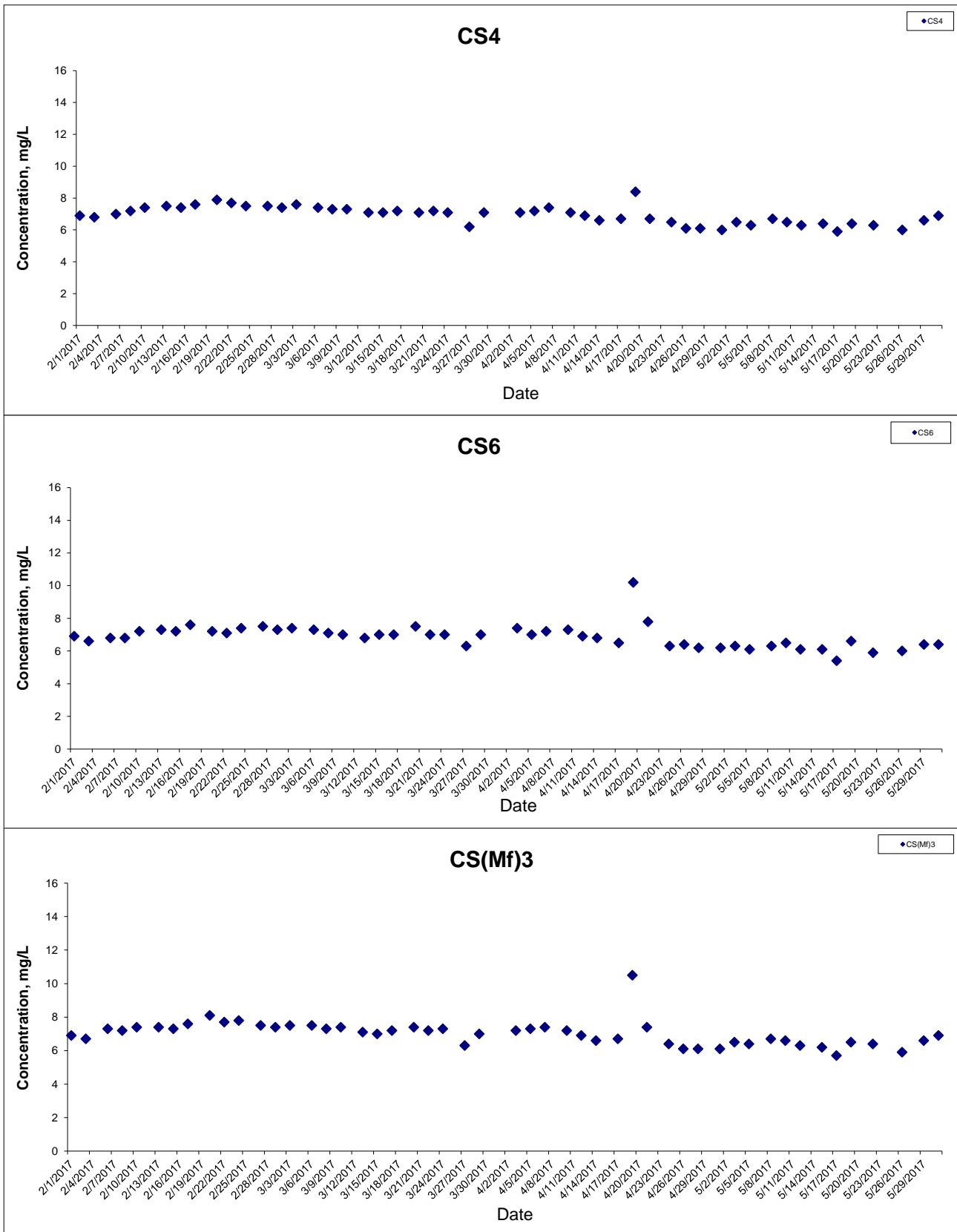
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Surface & Middle) at Mid-Flood Tide



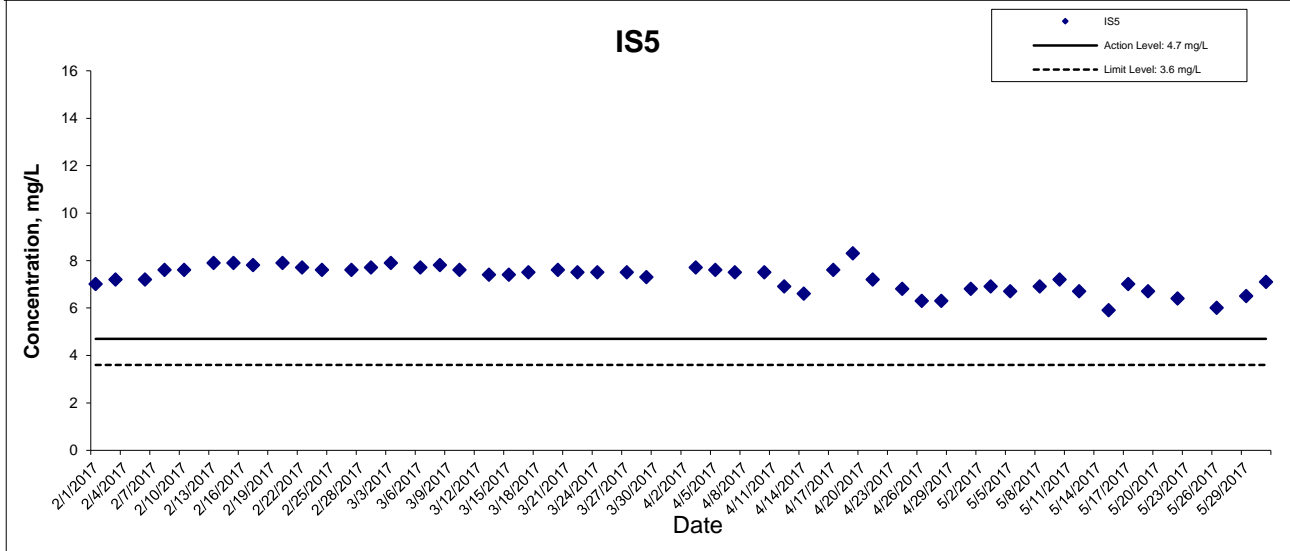
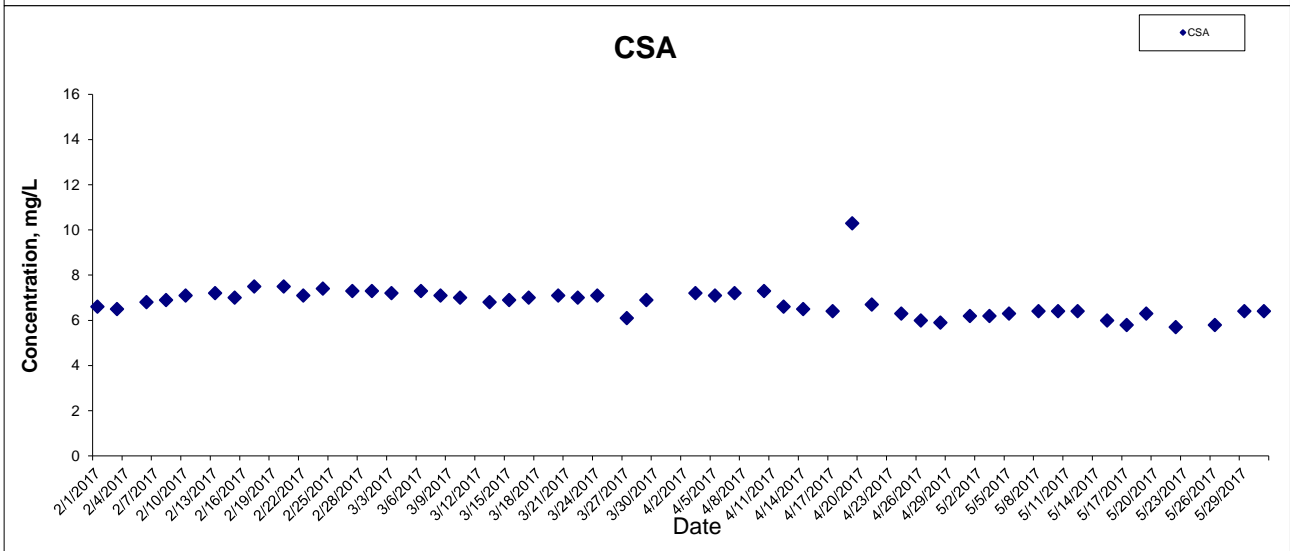
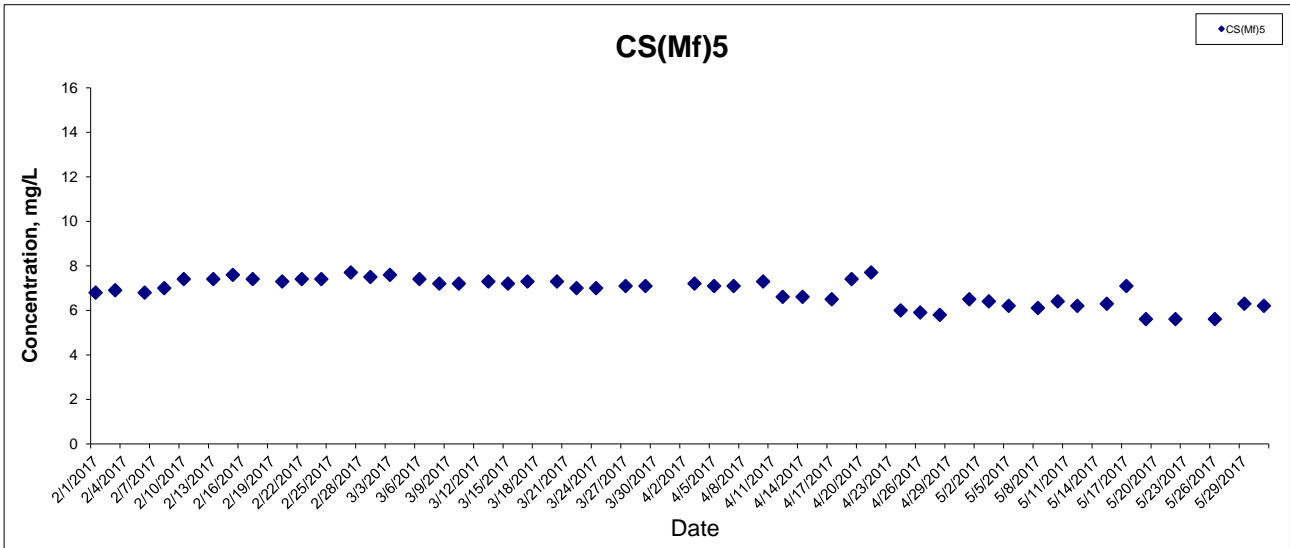
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Bottom) at Mid-Ebb Tide



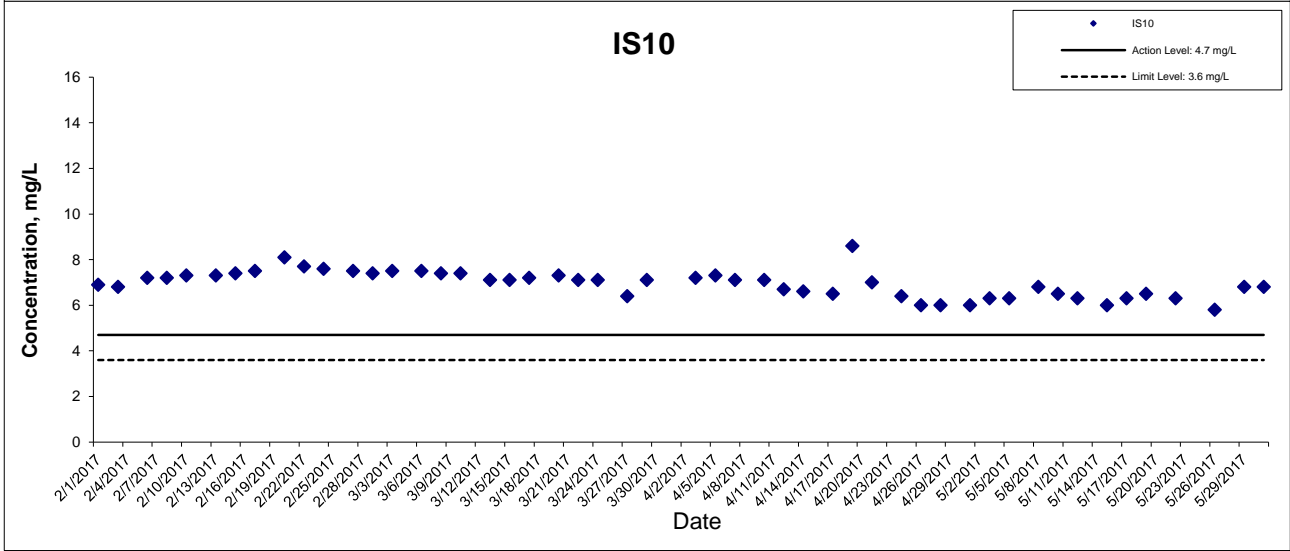
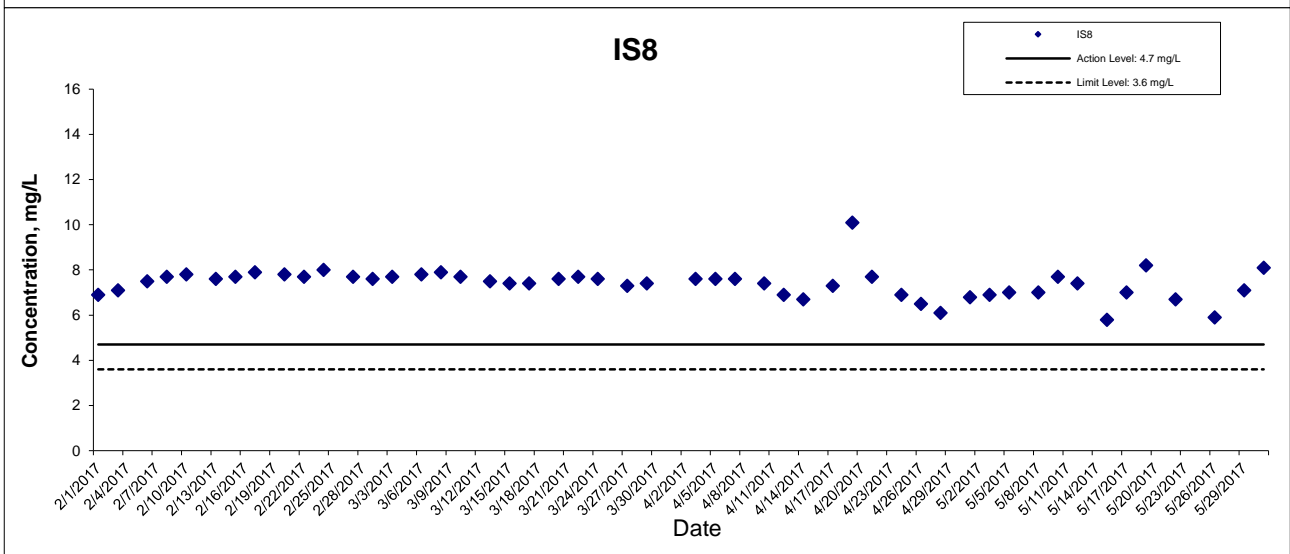
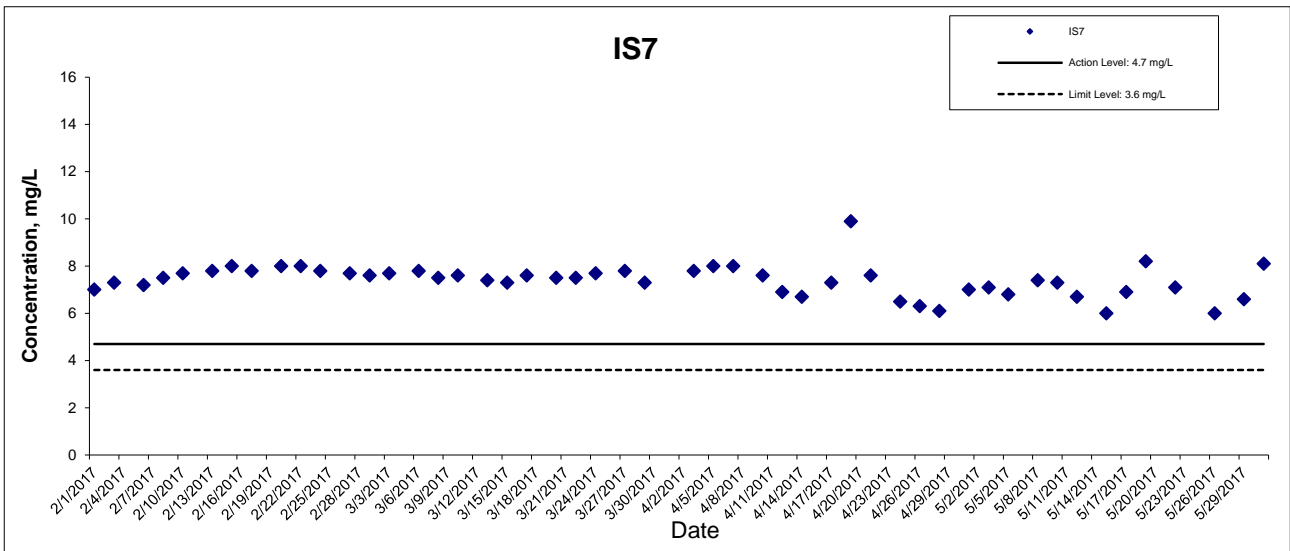
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

### Dissolved Oxygen (Bottom) at Mid-Ebb Tide



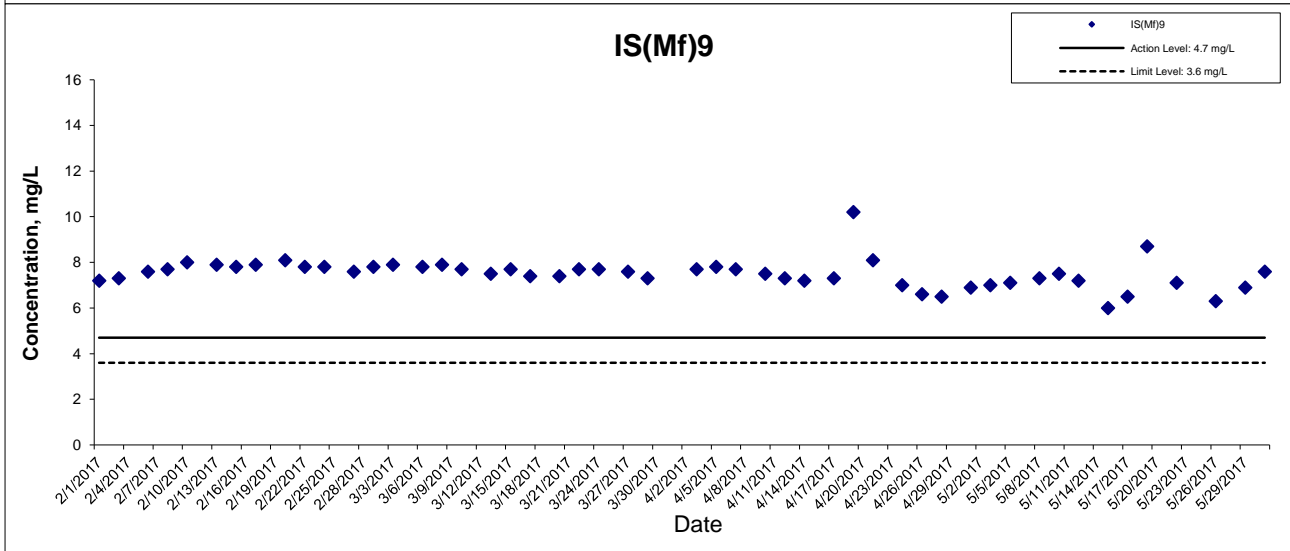
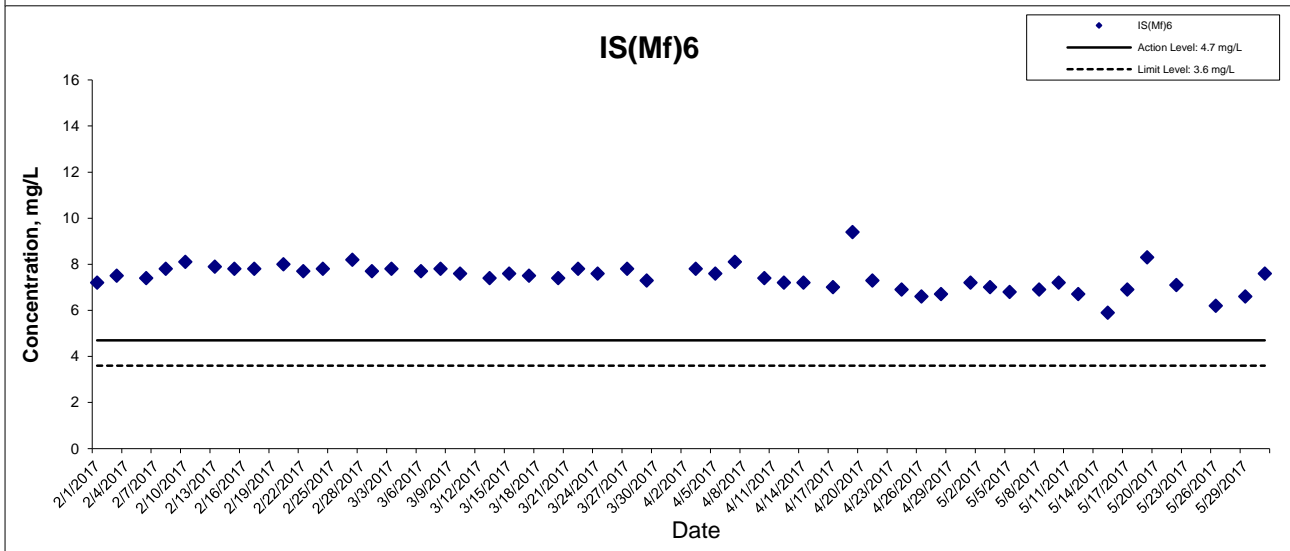
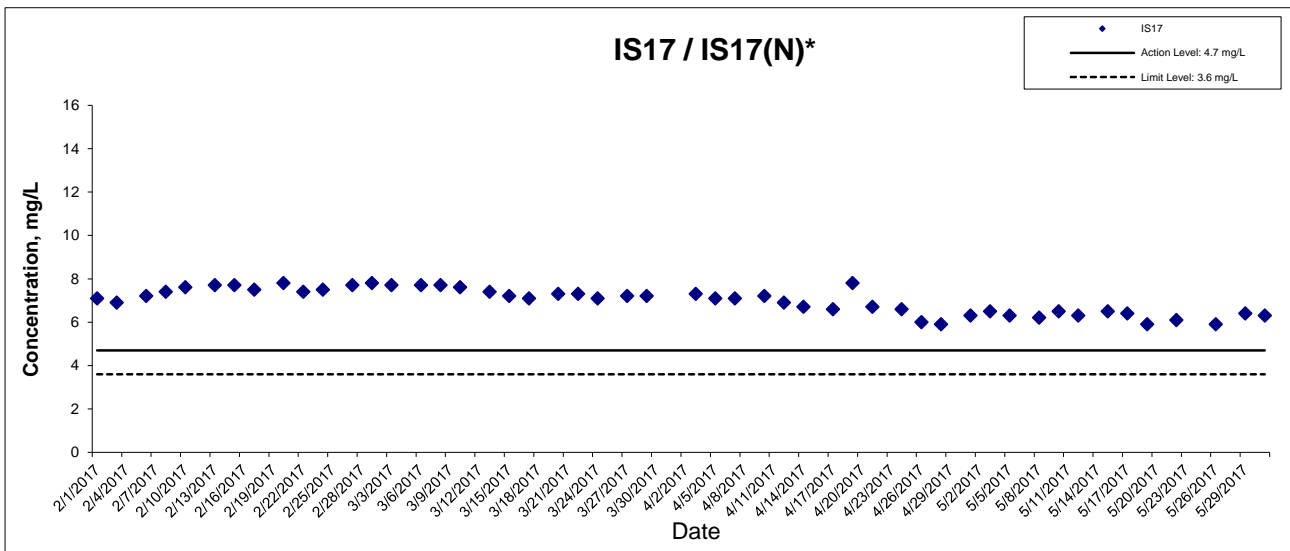
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

### Dissolved Oxygen (Bottom) at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

### Dissolved Oxygen (Bottom) at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

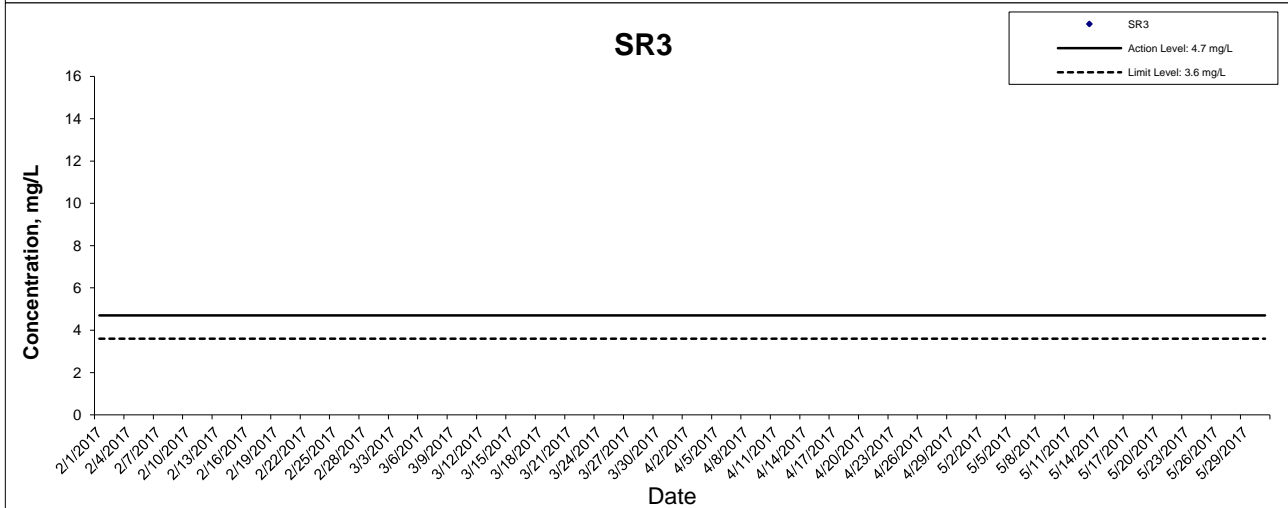
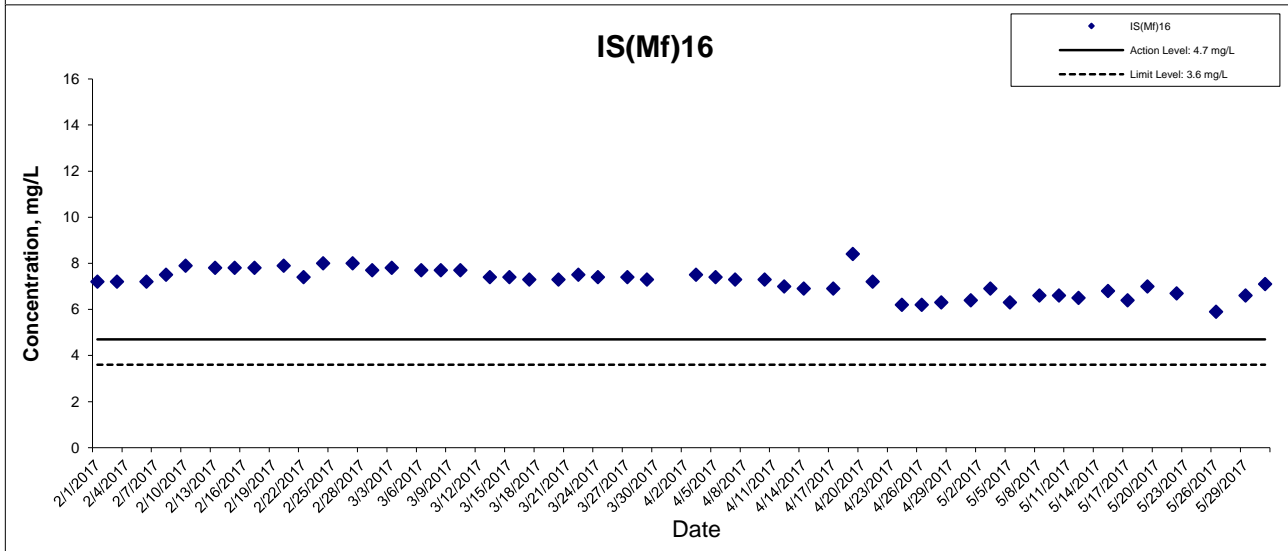
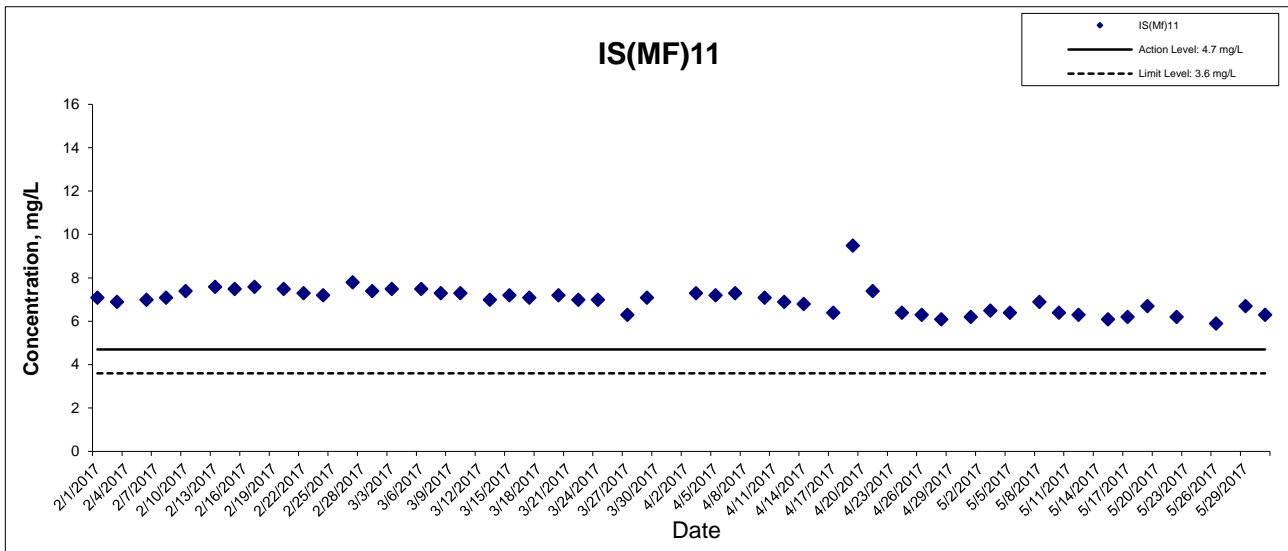
HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results





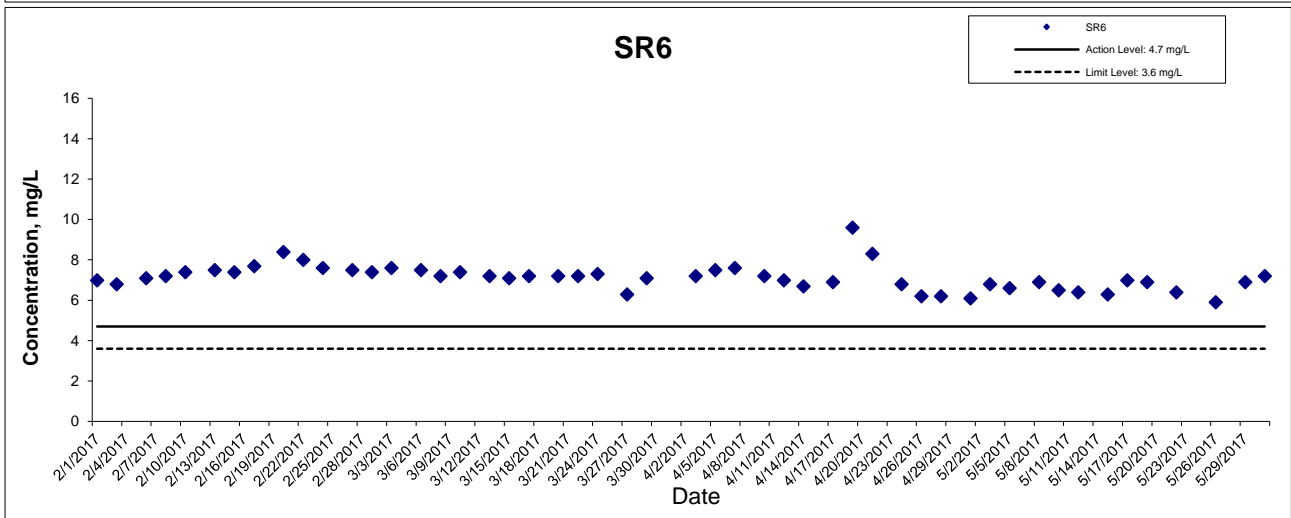
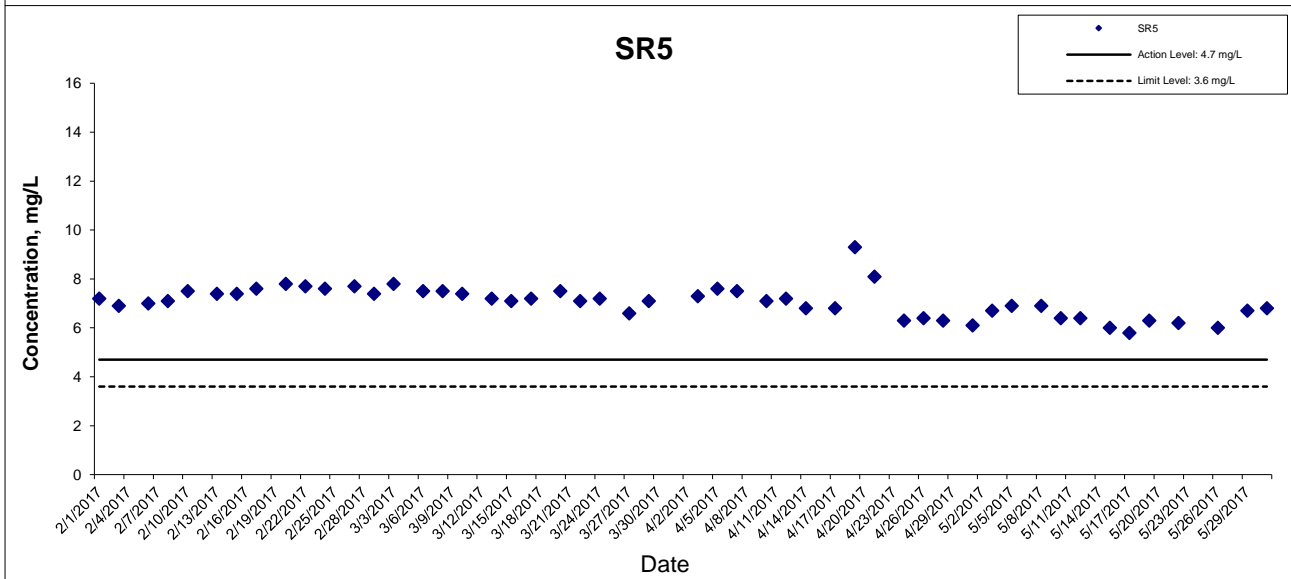
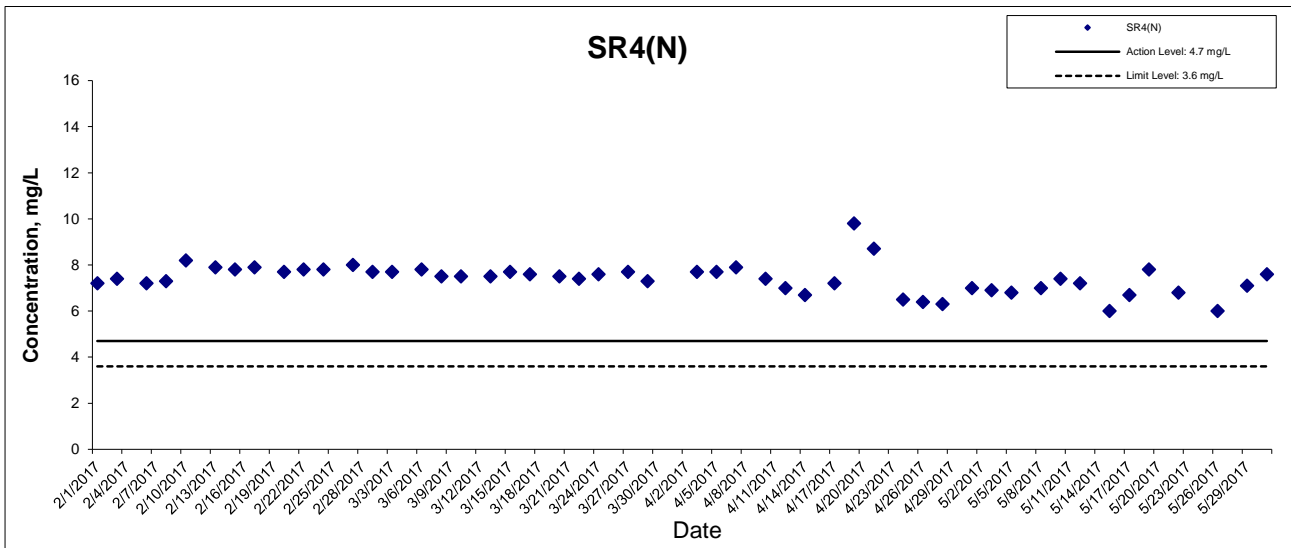
## Dissolved Oxygen (Bottom) at Mid-Ebb Tide



As the measured water depths were less than 3 m during all monitoring days, water samples are collected at mid-depth only .

This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

### Dissolved Oxygen (Bottom) at Mid-Ebb Tide



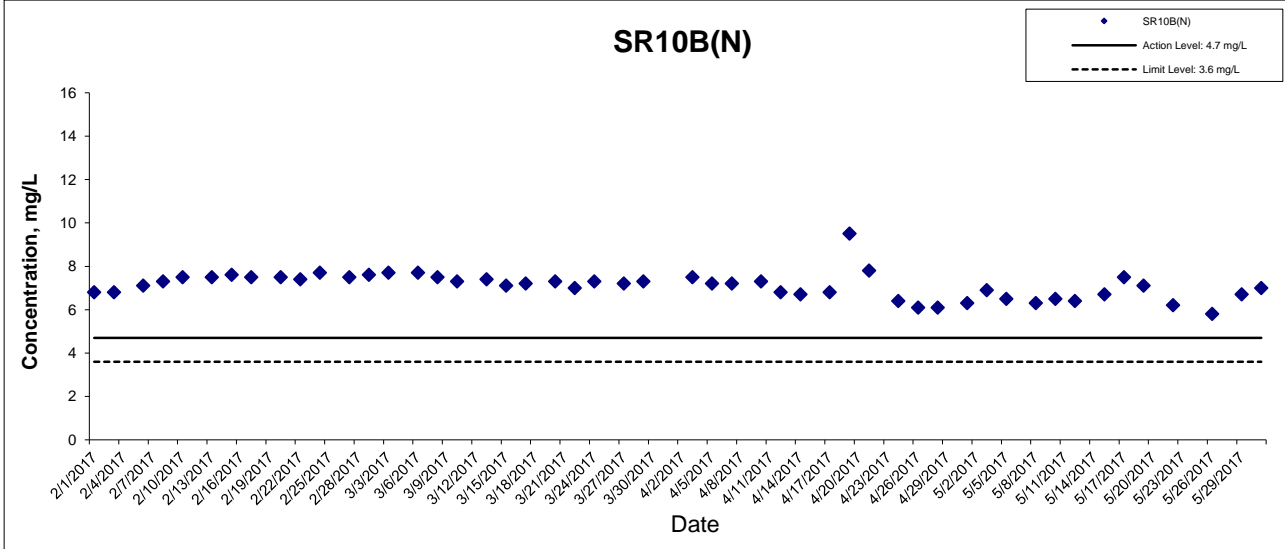
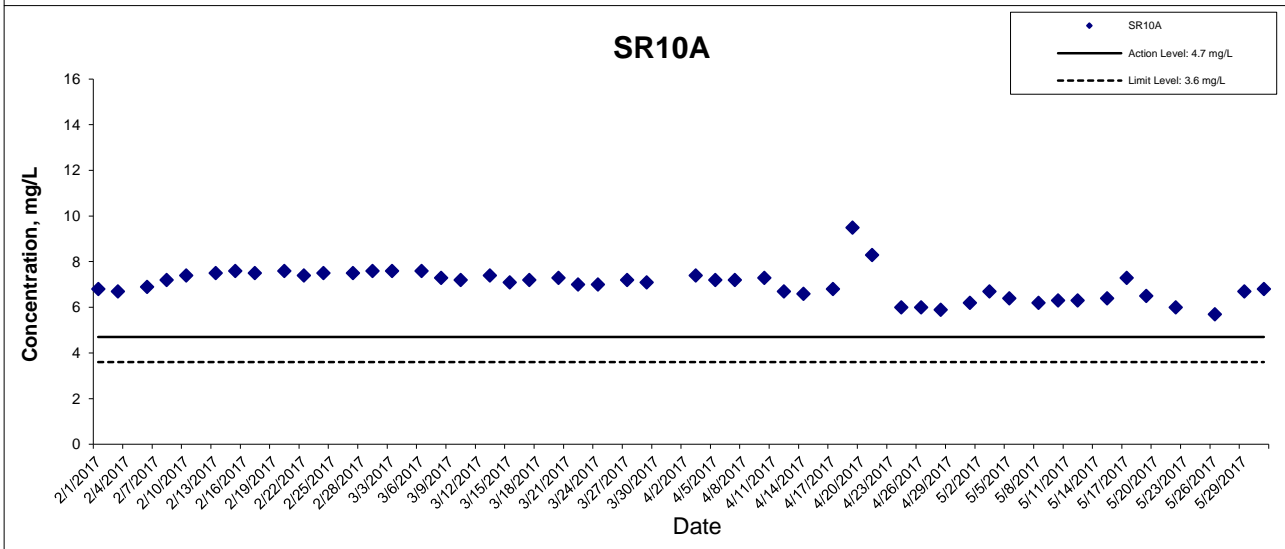
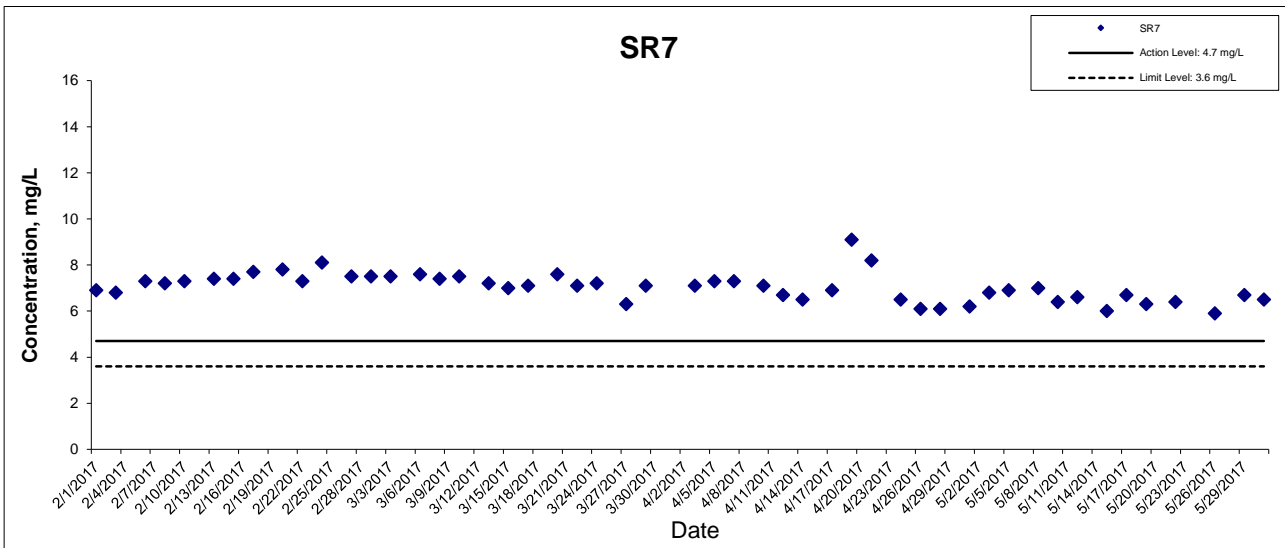
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results

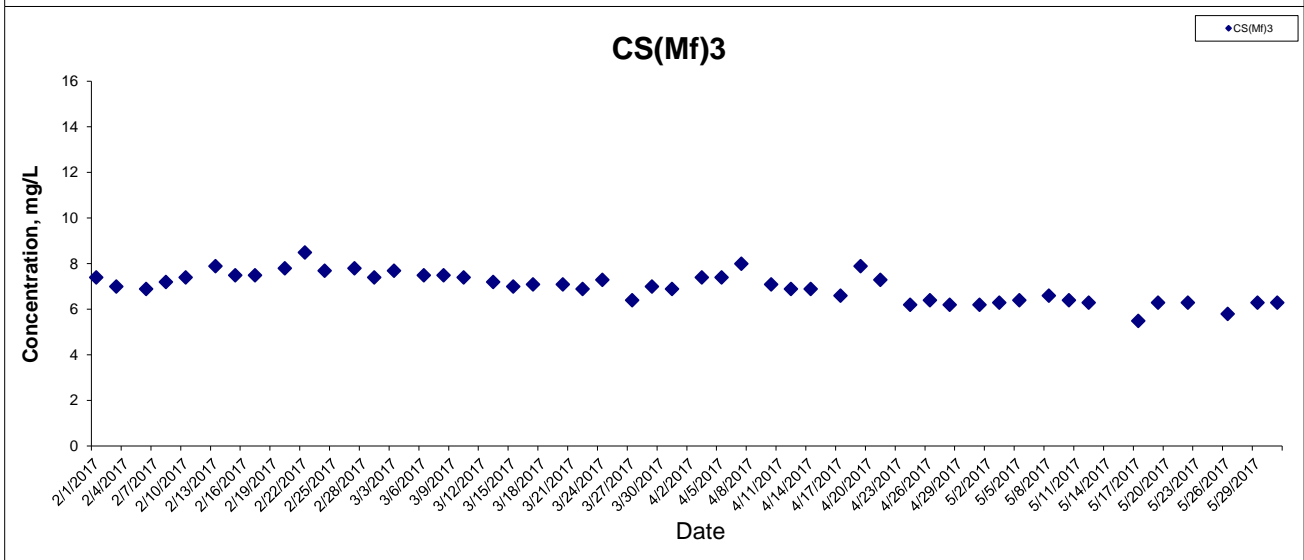
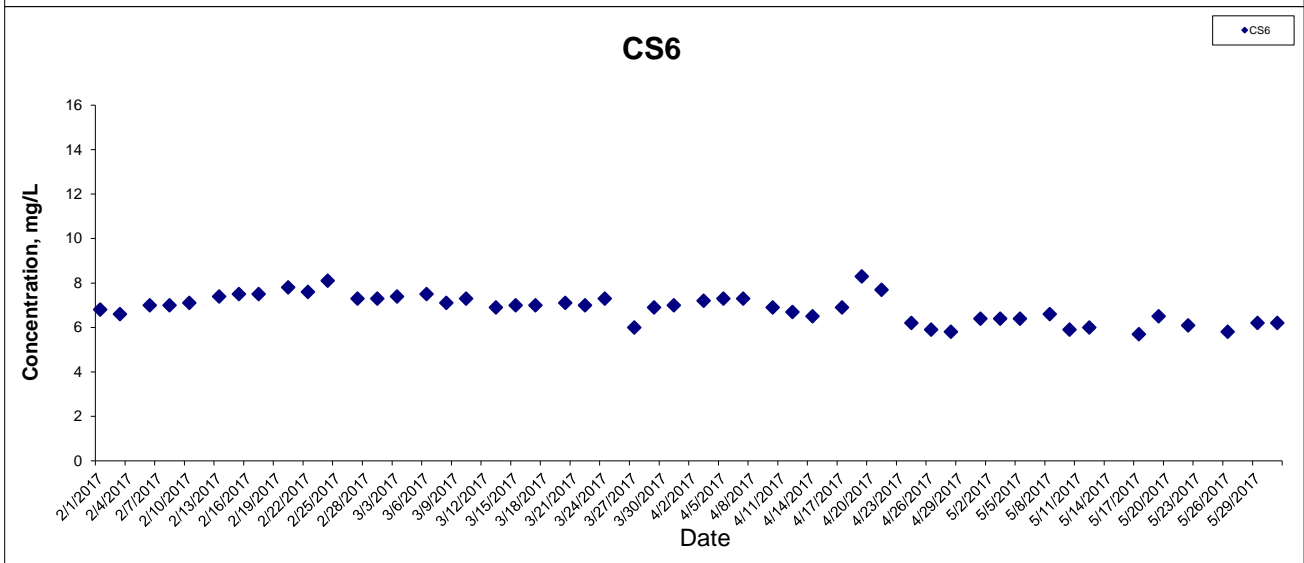
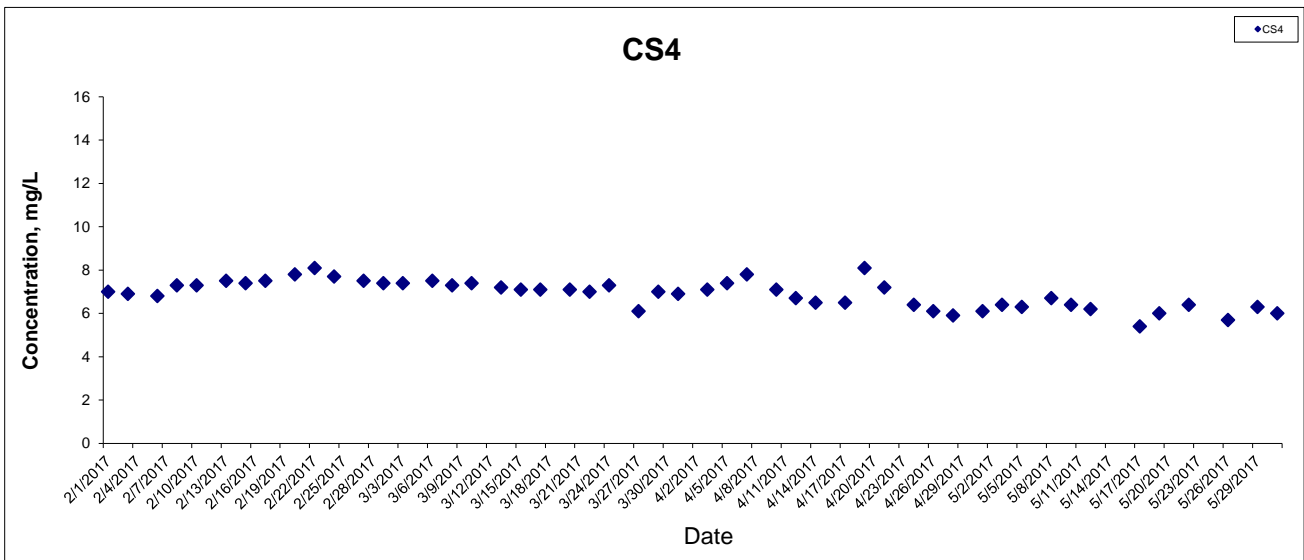


## Dissolved Oxygen (Bottom) at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Bottom) at Mid-Flood Tide



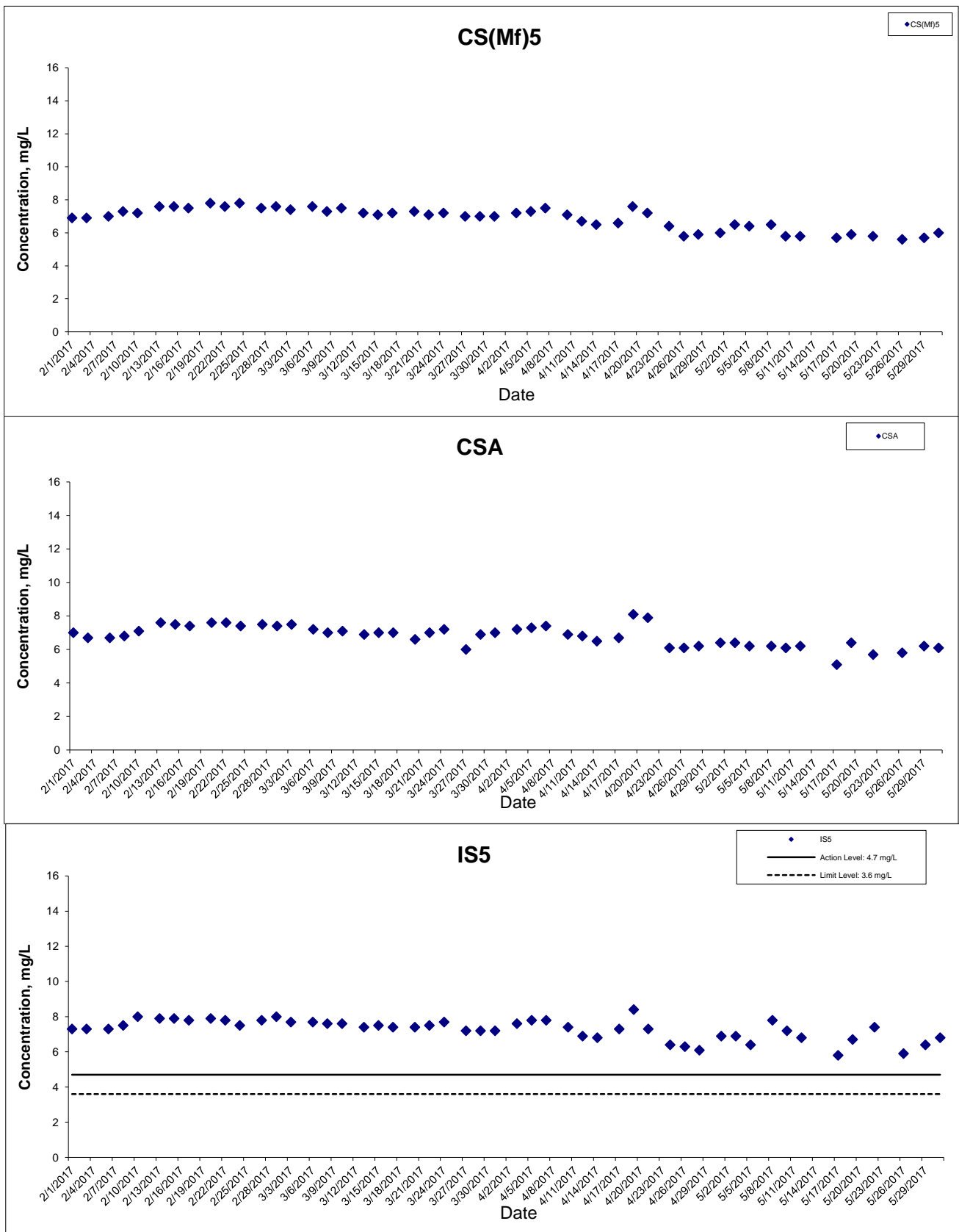
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

**HONG KONG - ZHUHAI - MACAO BRIDGE  
HONG KONG BOUNDARY CROSSING FACILITIES  
- RECLAMATION WORKS**

**Graphical Presentation of Impact Water Quality  
Monitoring Results**



## Dissolved Oxygen (Bottom) at Mid-Flood Tide



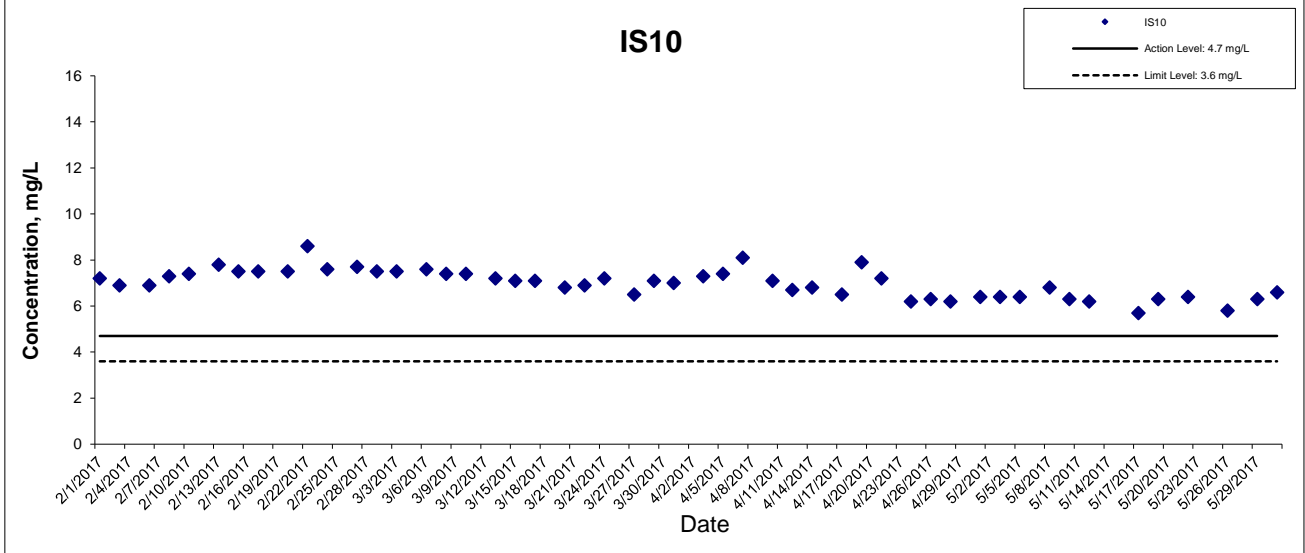
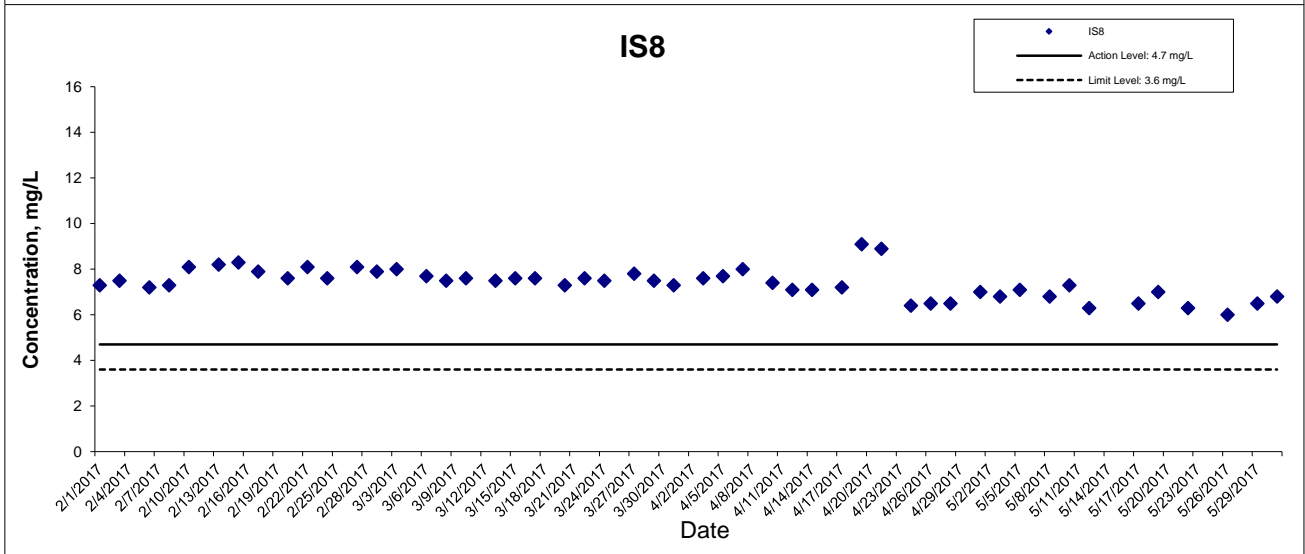
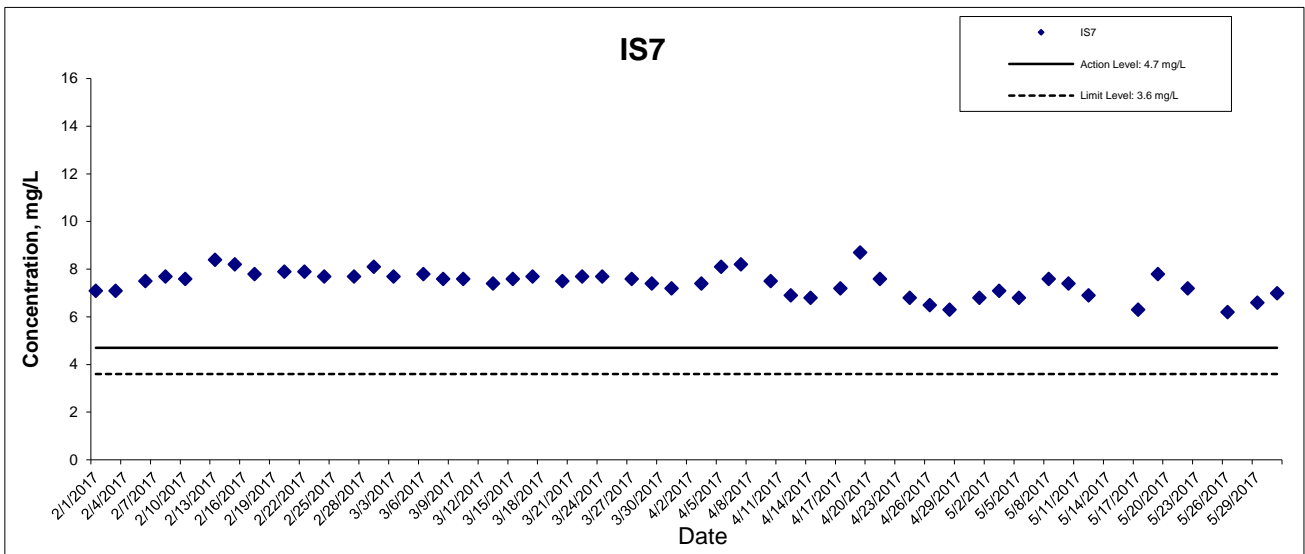
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

Graphical Presentation of Impact Water Quality  
 Monitoring Results

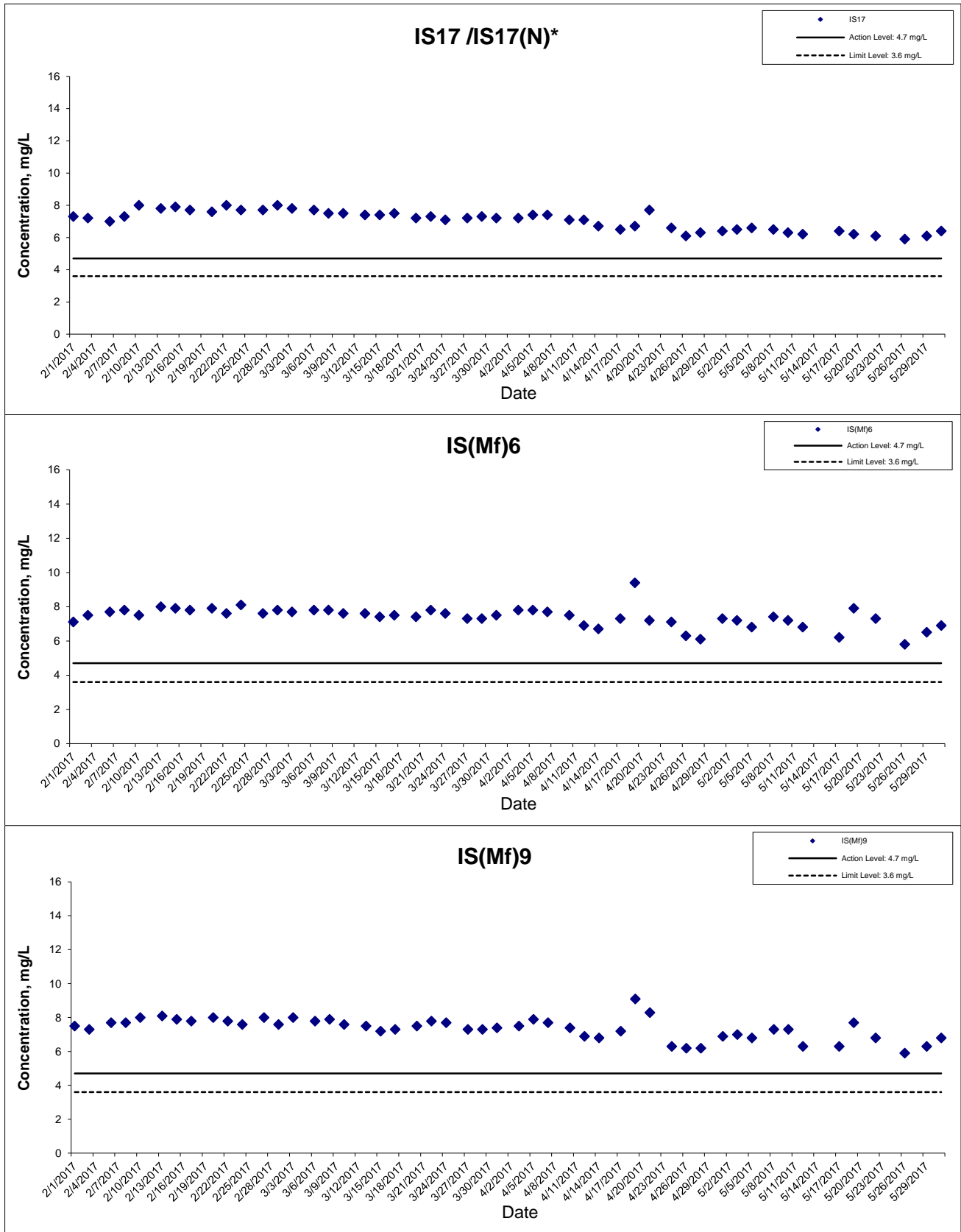


## Dissolved Oxygen (Bottom) at Mid-Flood Tide



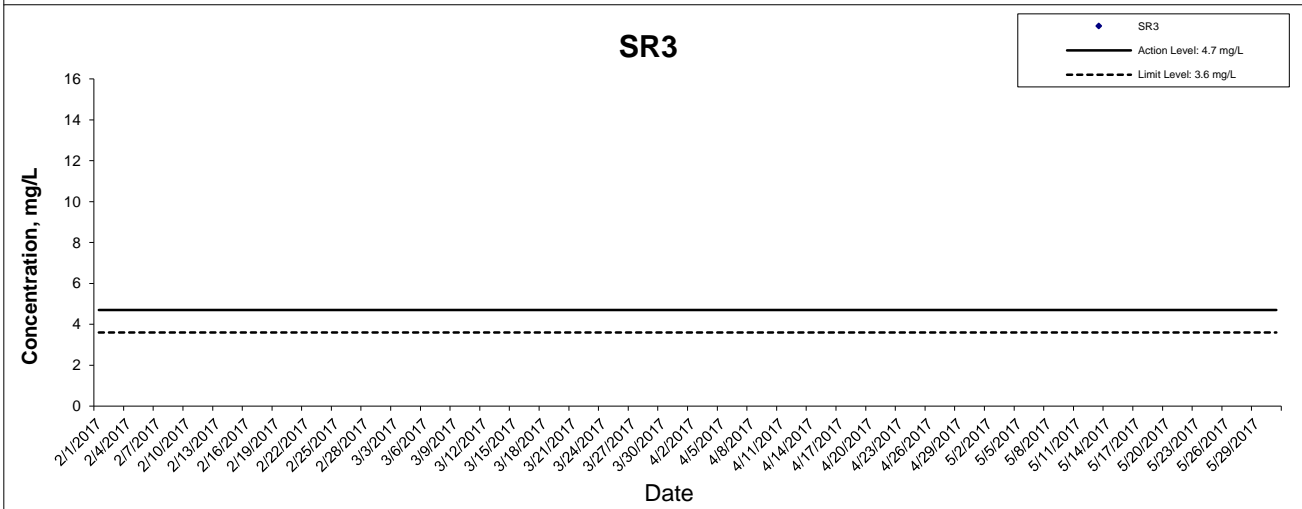
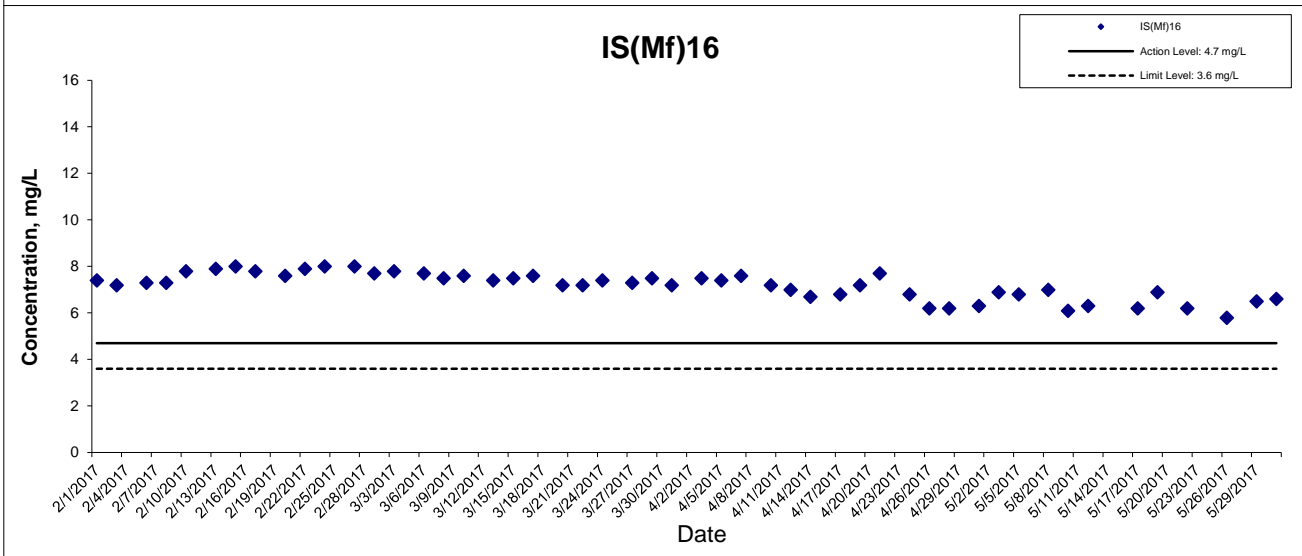
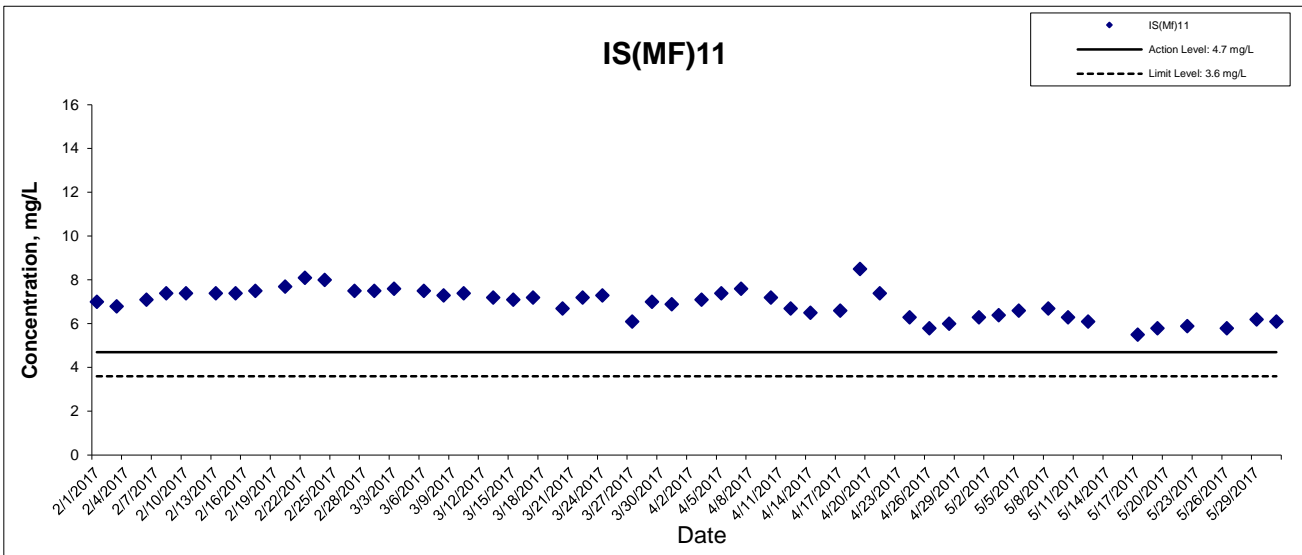
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Bottom) at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Bottom) at Mid-Flood Tide

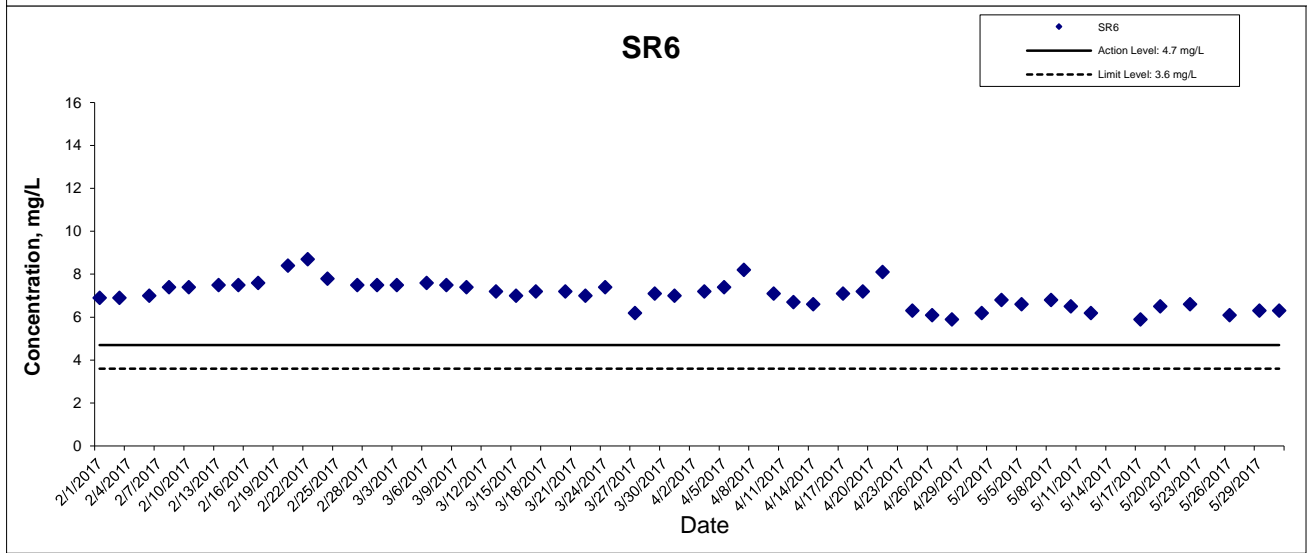
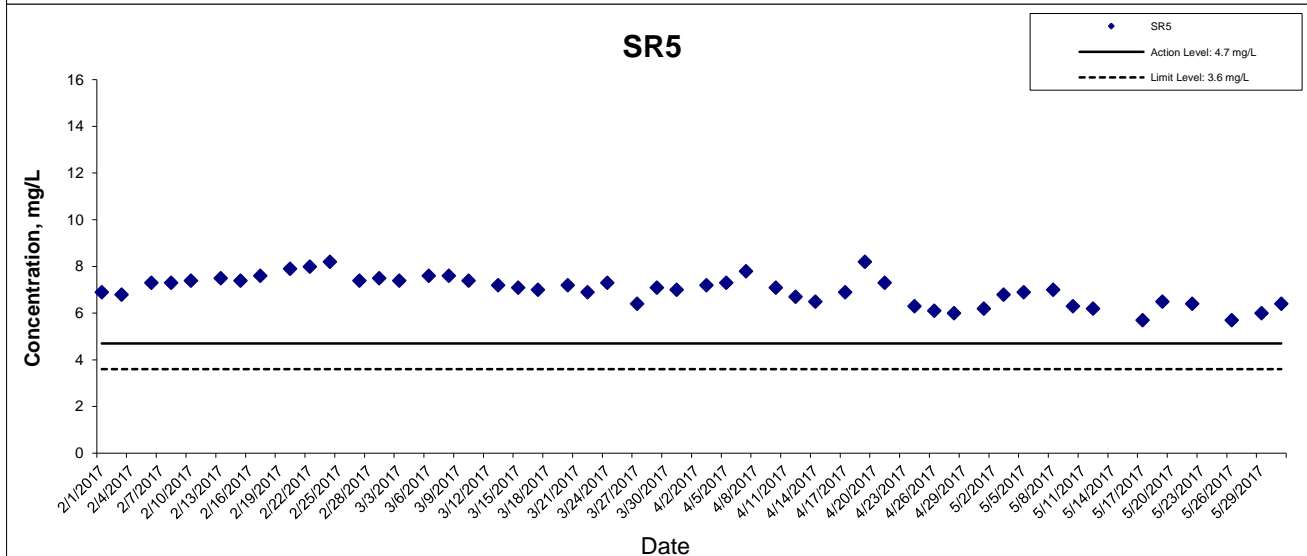
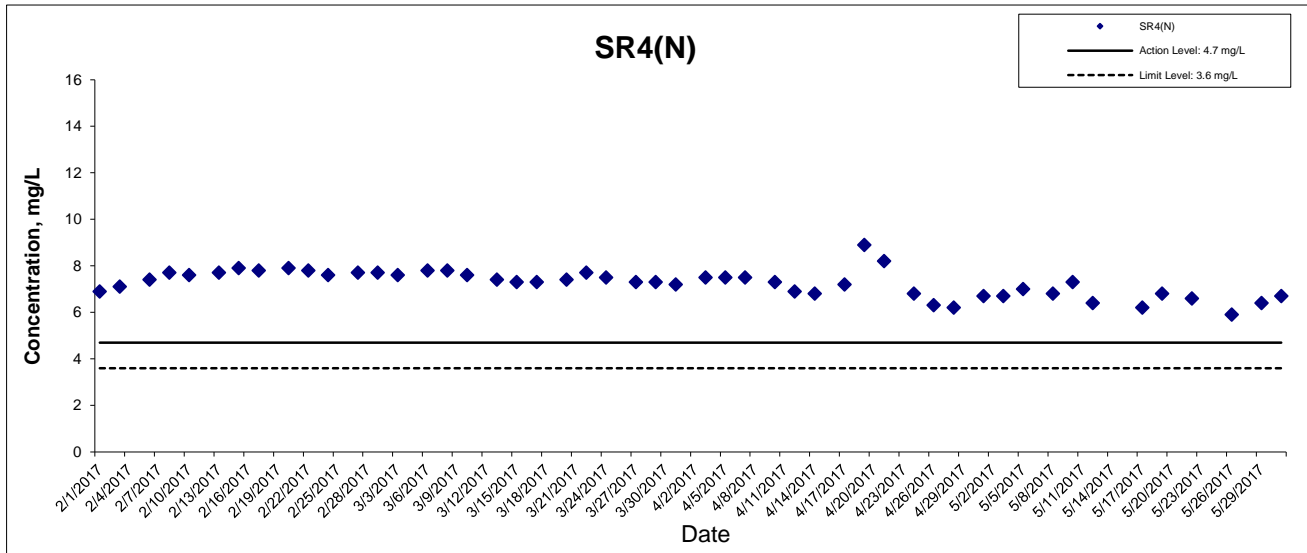


As the measured water depths were less than 3 m during all monitoring days, water samples are collected at mid-depth only .

This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

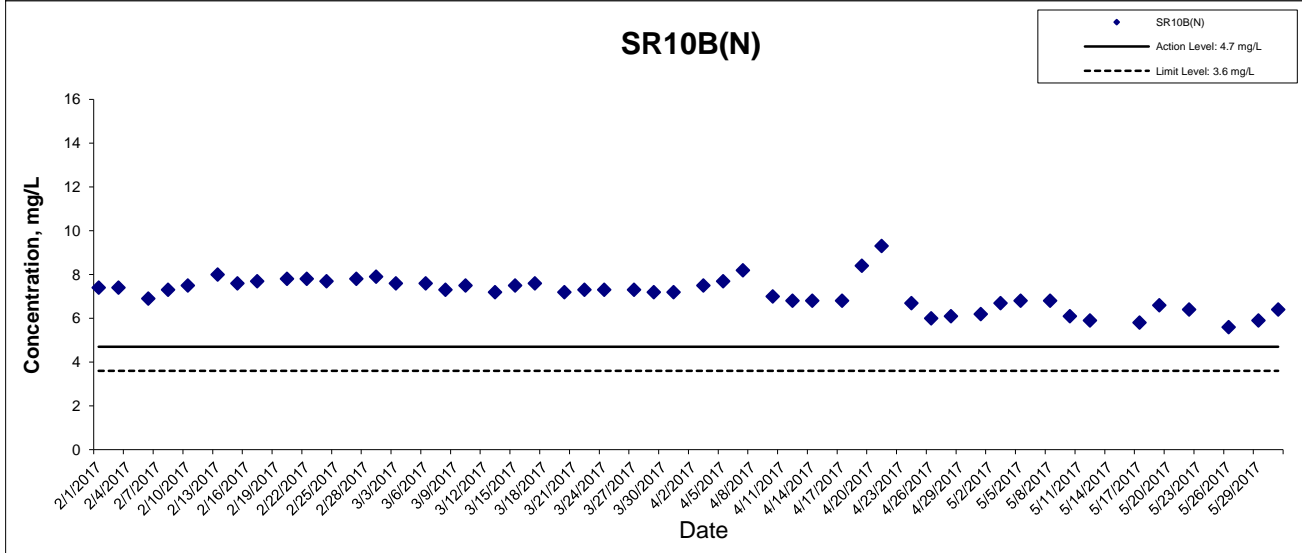
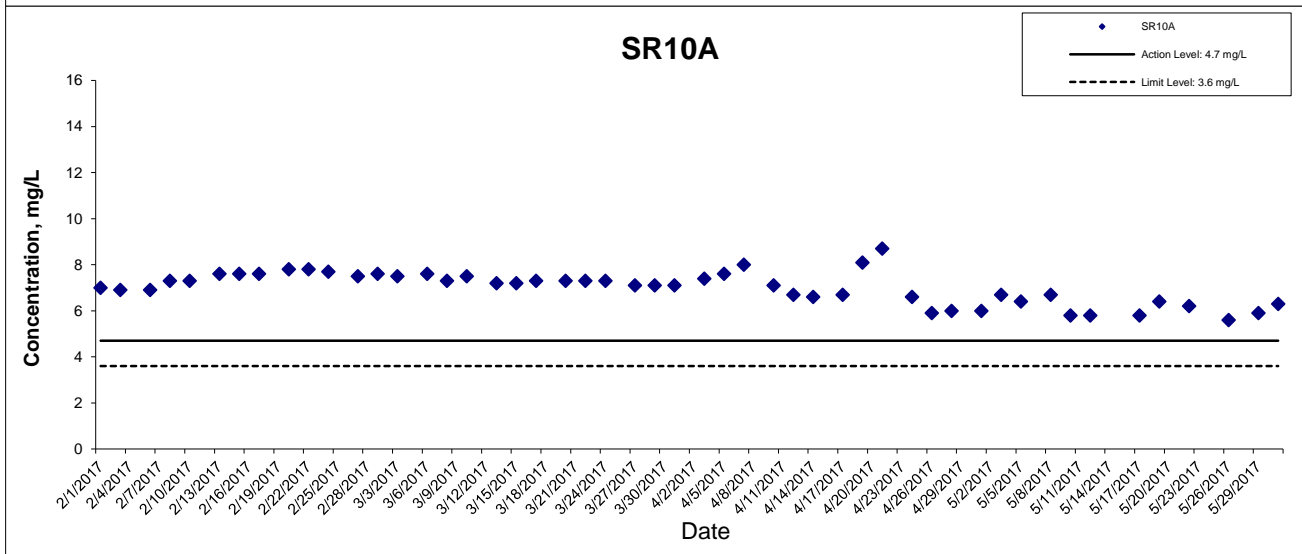
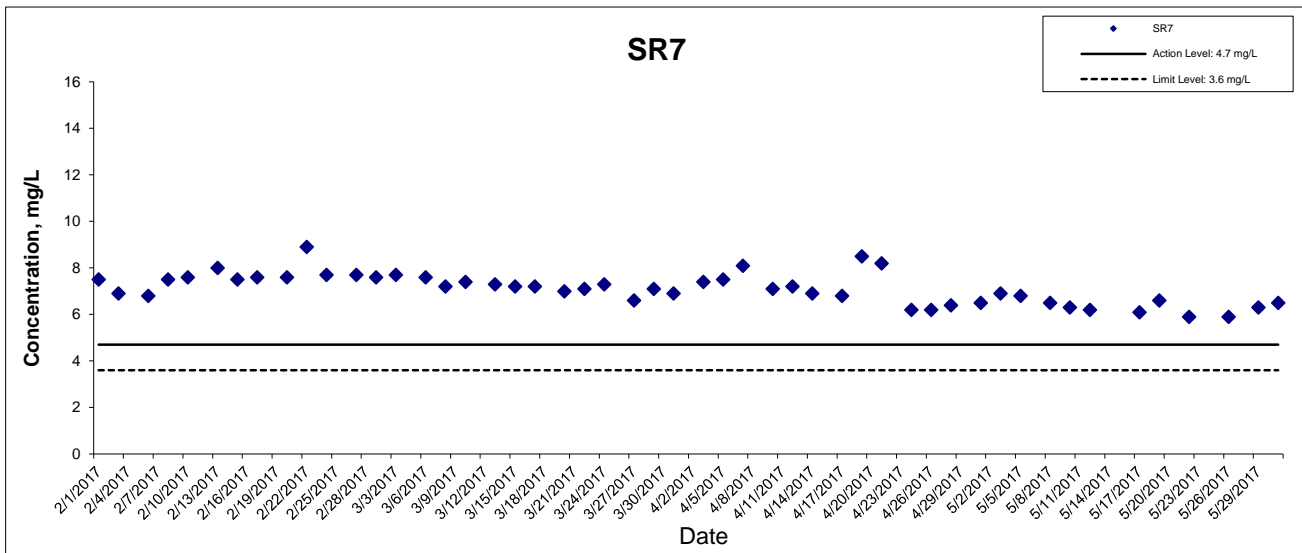


## Dissolved Oxygen (Bottom) at Mid-Flood Tide



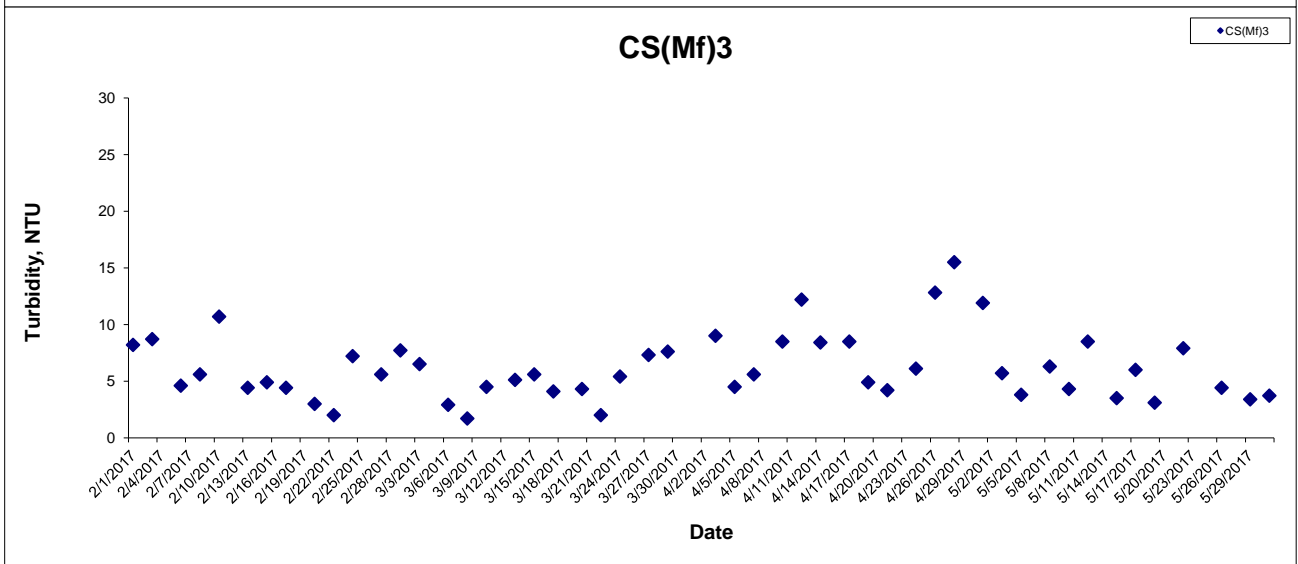
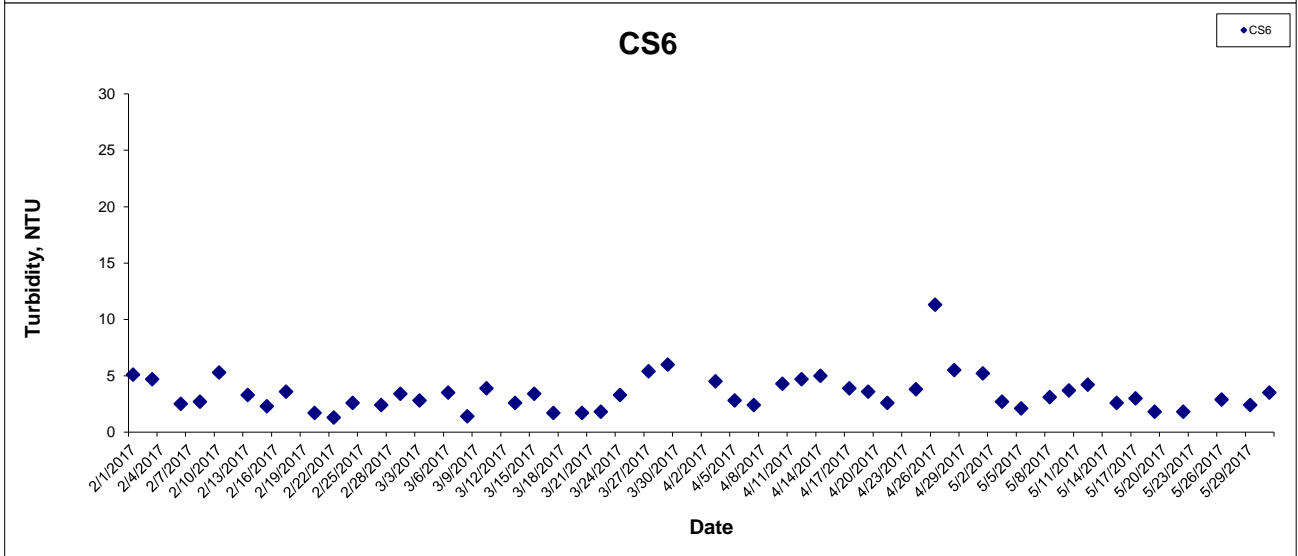
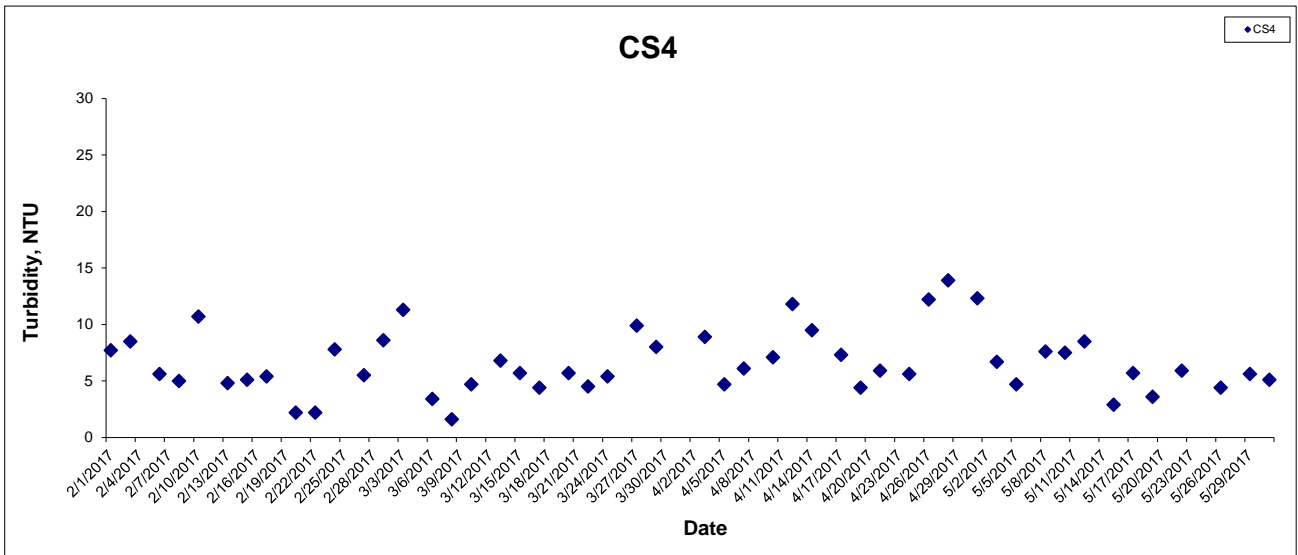
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Dissolved Oxygen (Bottom) at Mid-Flood Tide



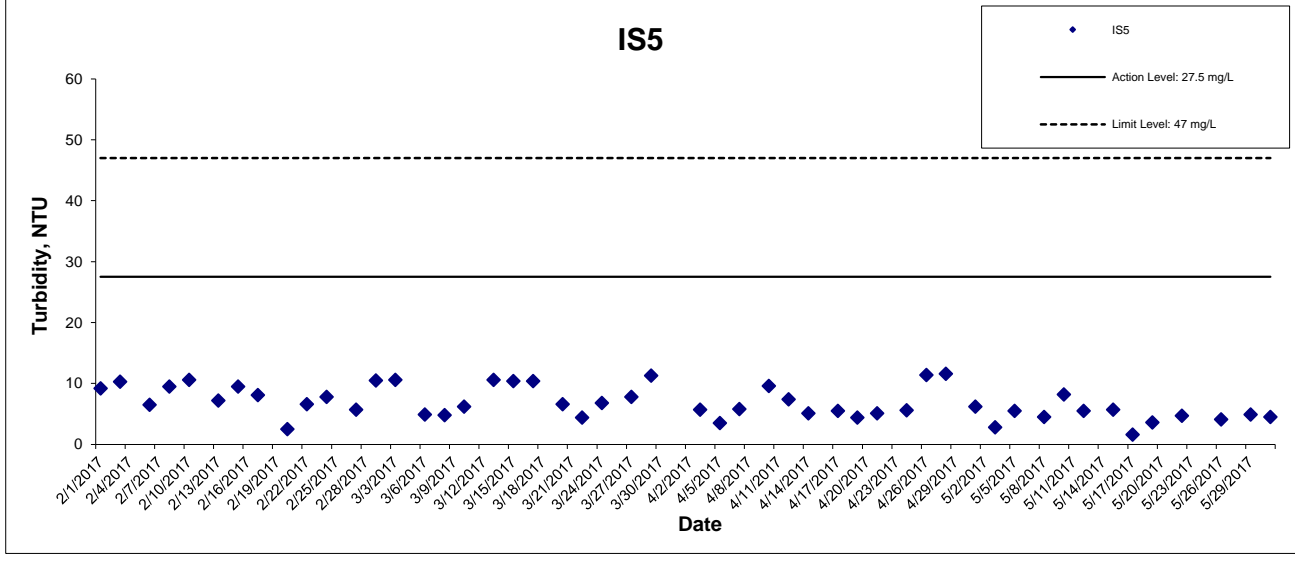
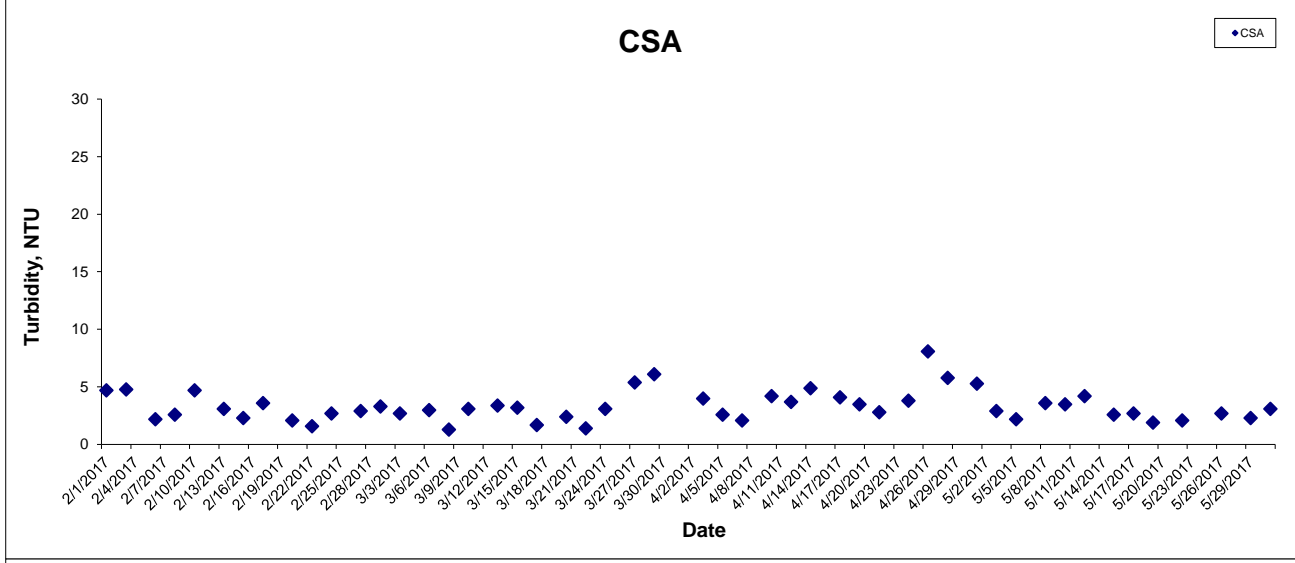
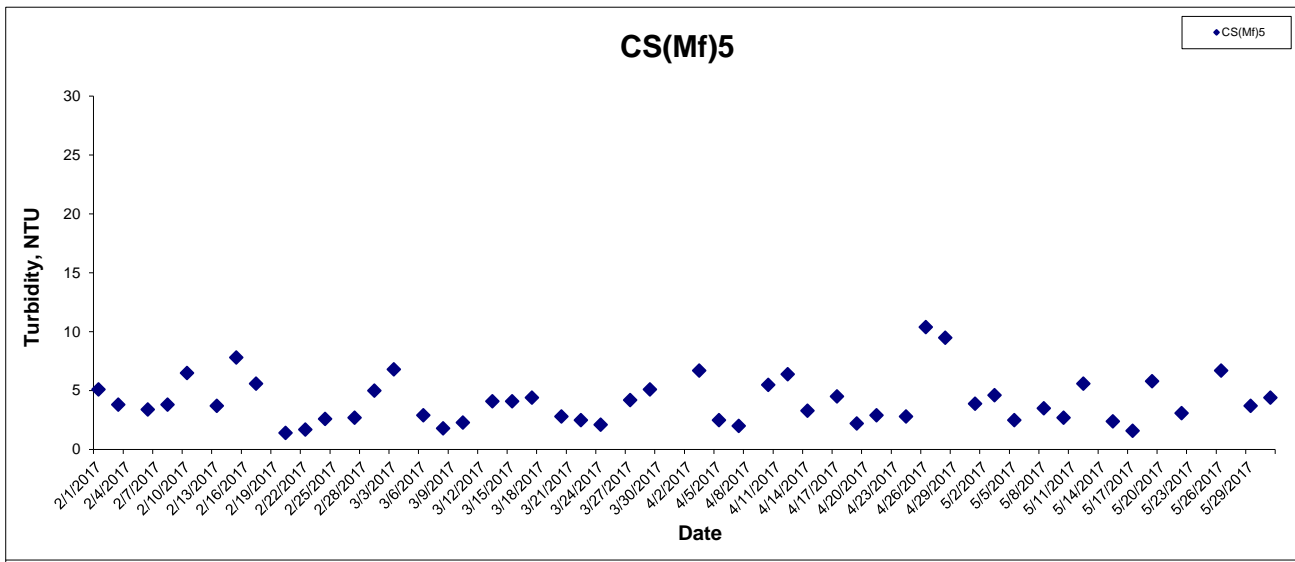
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

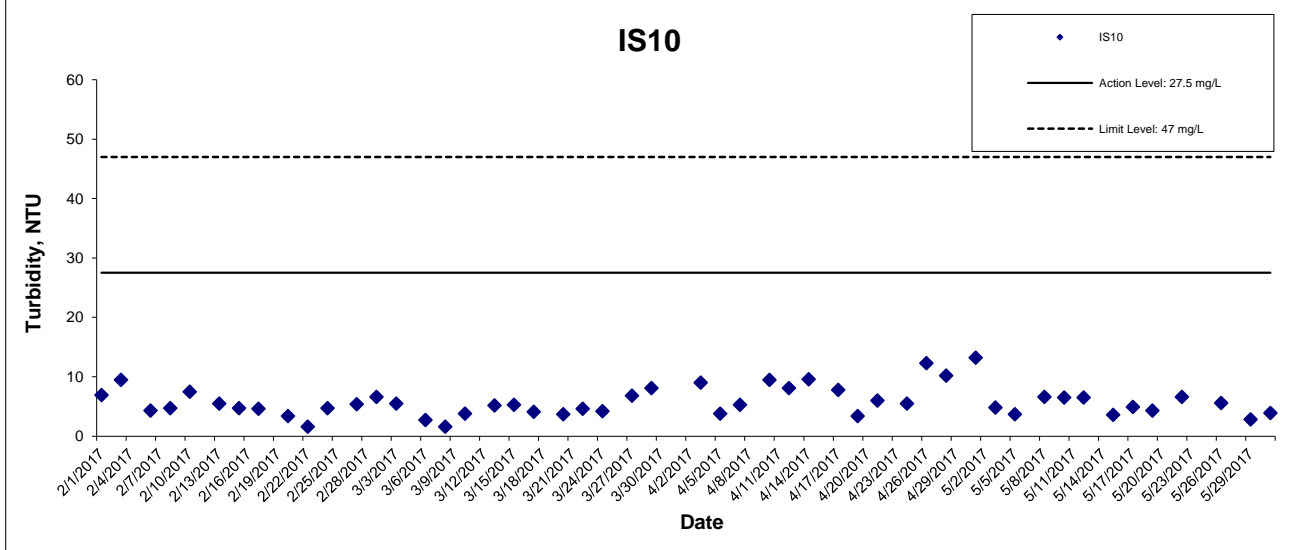
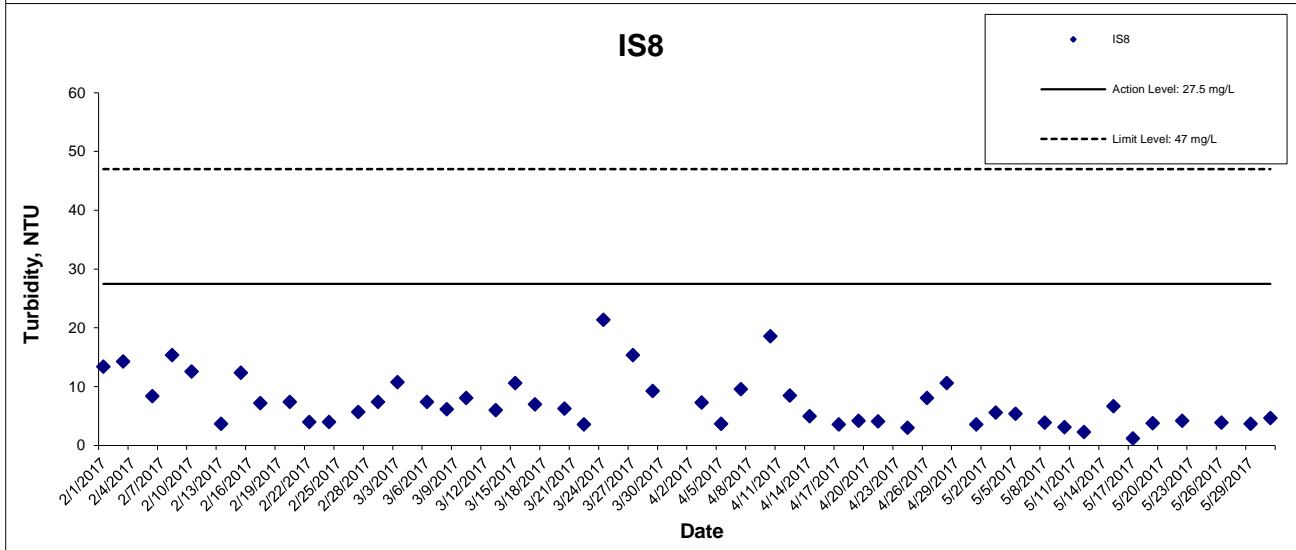
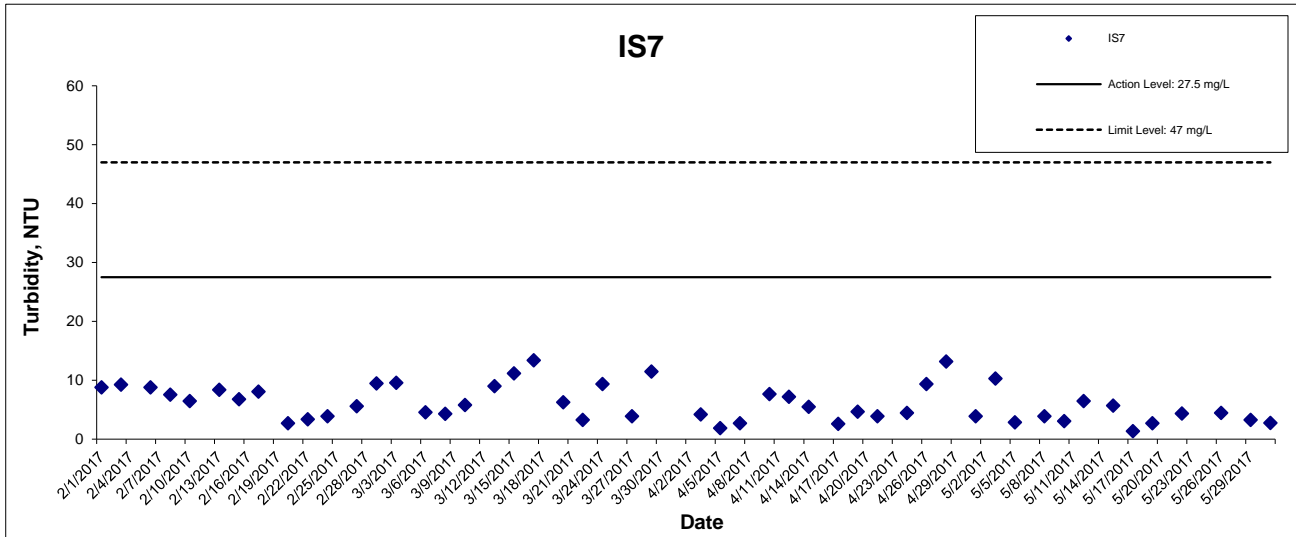
## Turbidity at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.



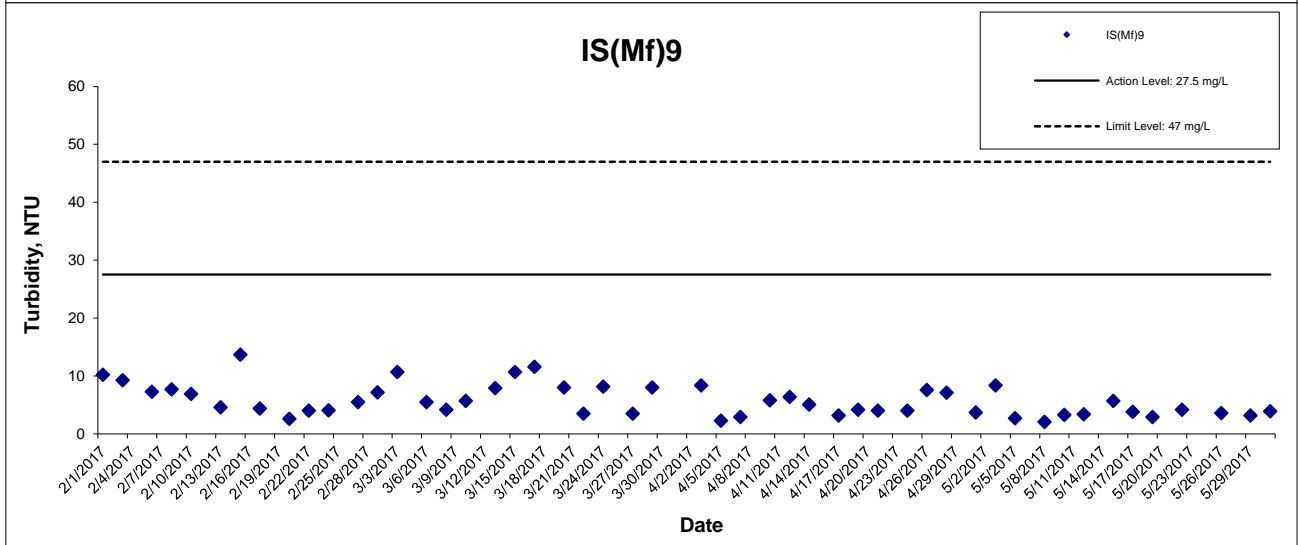
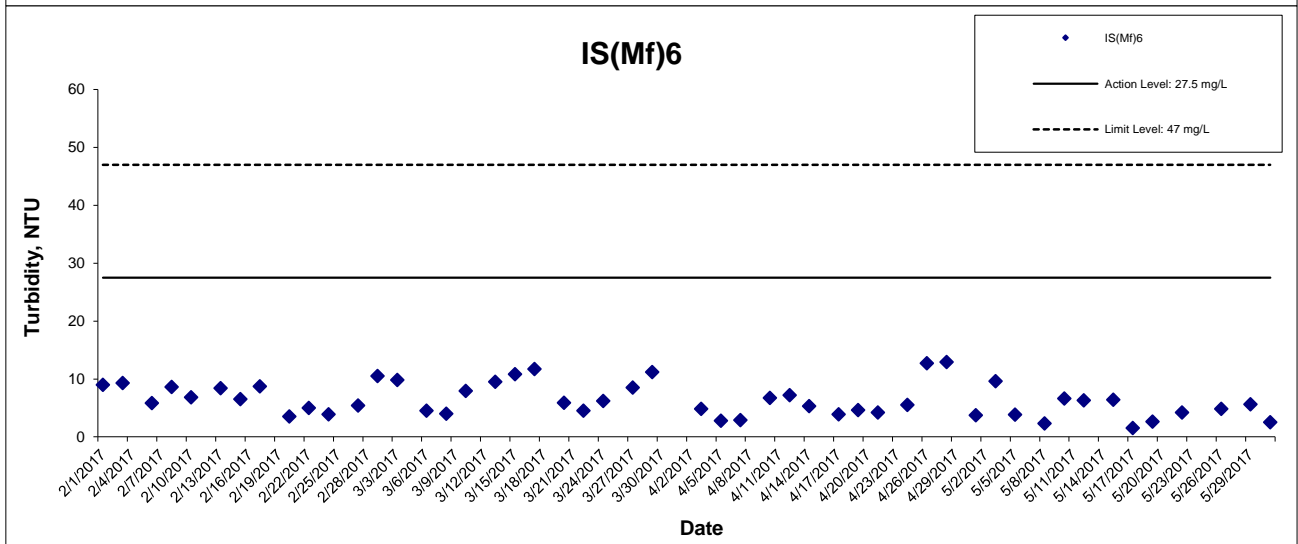
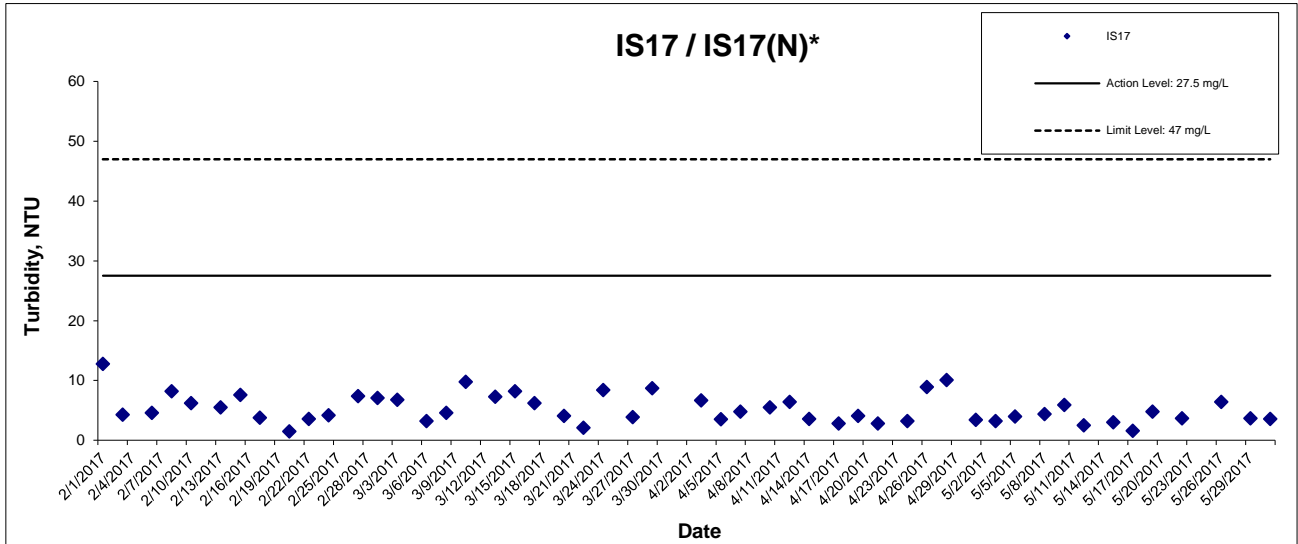
### Turbidity at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

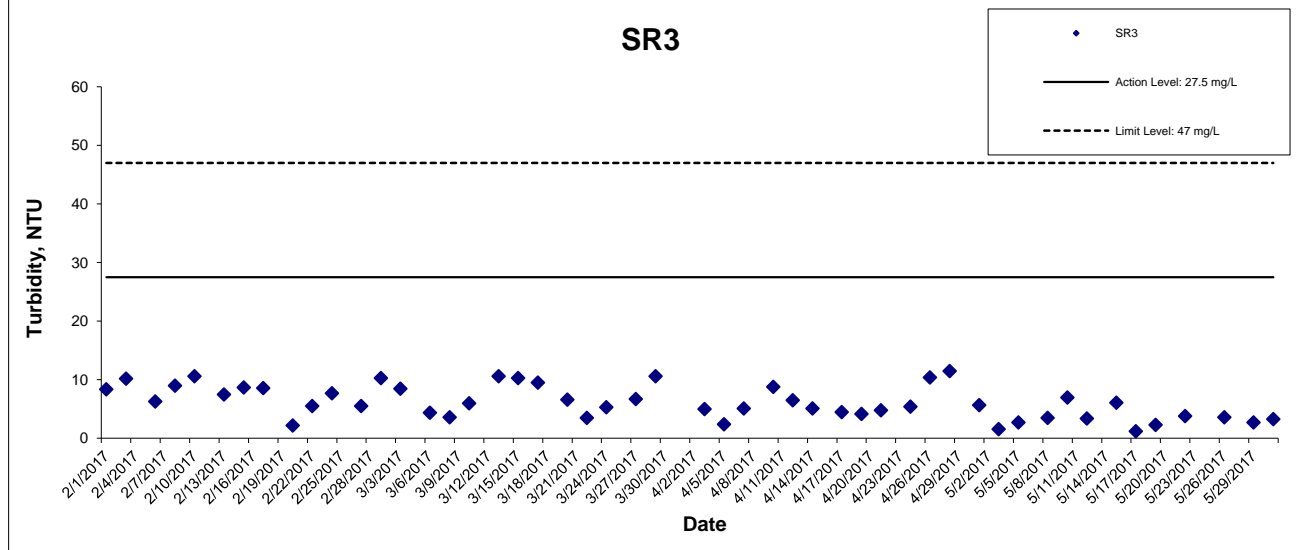
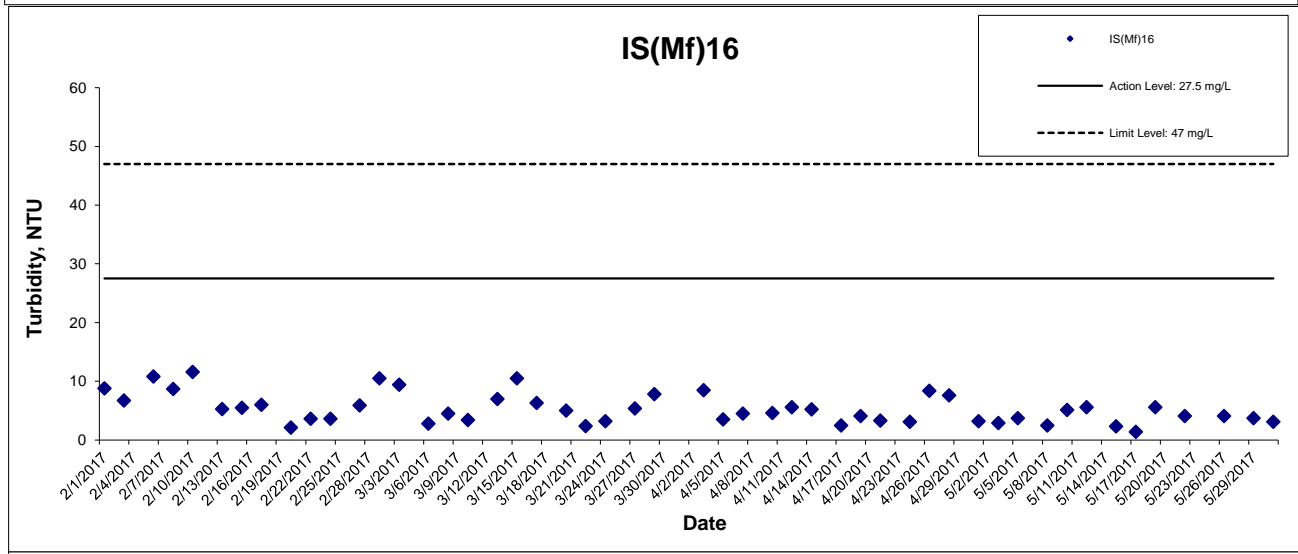
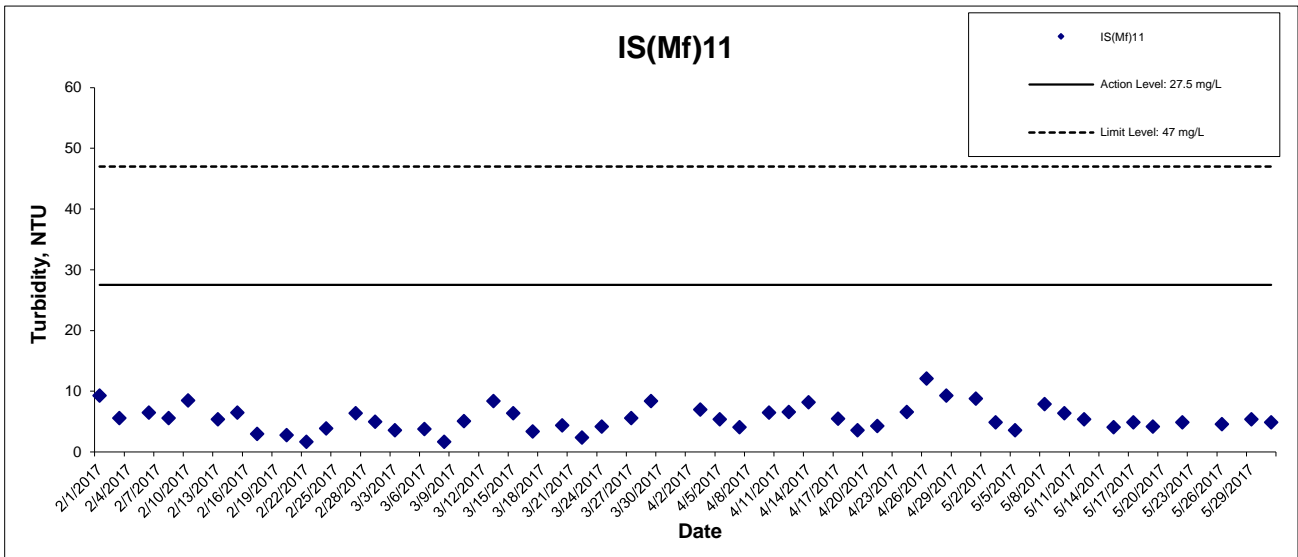


## Turbidity at Mid-Ebb Tide



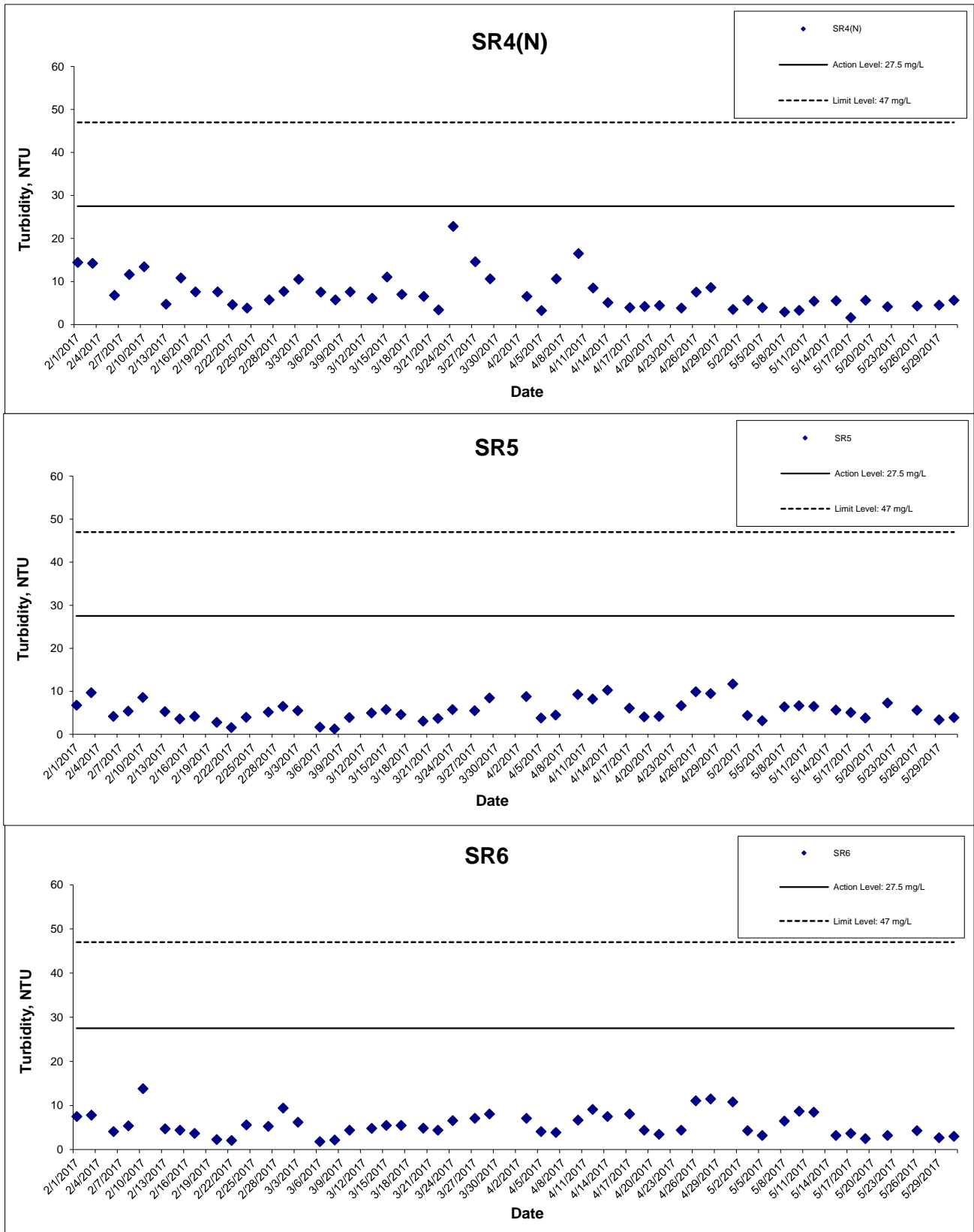
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

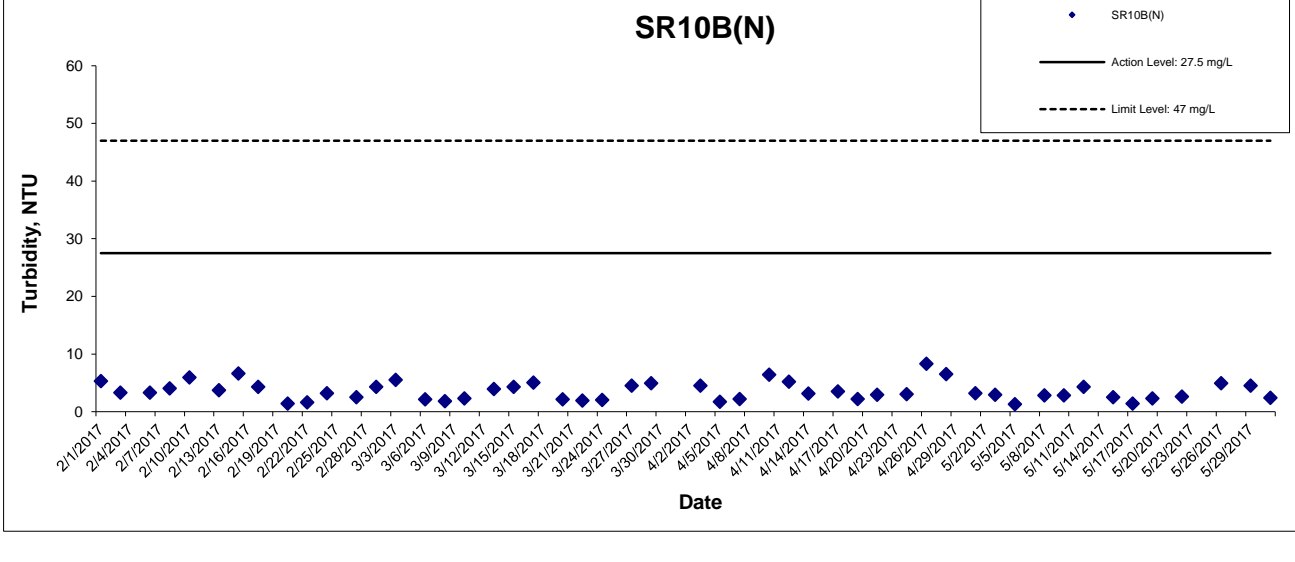
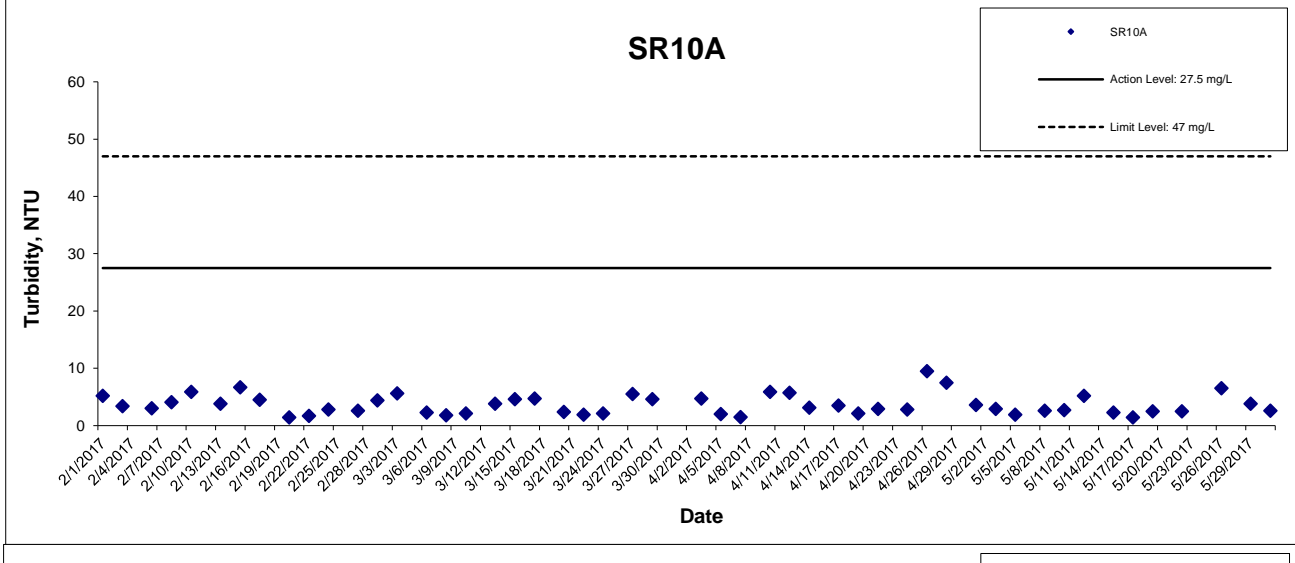
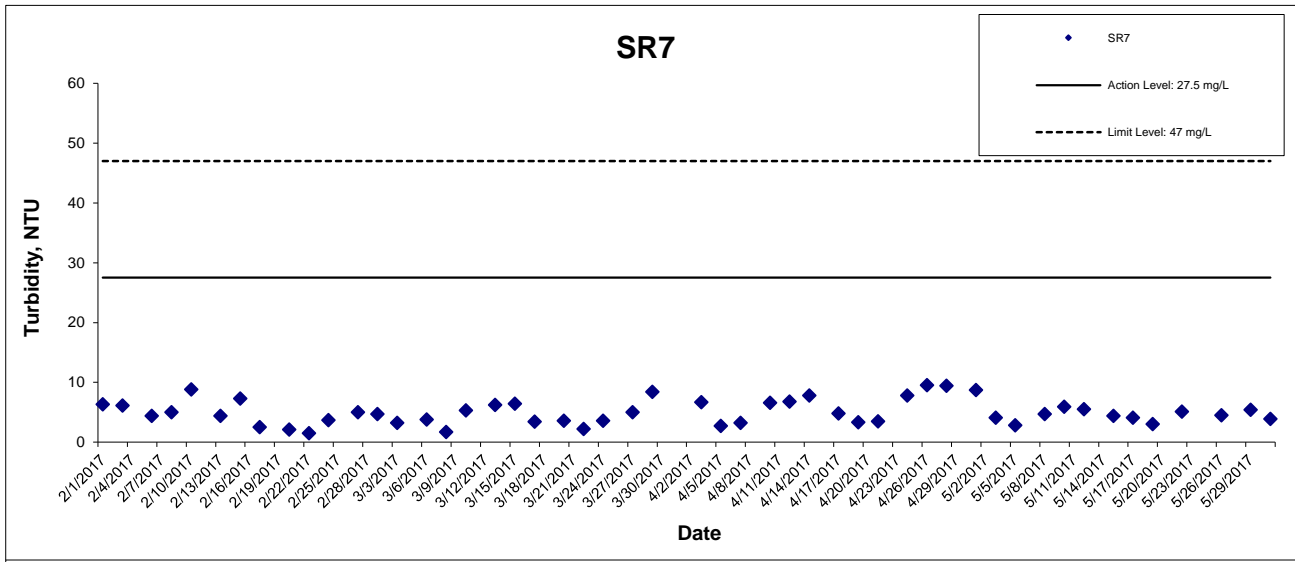
## Turbidity at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

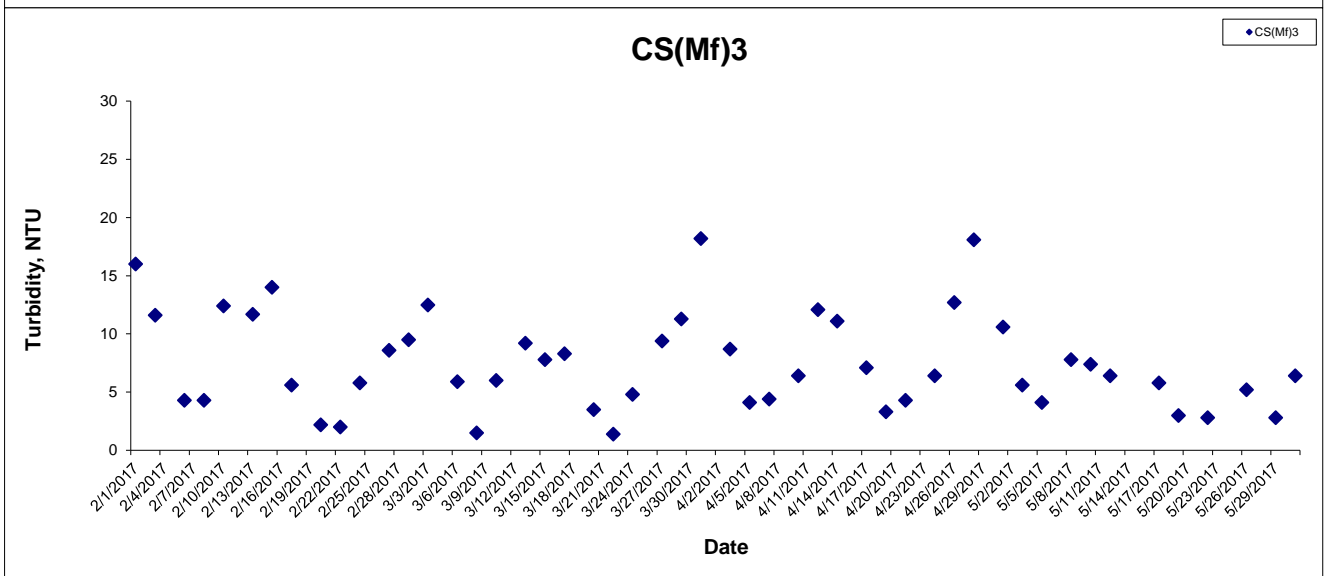
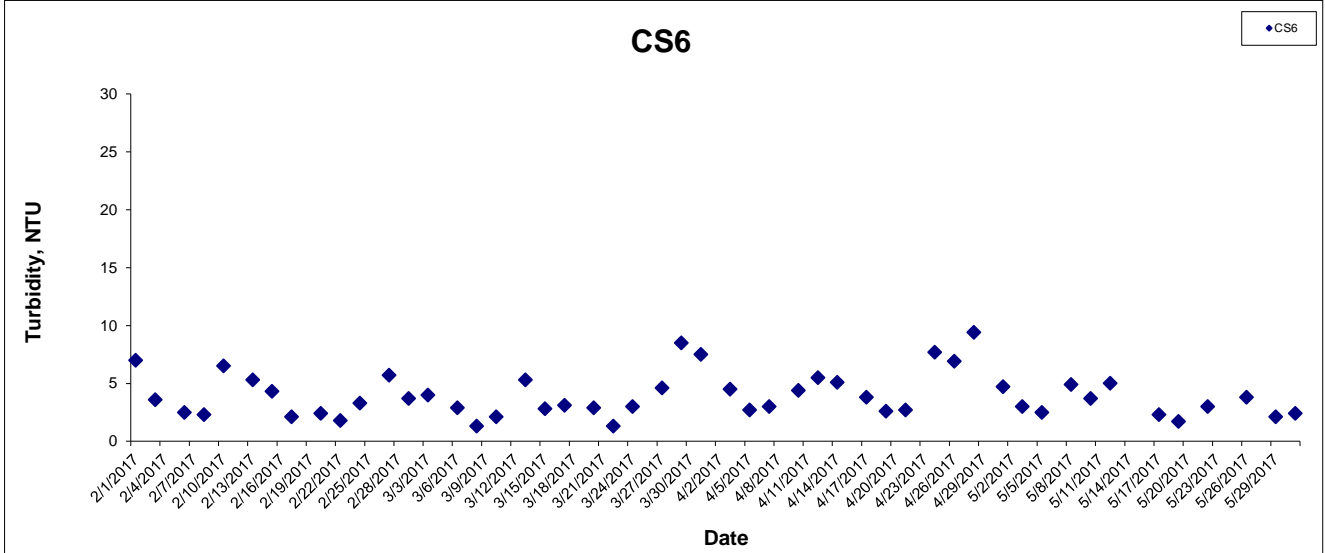
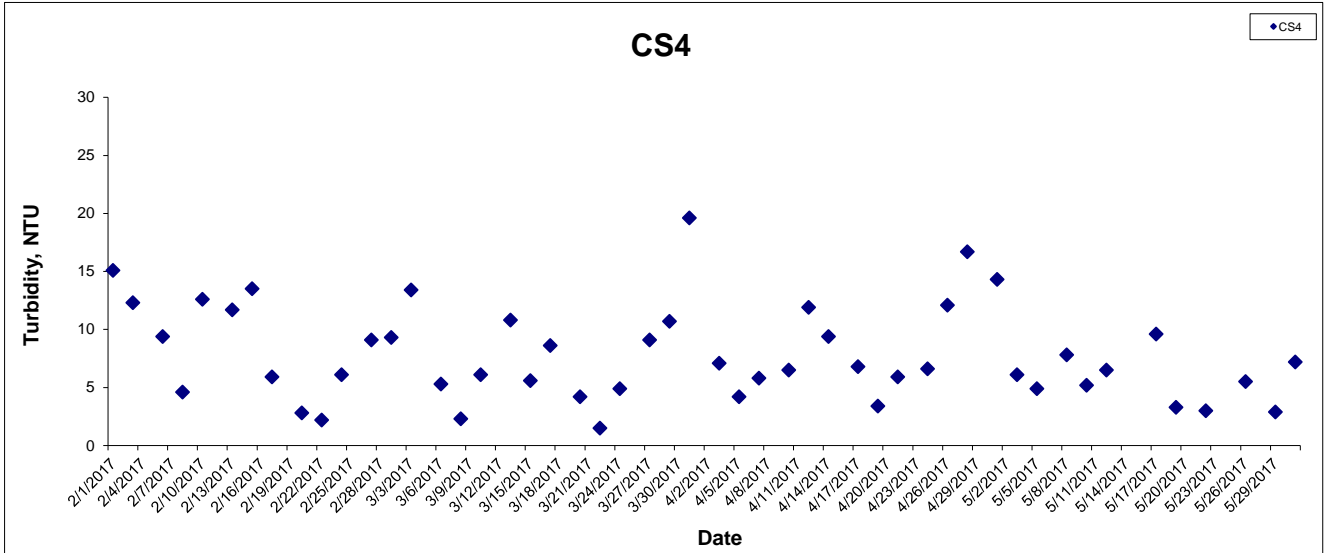


### Turbidity at Mid-Ebb Tide



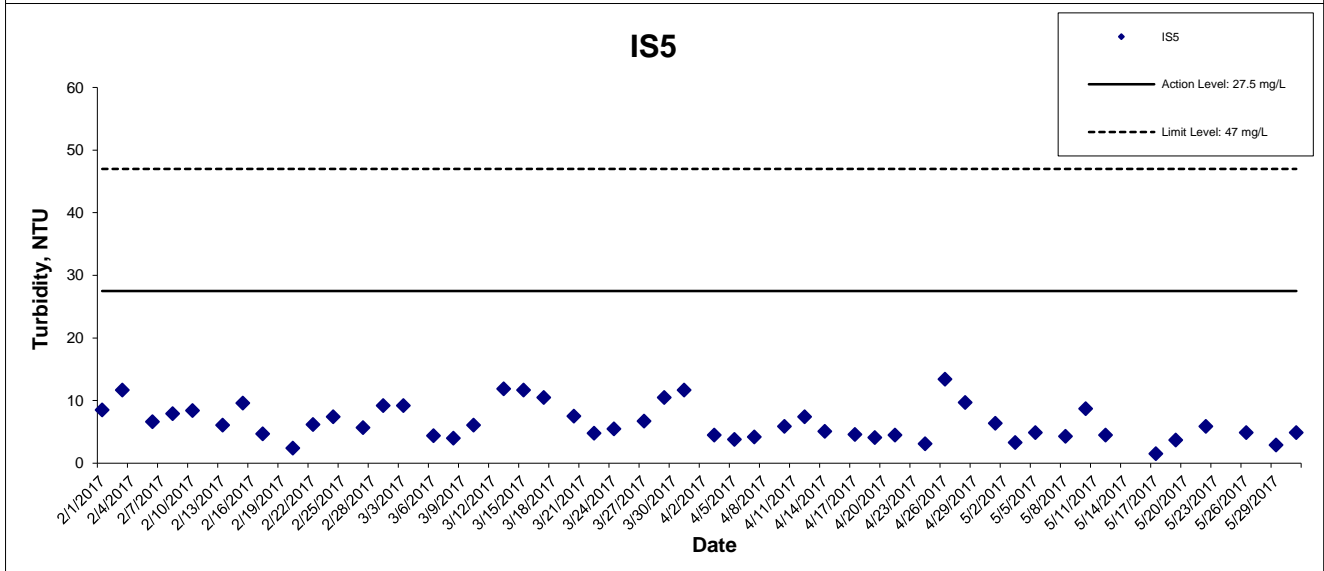
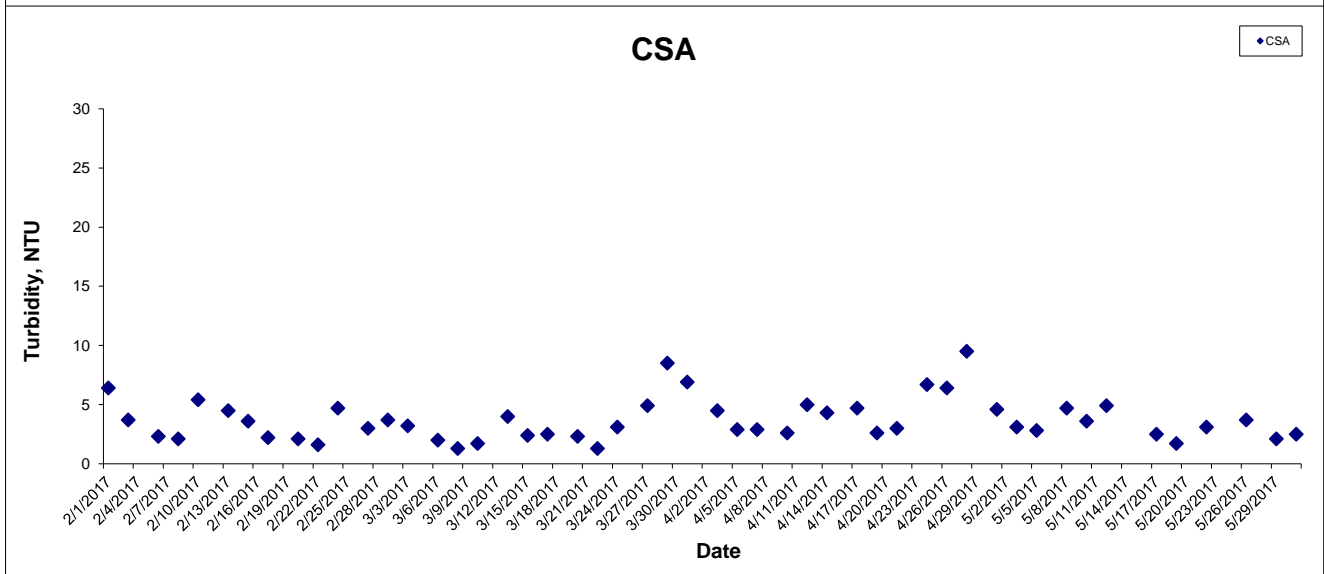
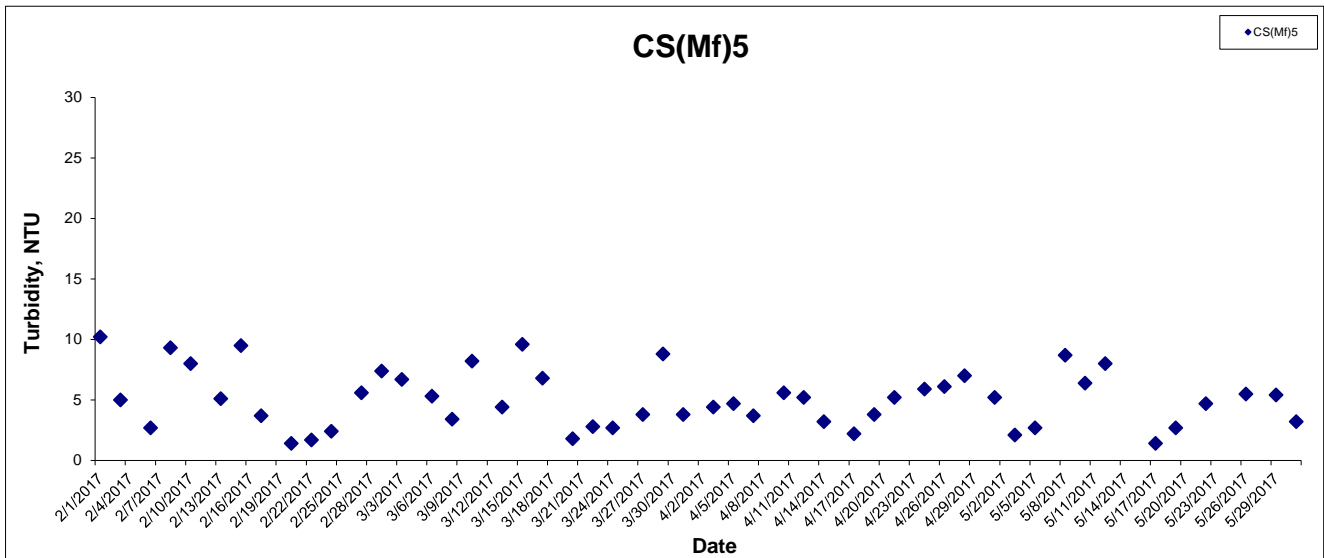
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Flood Tide



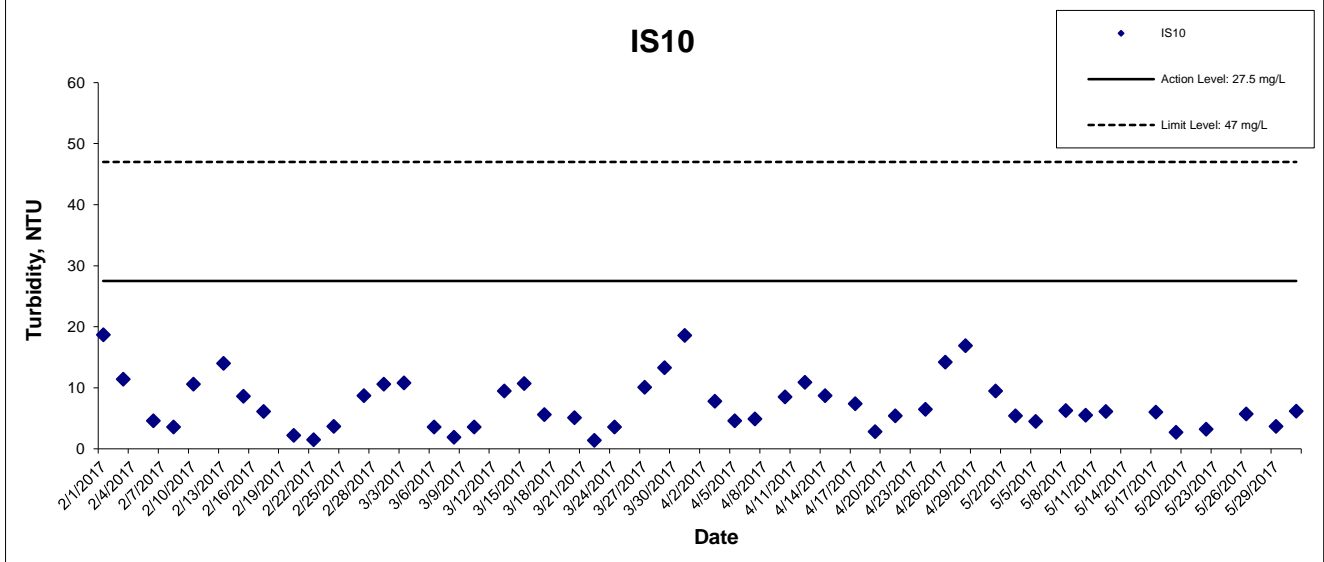
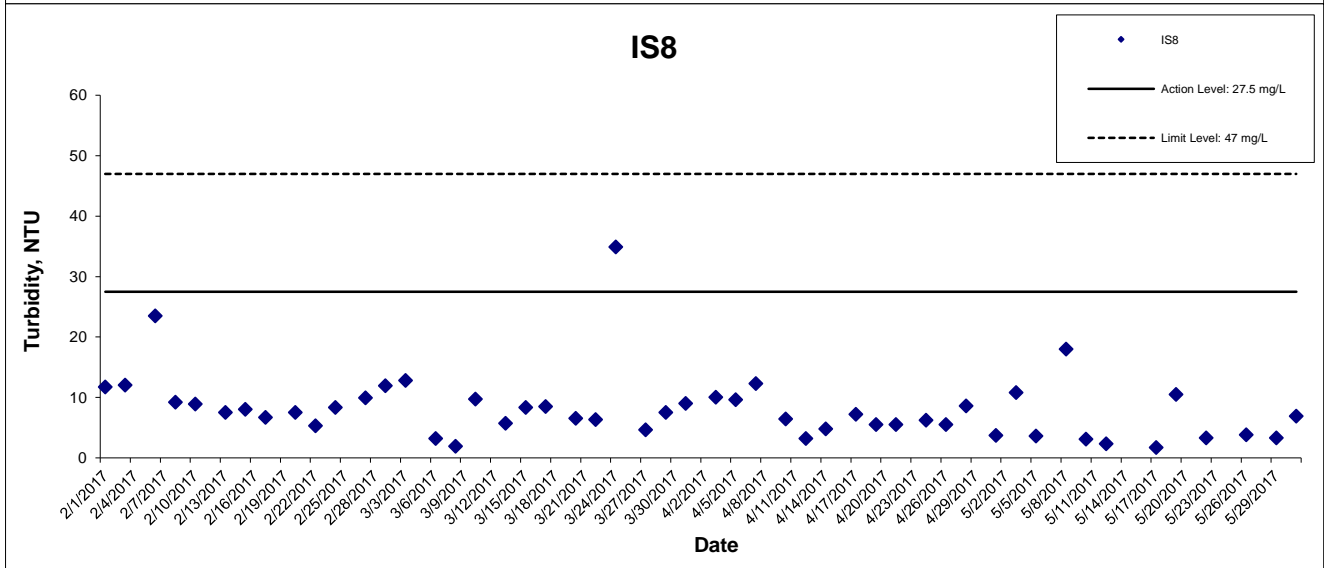
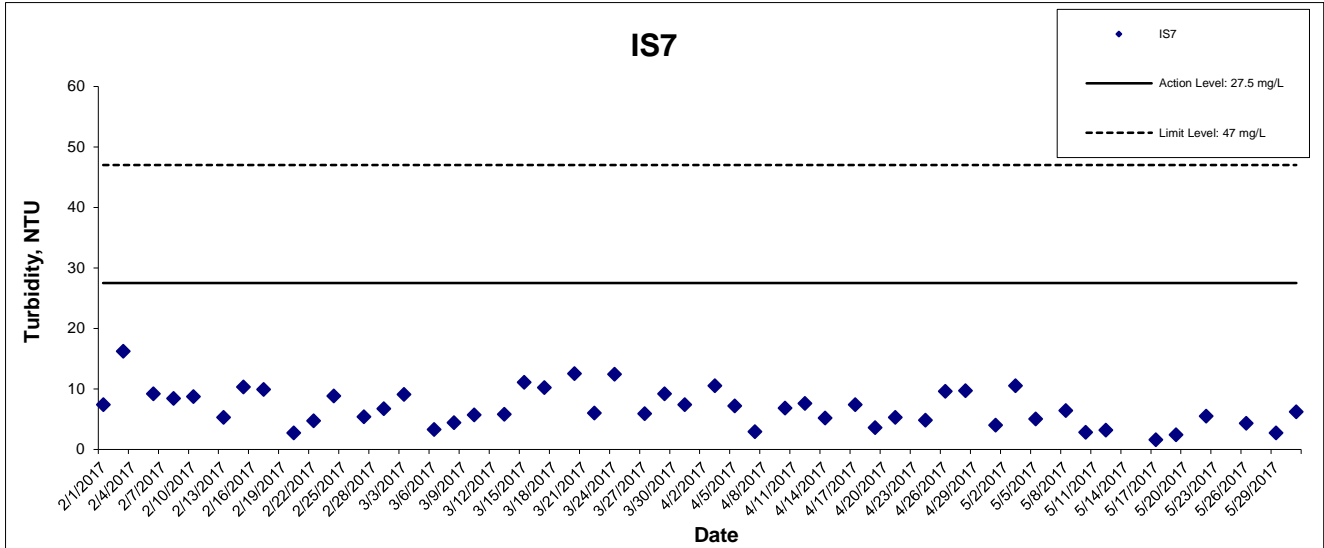
This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Flood Tide



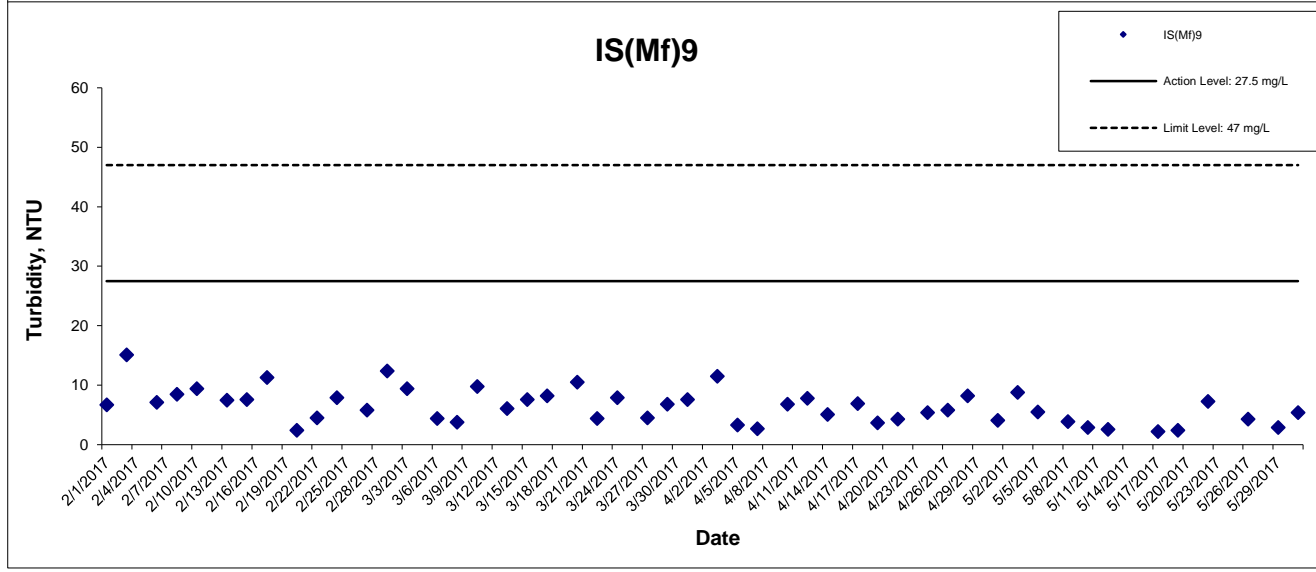
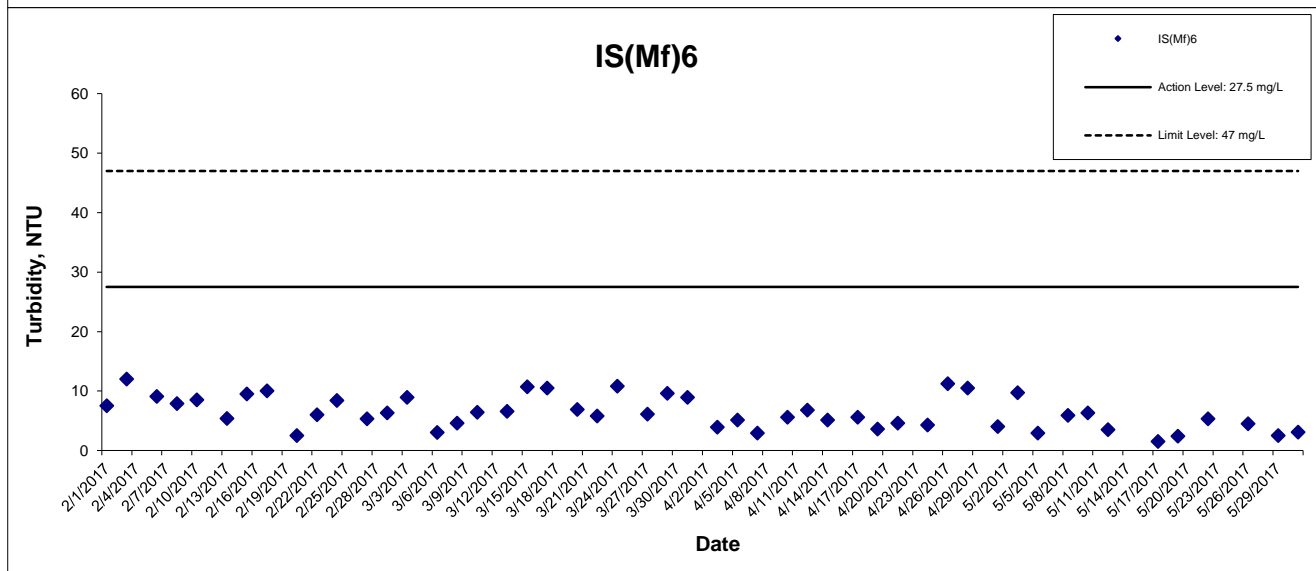
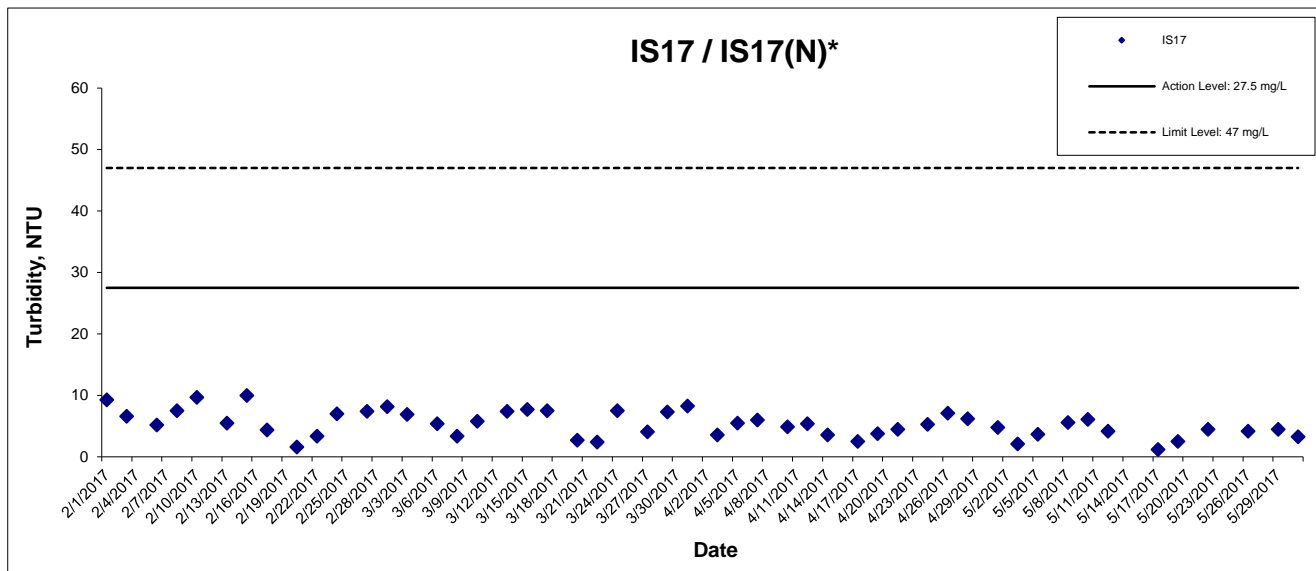
This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Flood Tide



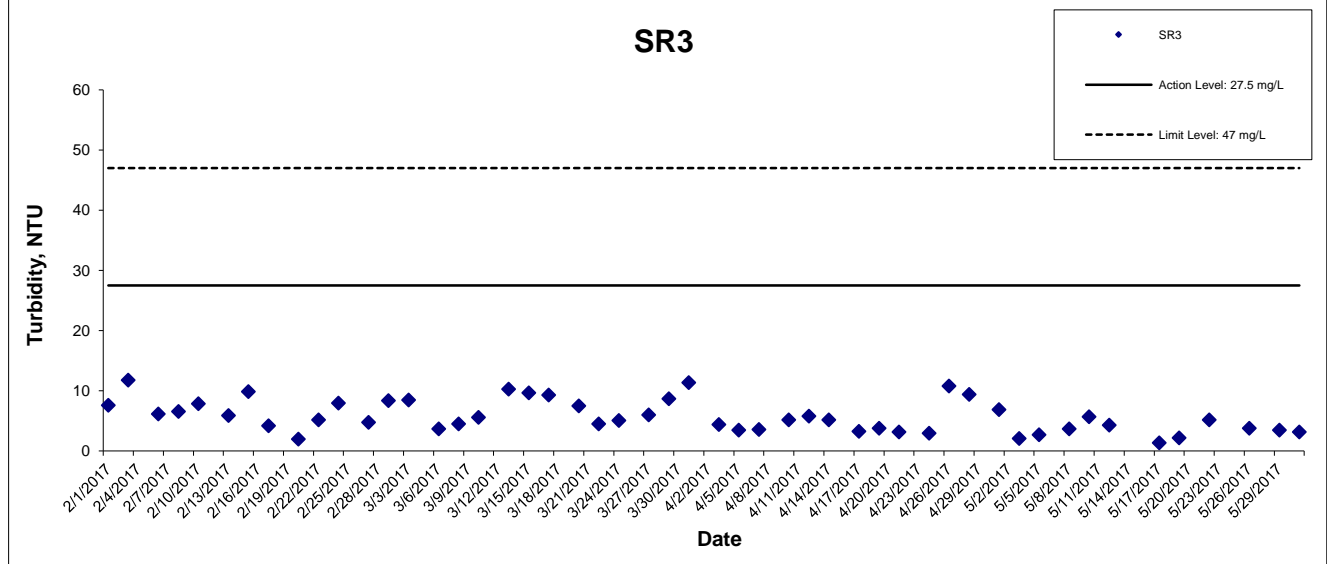
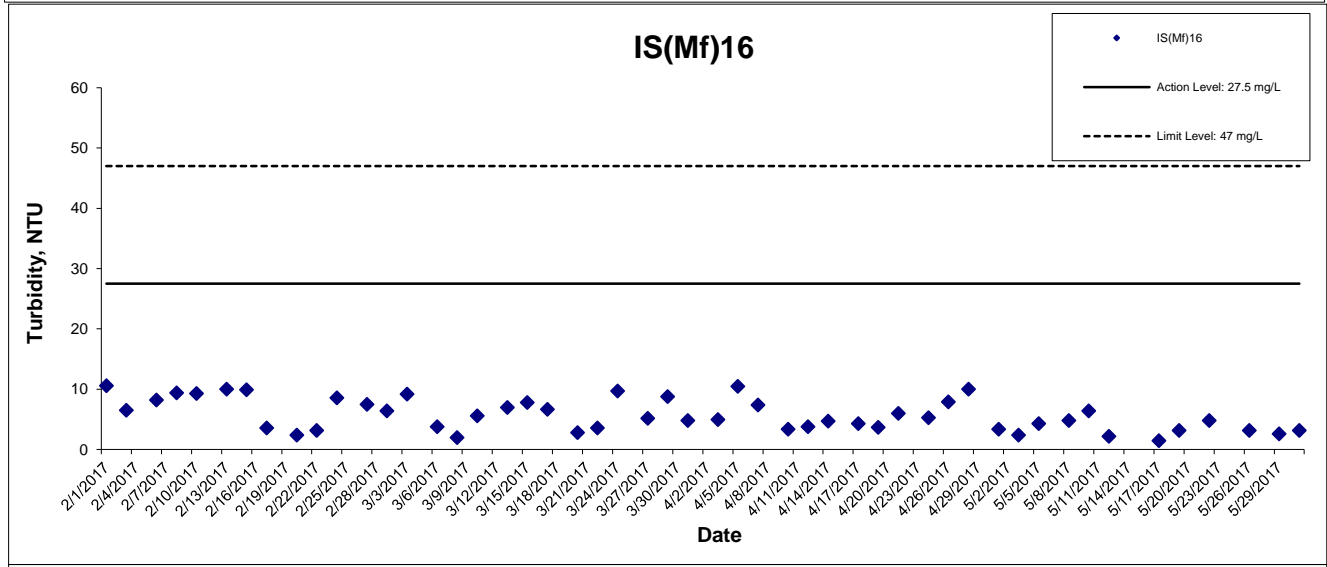
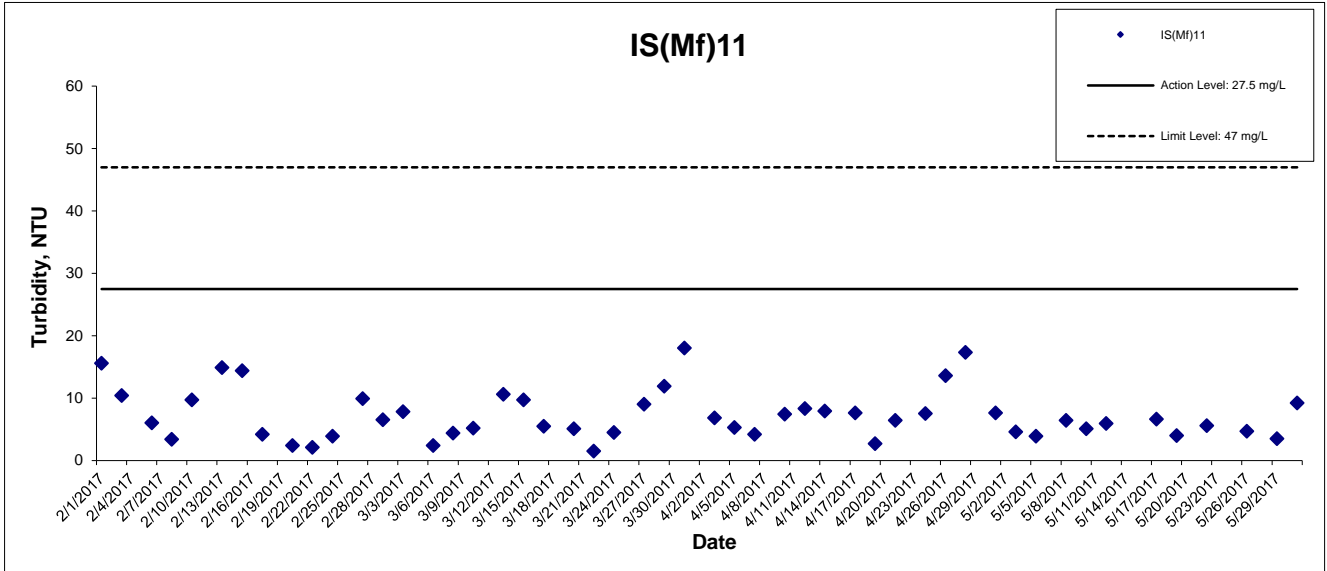
This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Flood Tide



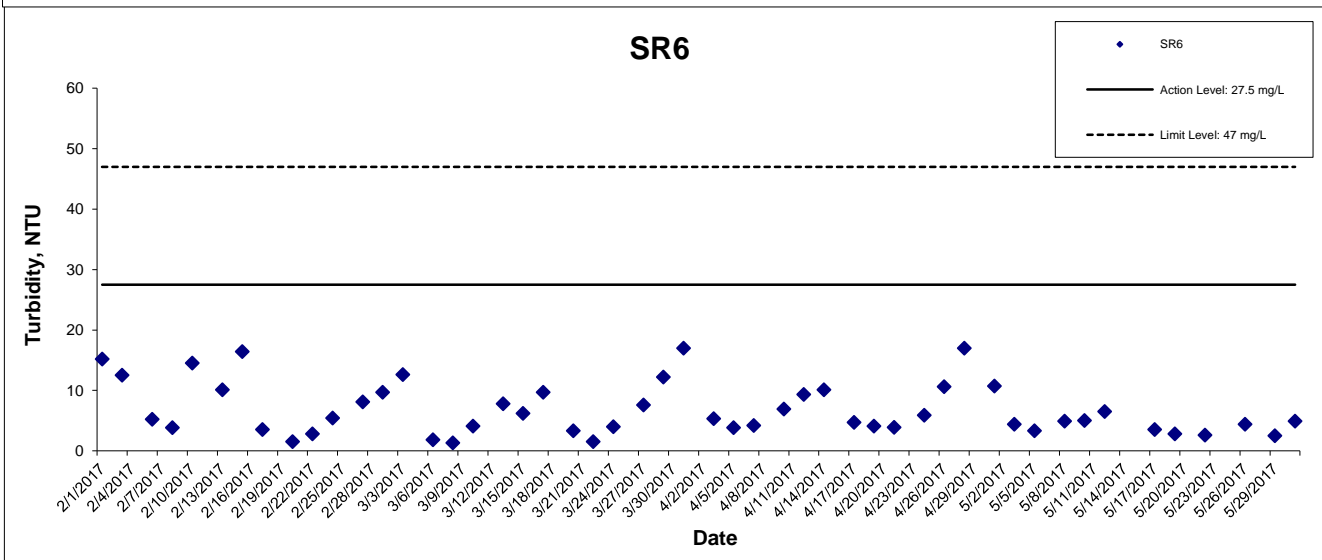
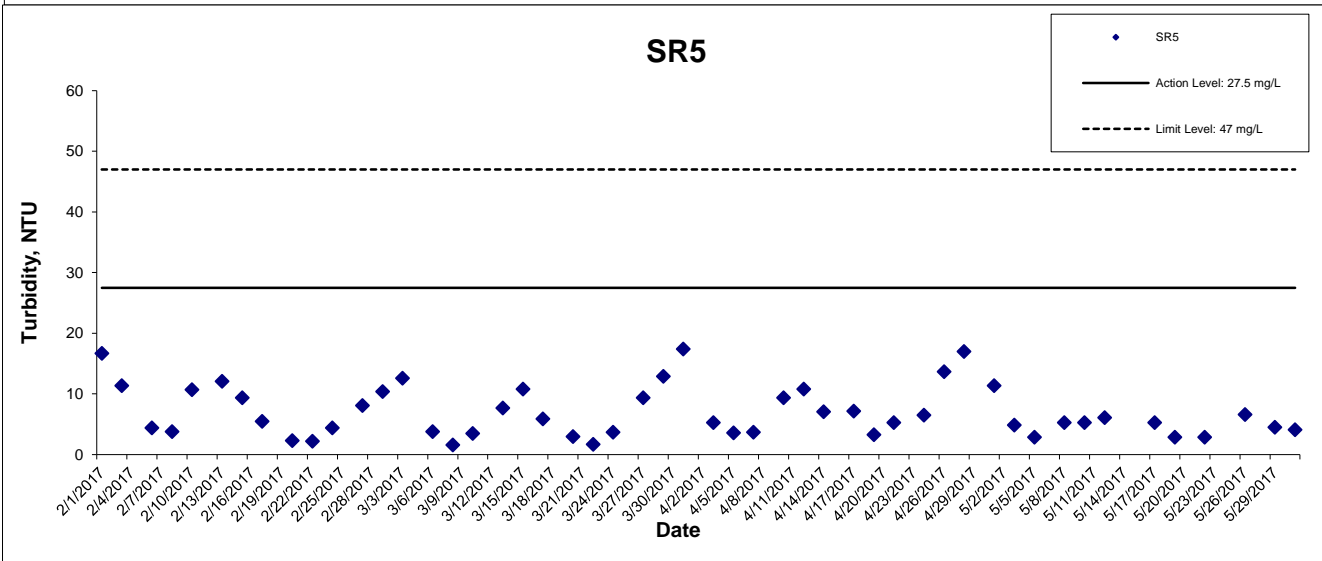
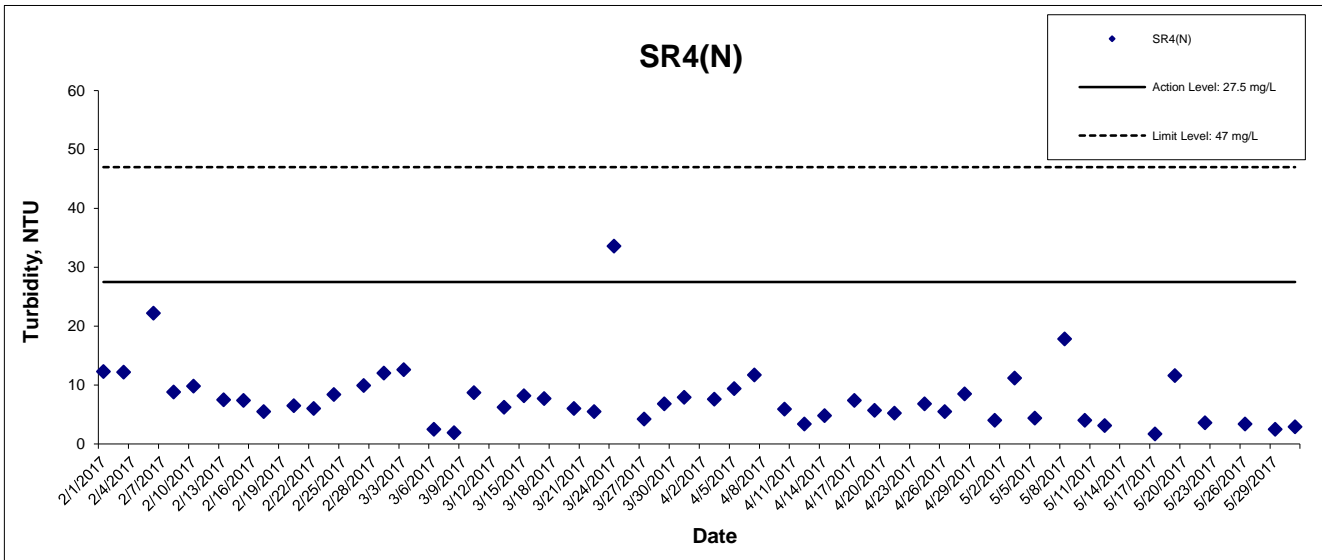
This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Flood Tide



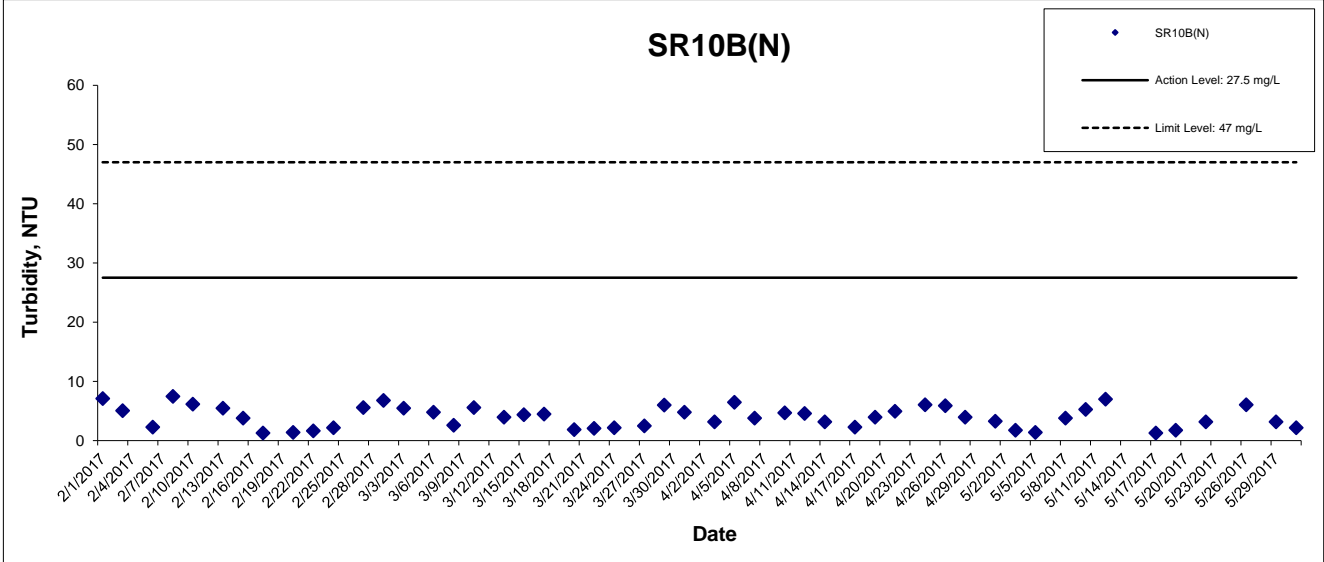
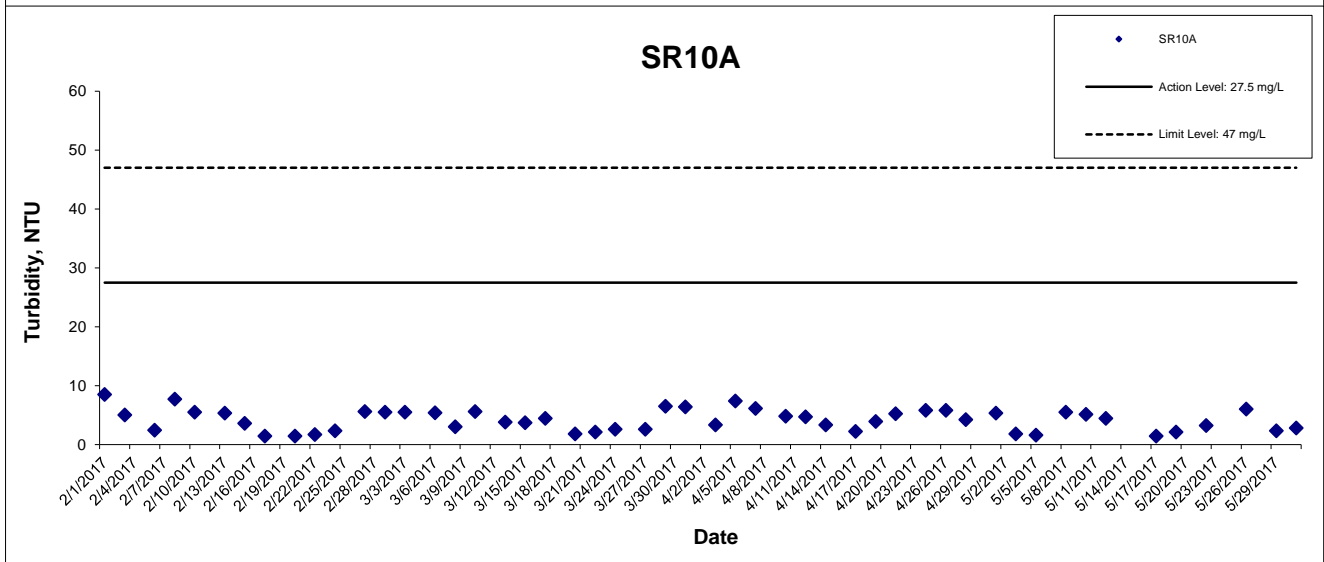
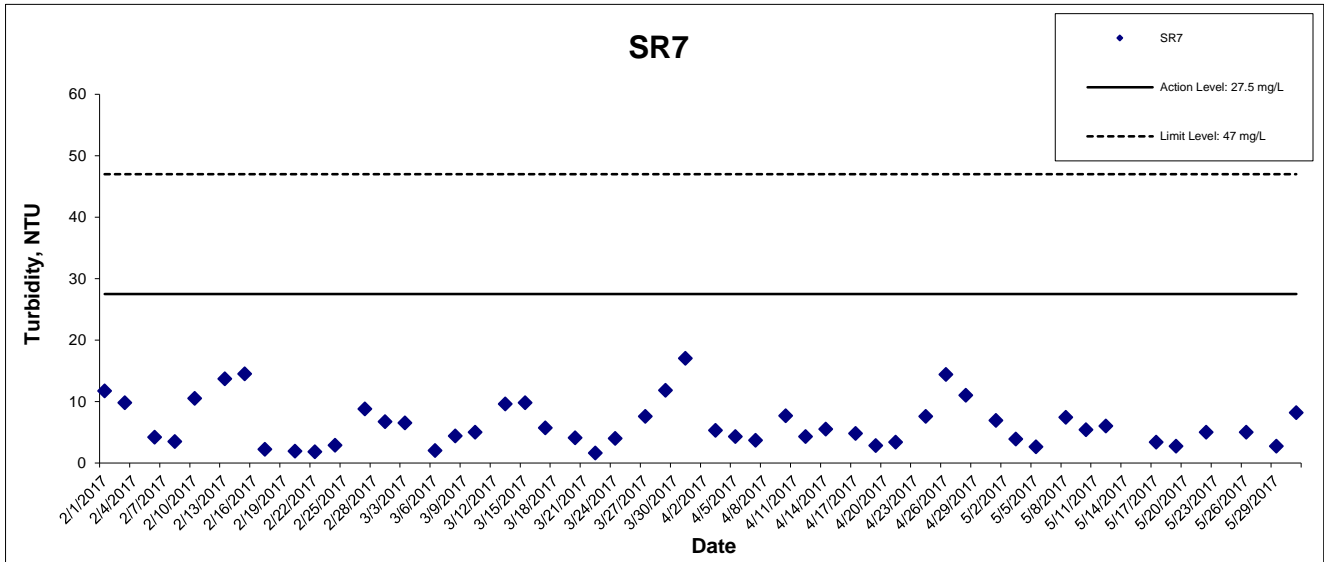
This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Turbidity at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

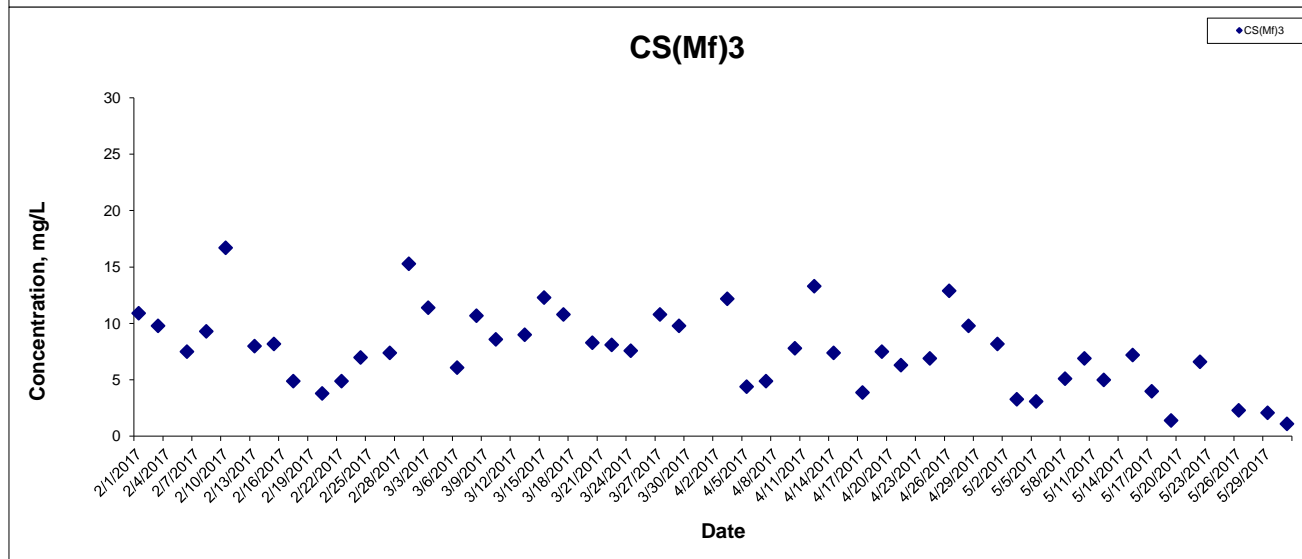
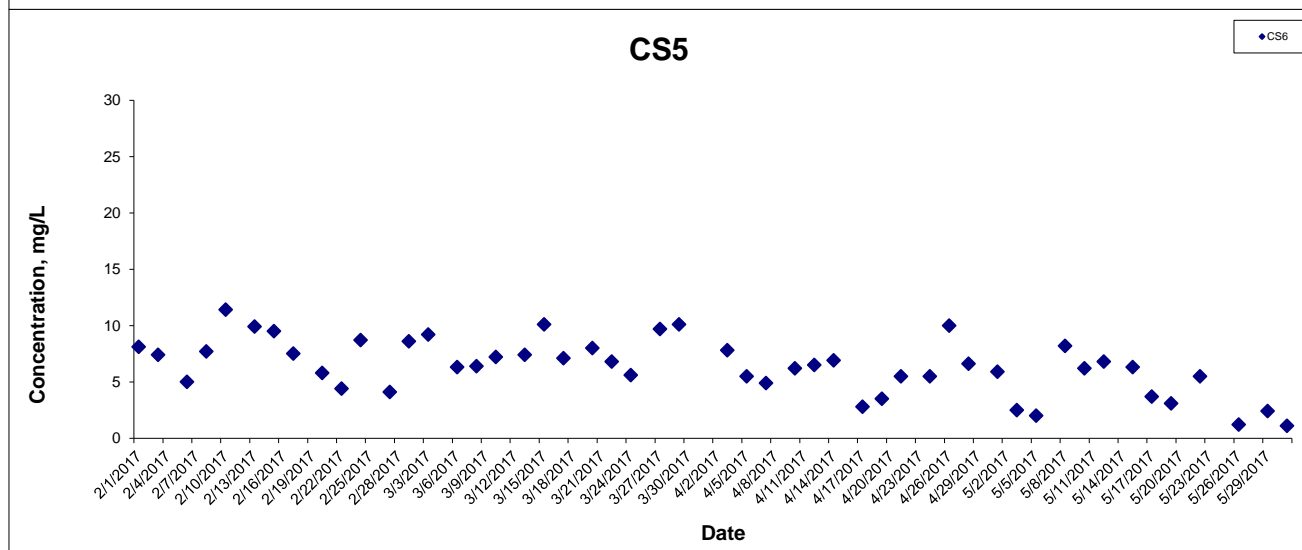
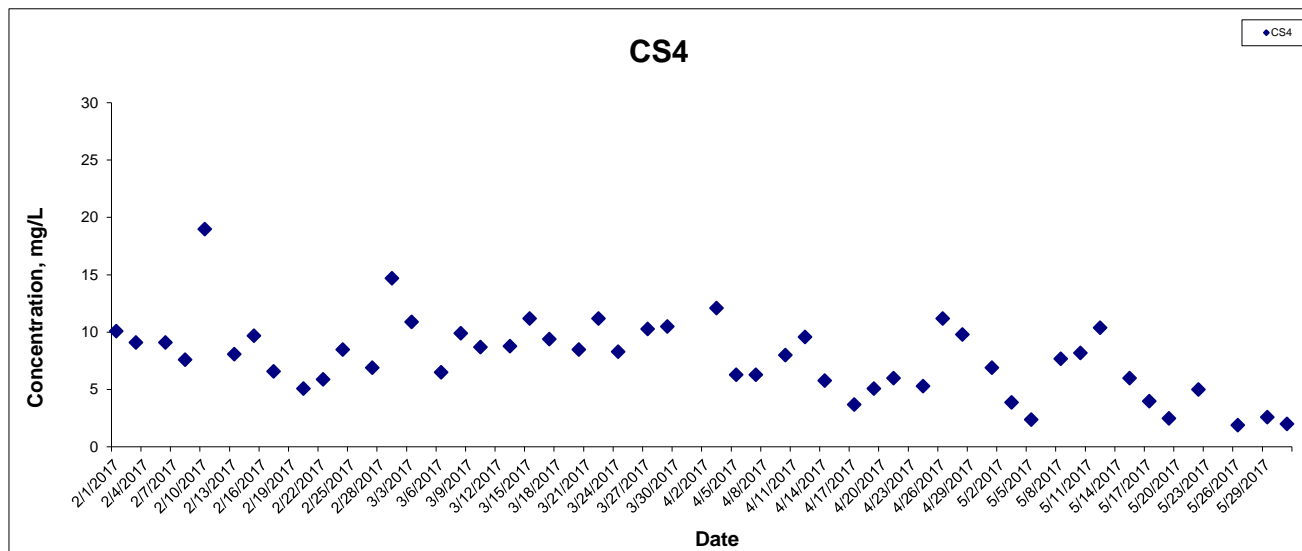
## Turbidity at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

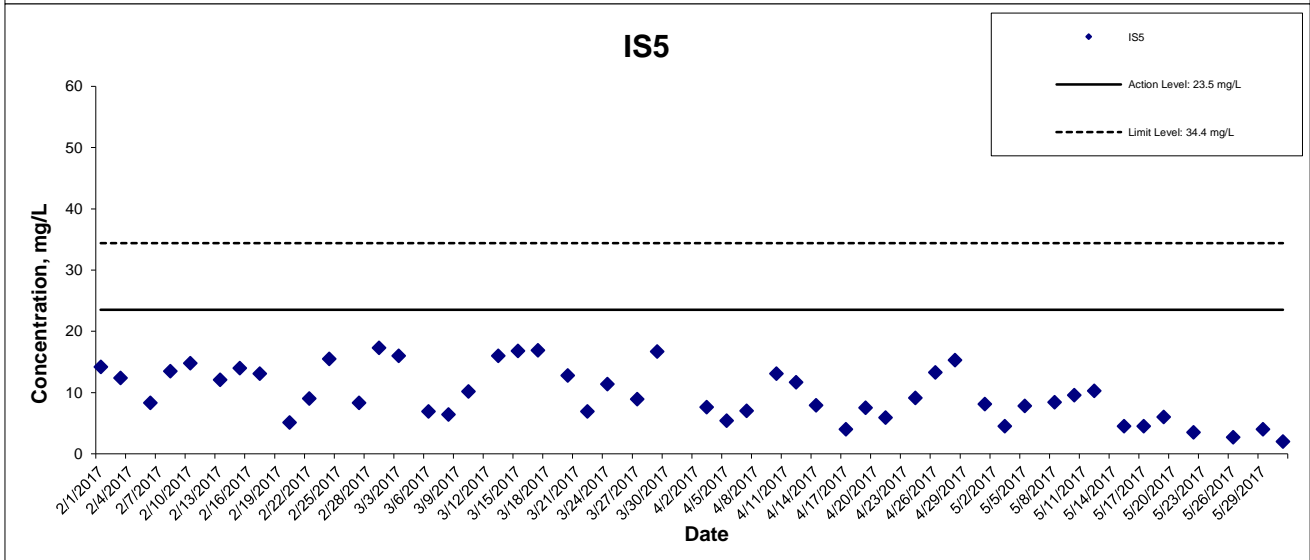
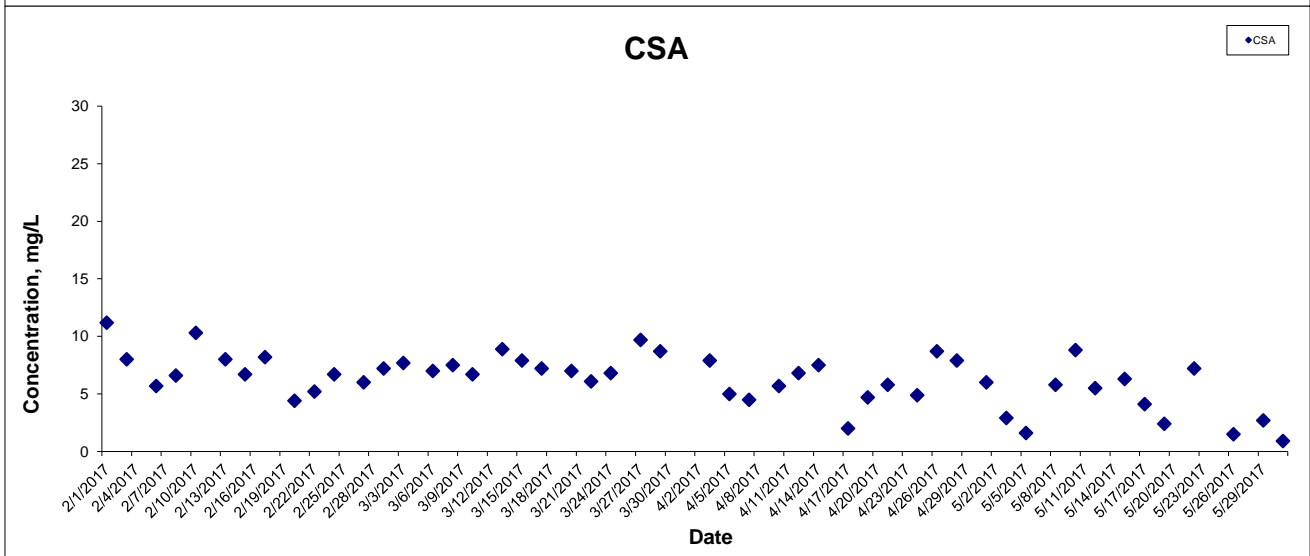
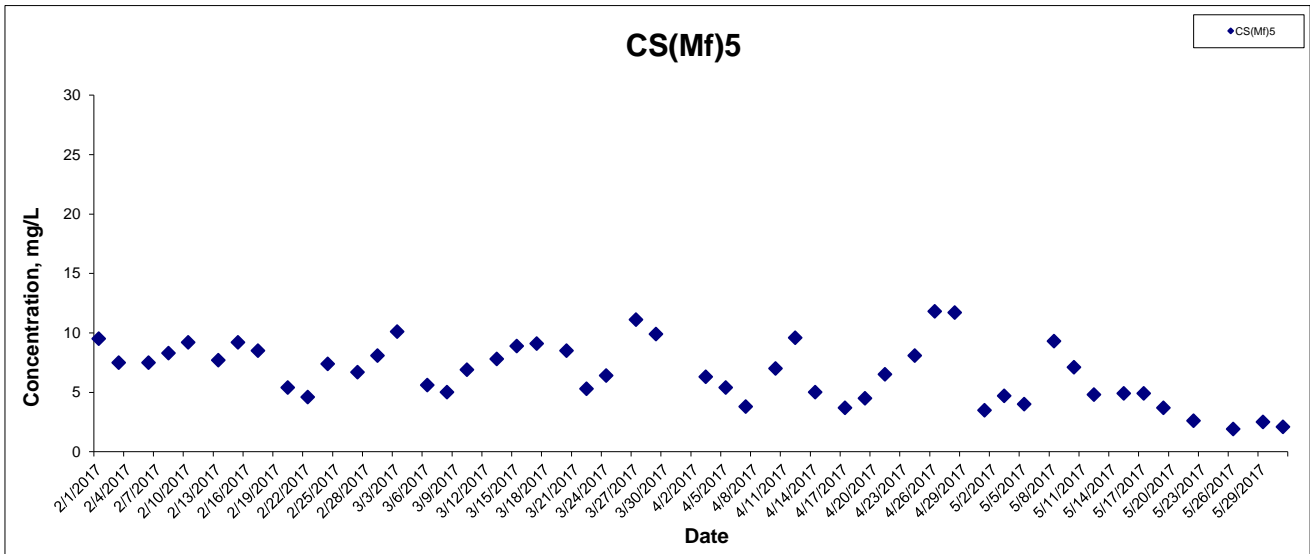


## Suspended Solids at Mid-Ebb Tide



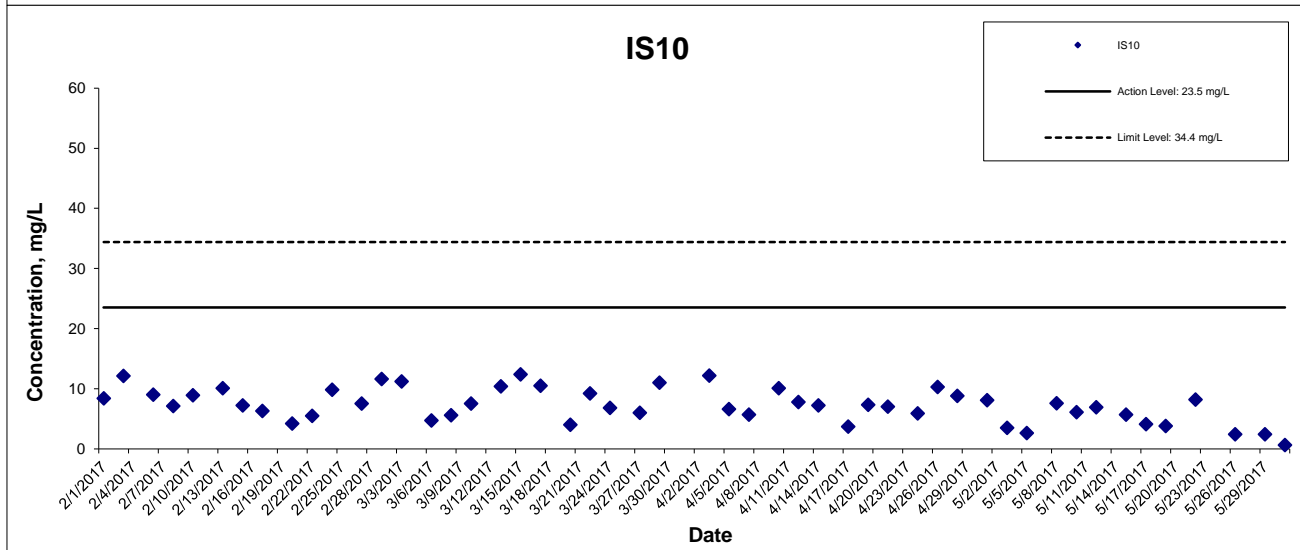
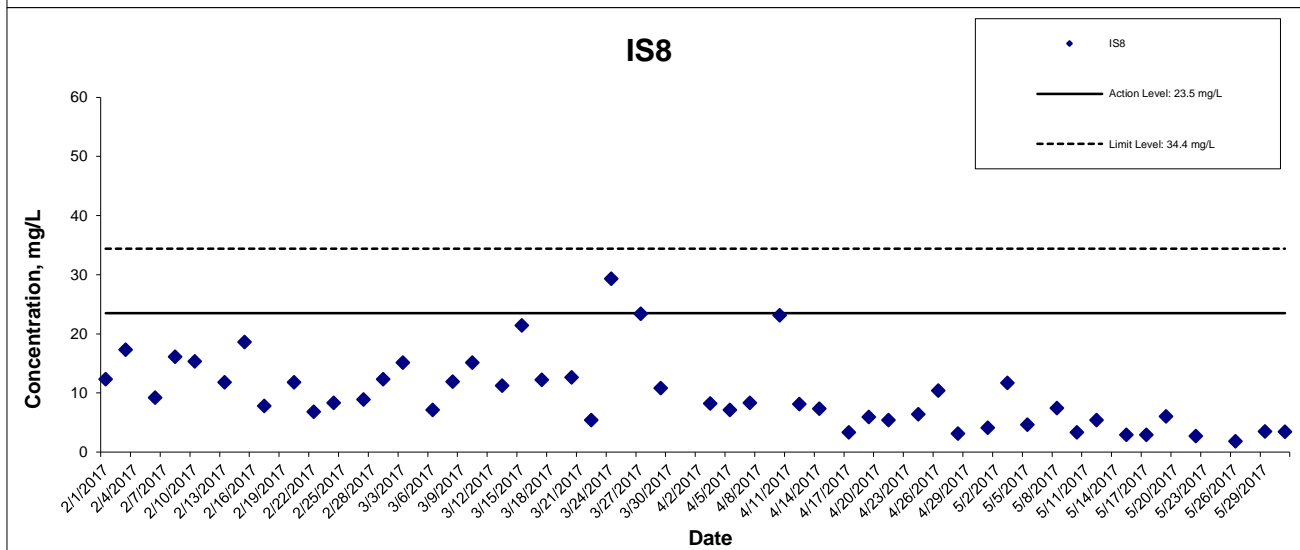
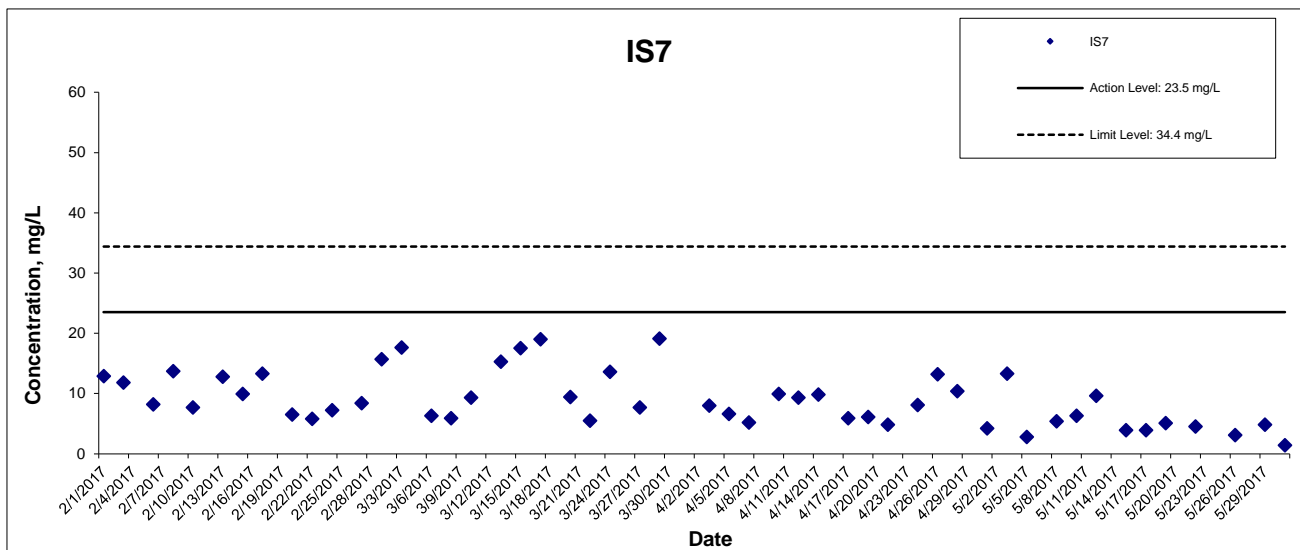
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Ebb Tide



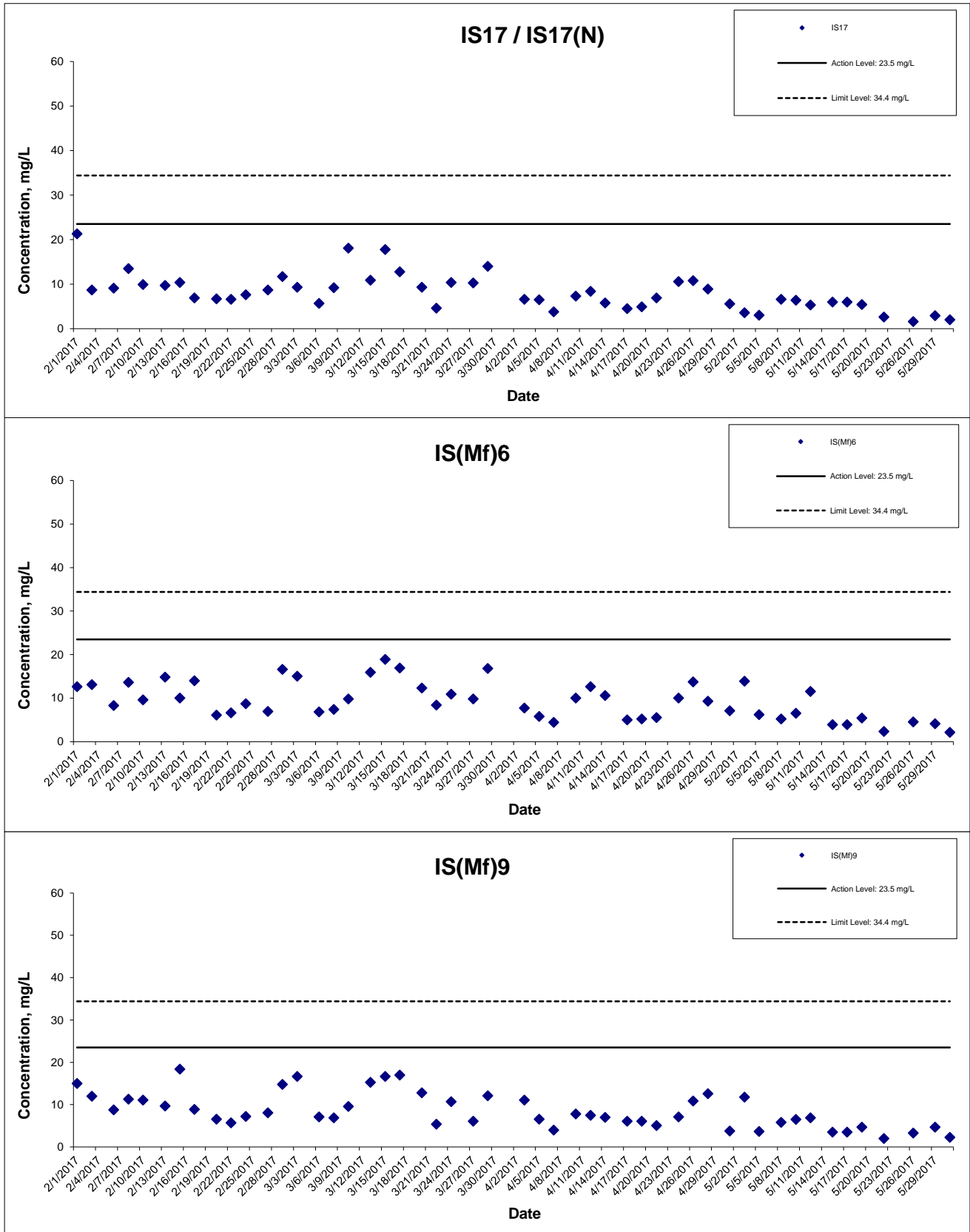
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this Drawing without AECOM's express written consent.

## Suspended Solids at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Ebb Tide



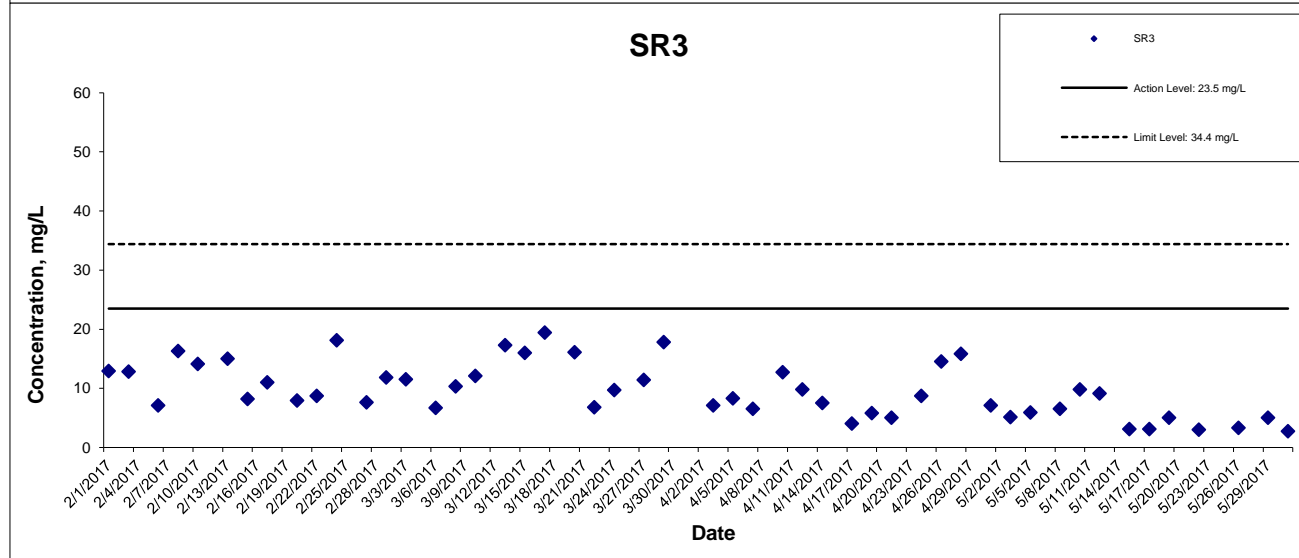
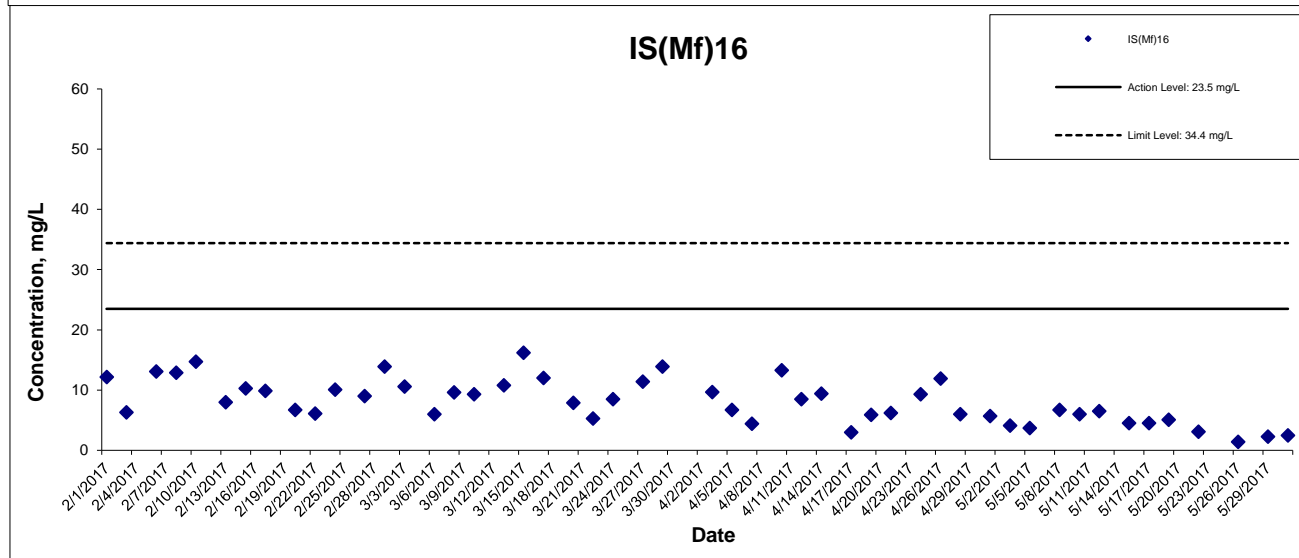
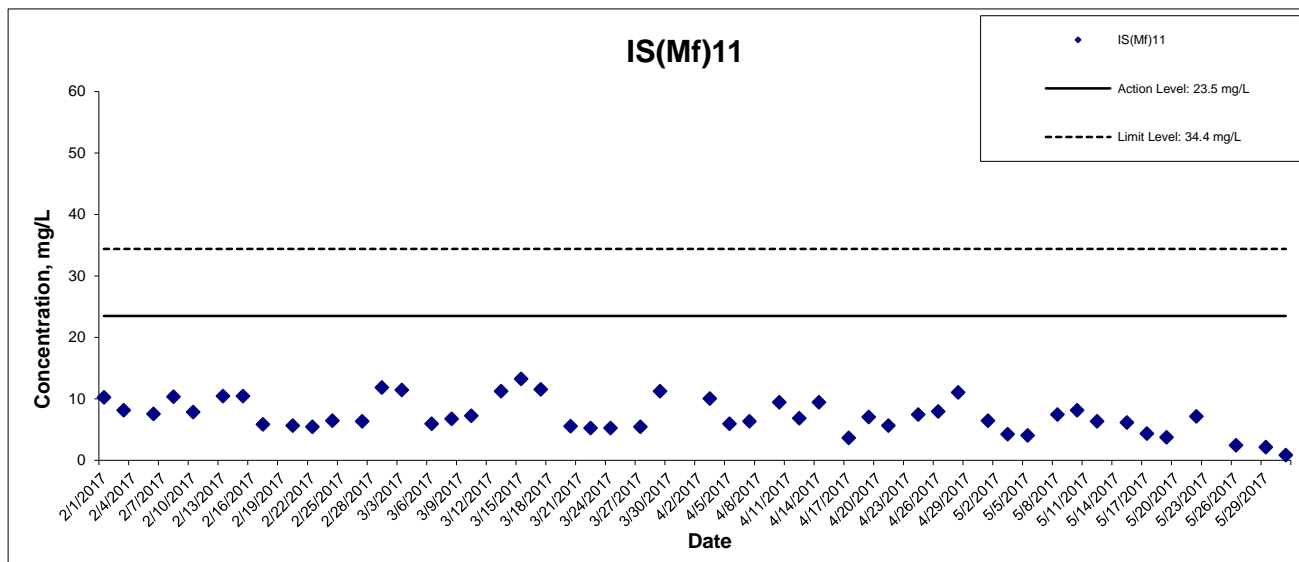
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

HONG KONG - ZHUHAI - MACAO BRIDGE  
 HONG KONG BOUNDARY CROSSING FACILITIES  
 - RECLAMATION WORKS

**Graphical Presentation of Impact Water Quality  
 Monitoring Results**

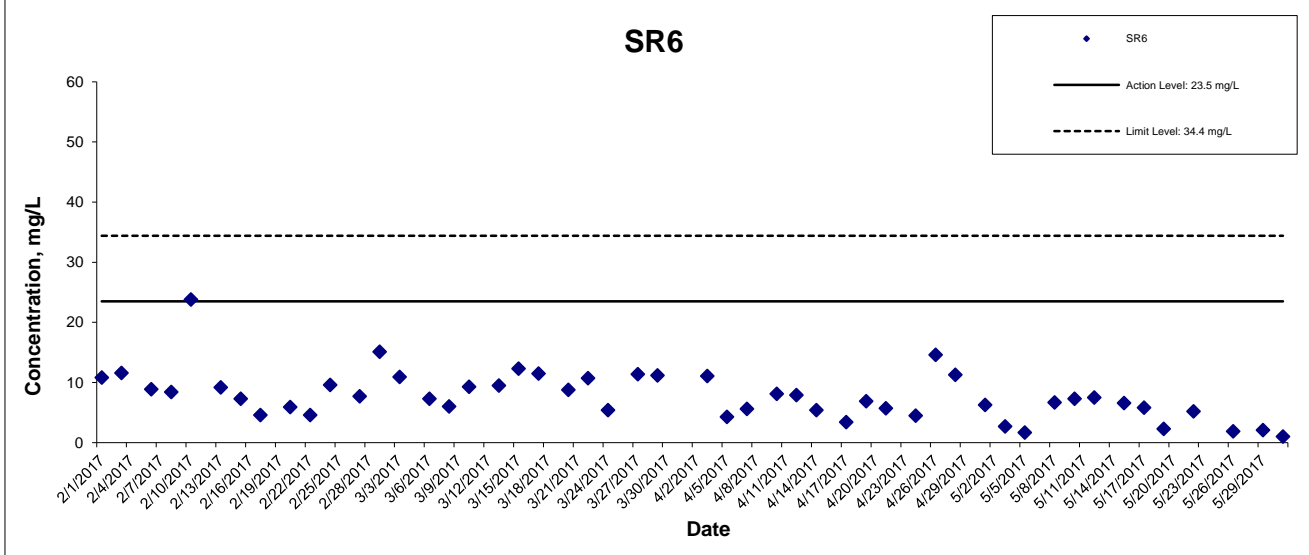
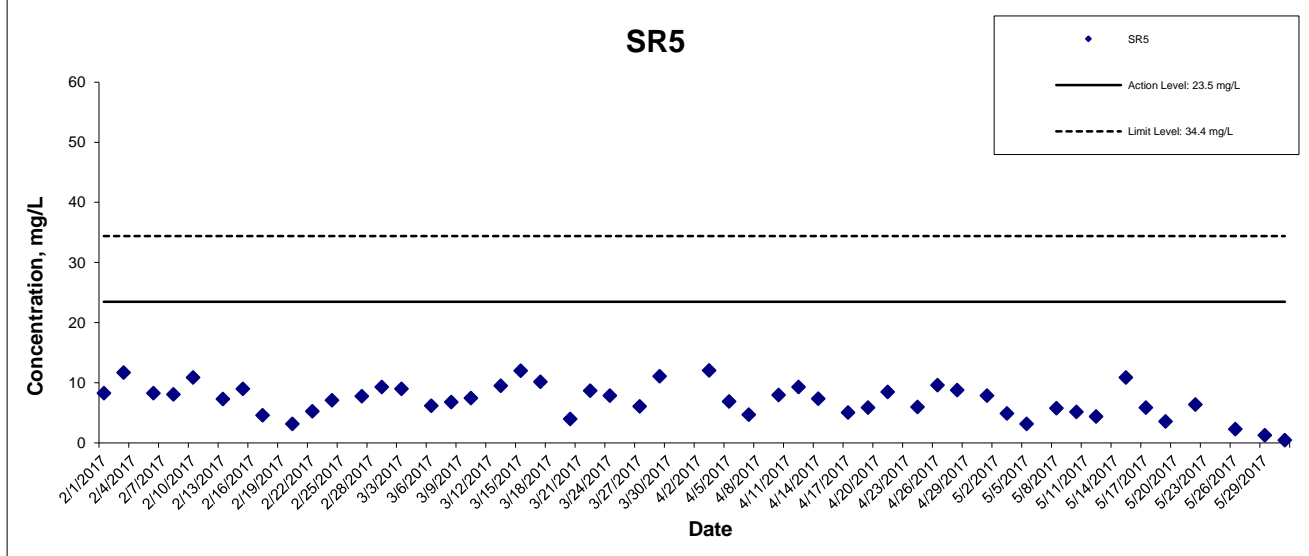
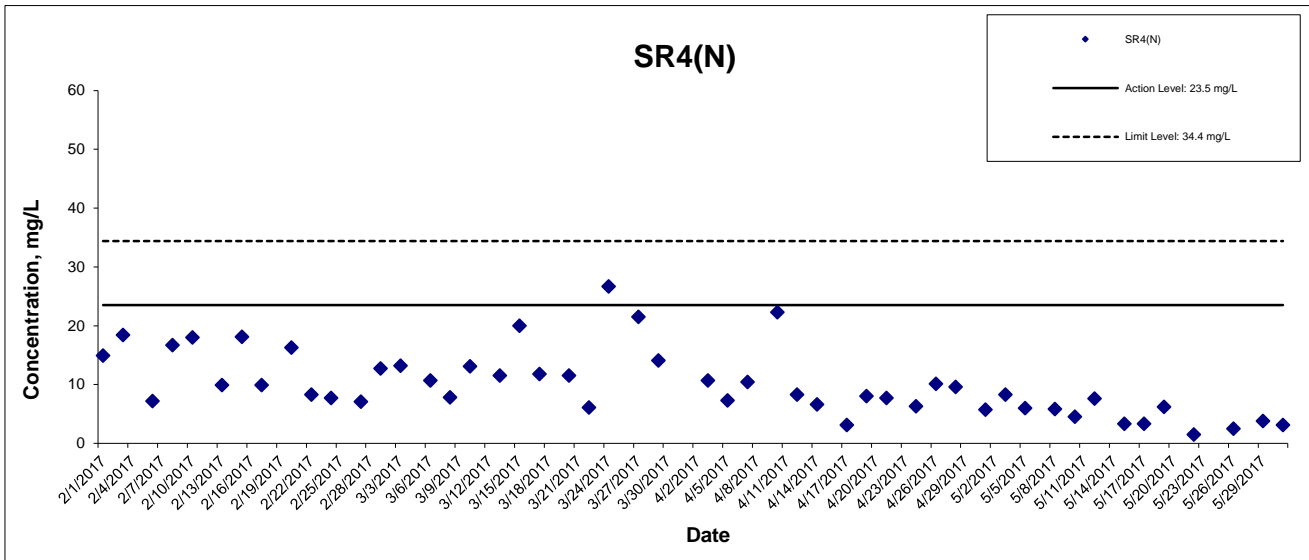


## Suspended Solids at Mid-Ebb Tide



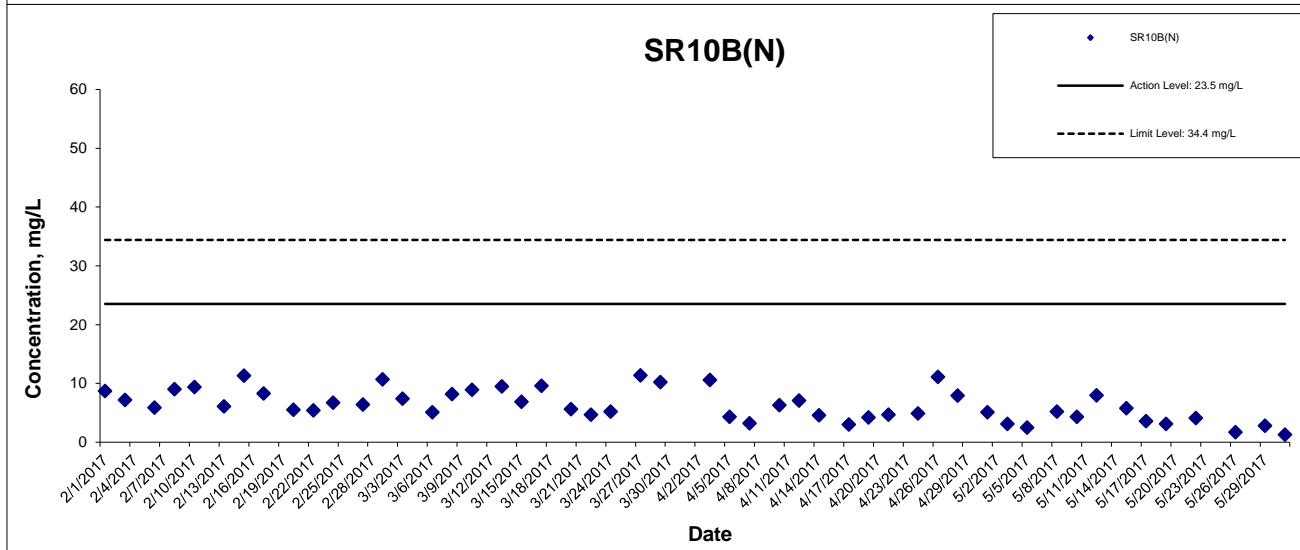
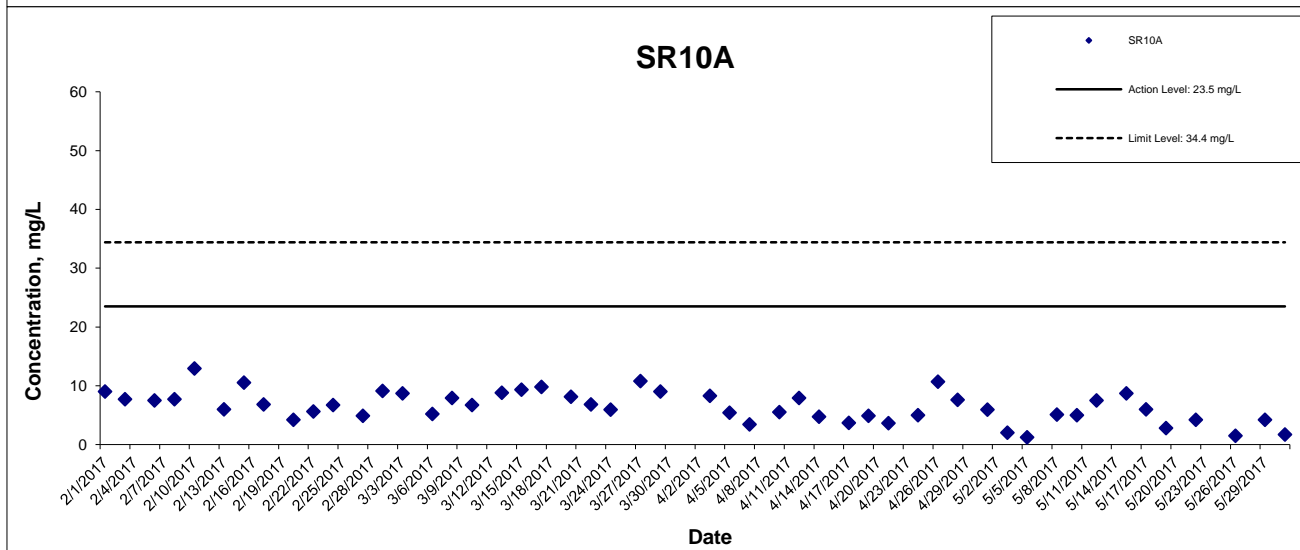
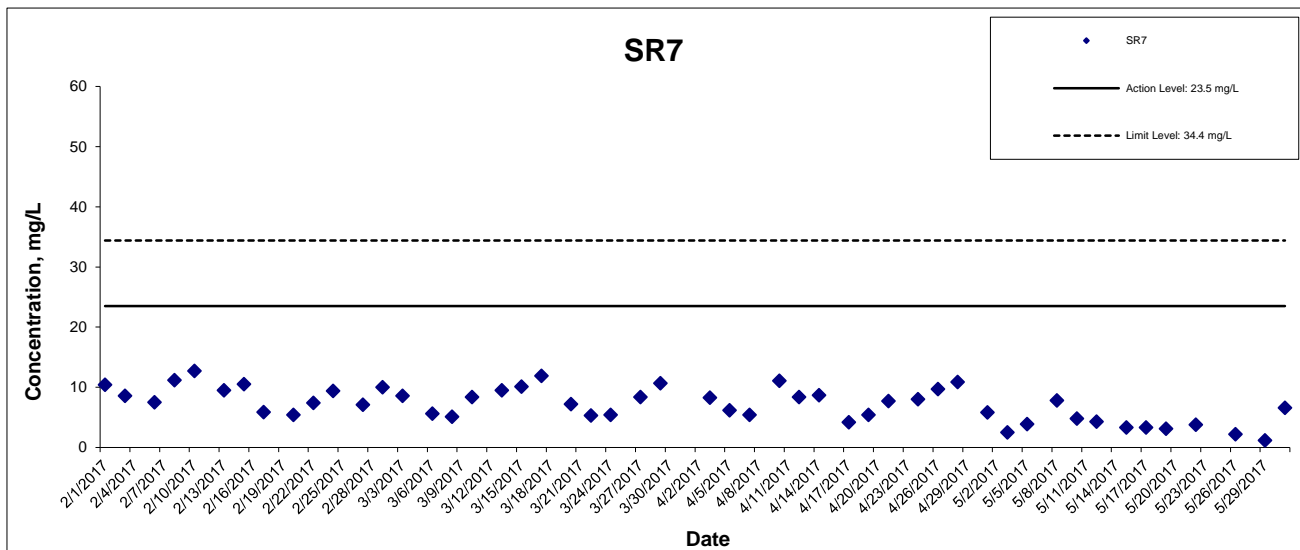
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Ebb Tide



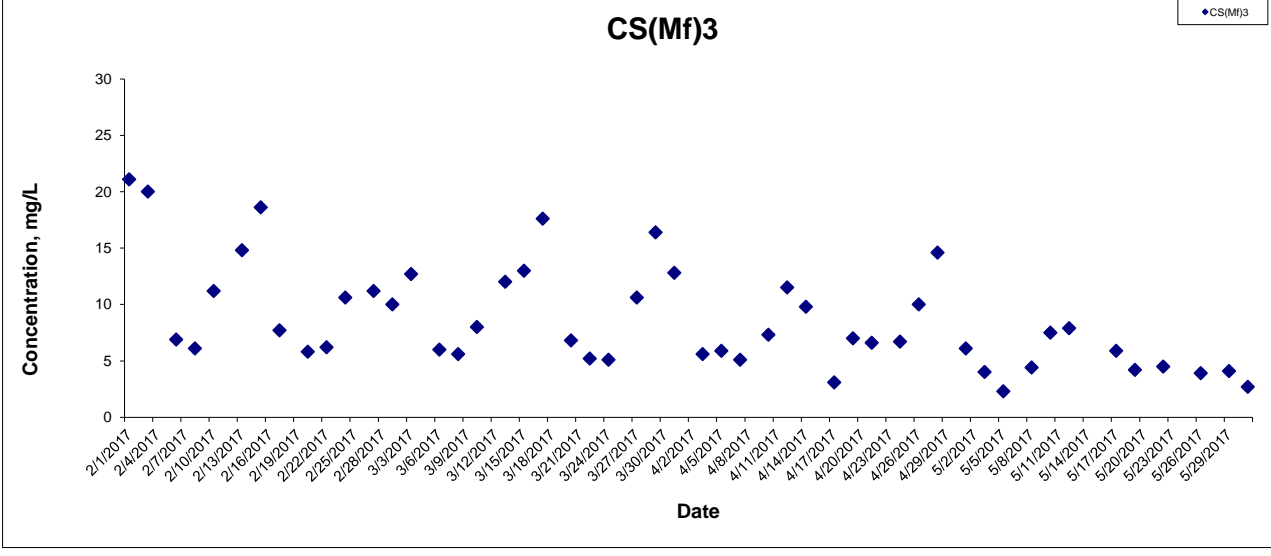
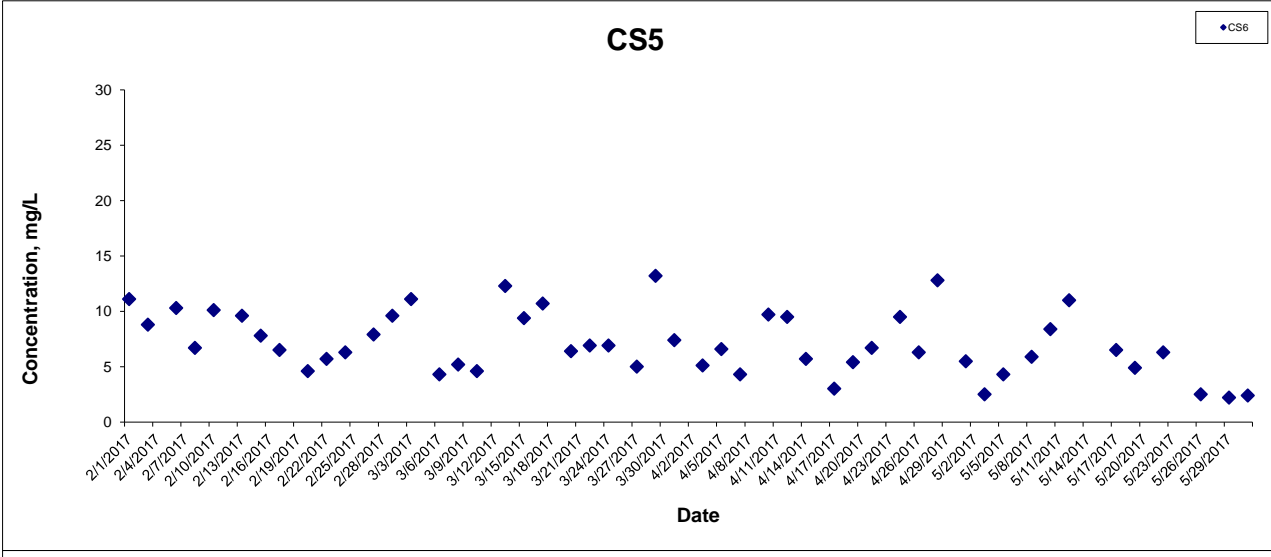
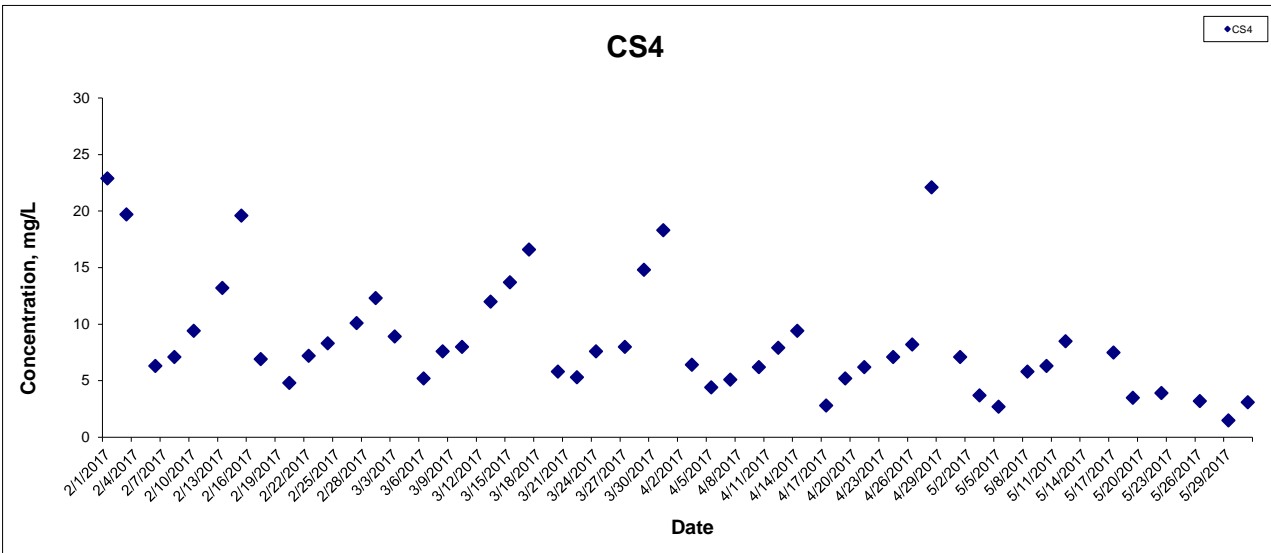
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Ebb Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

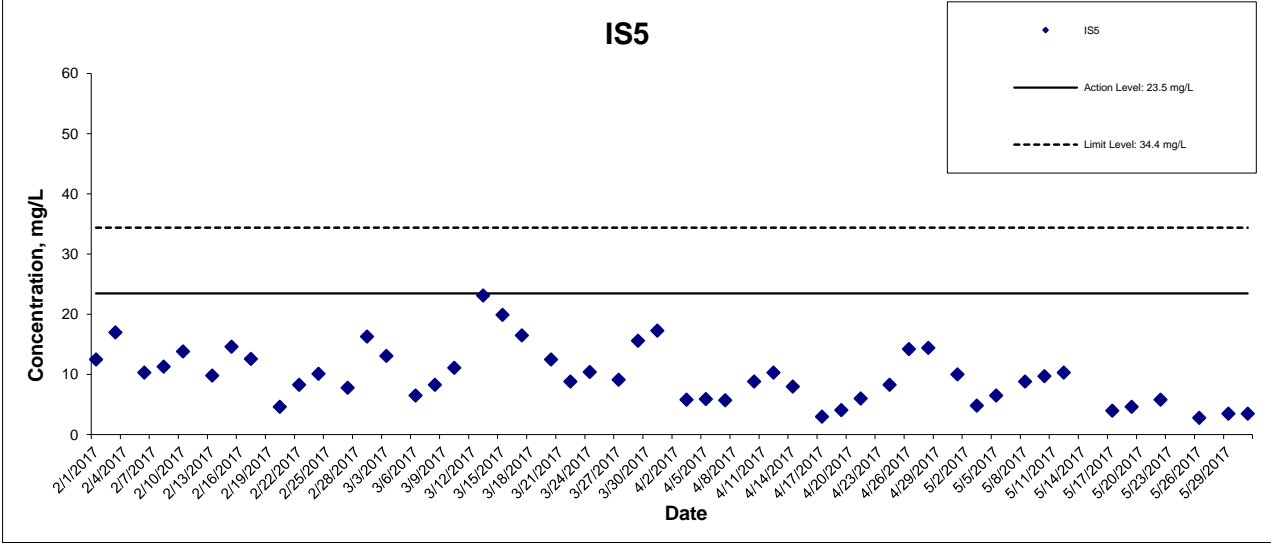
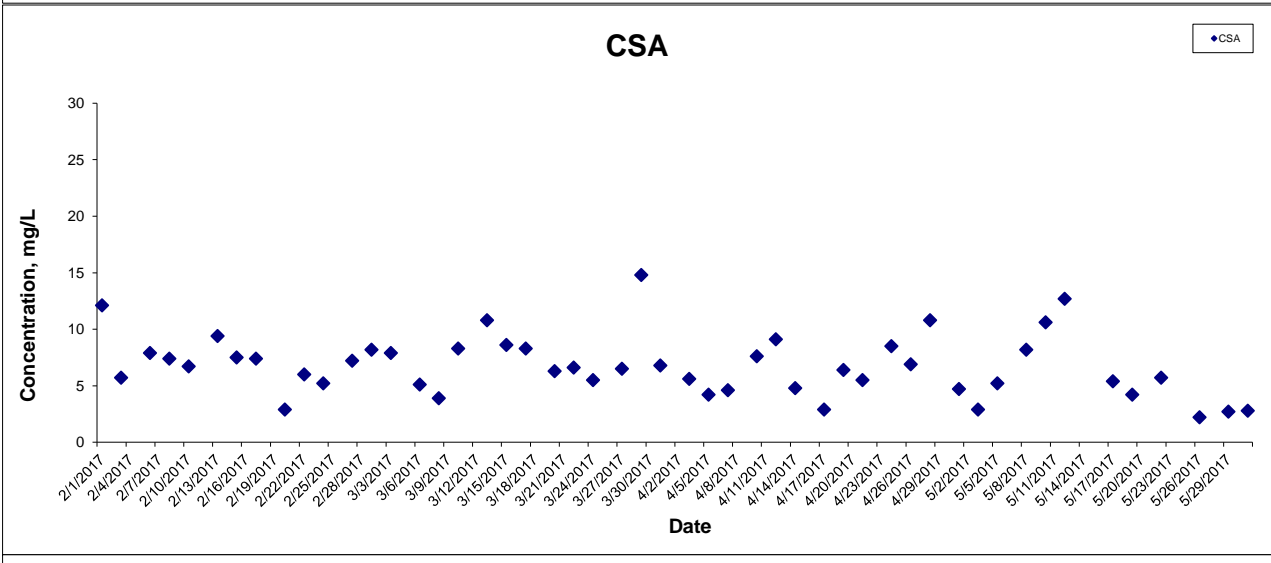
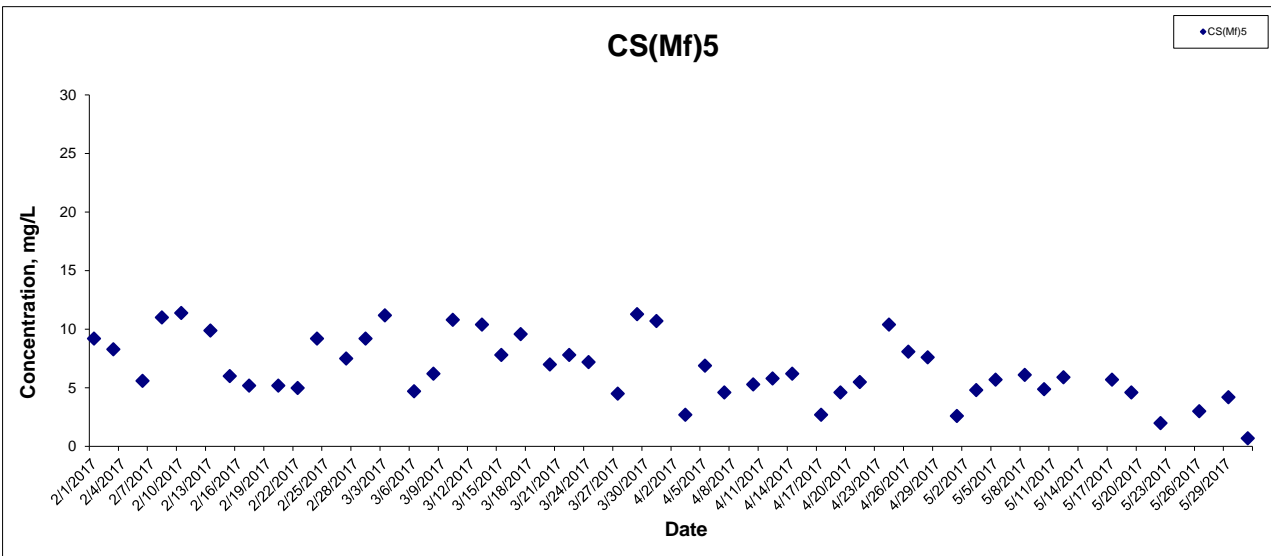
### Suspended Solids at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It Dec not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

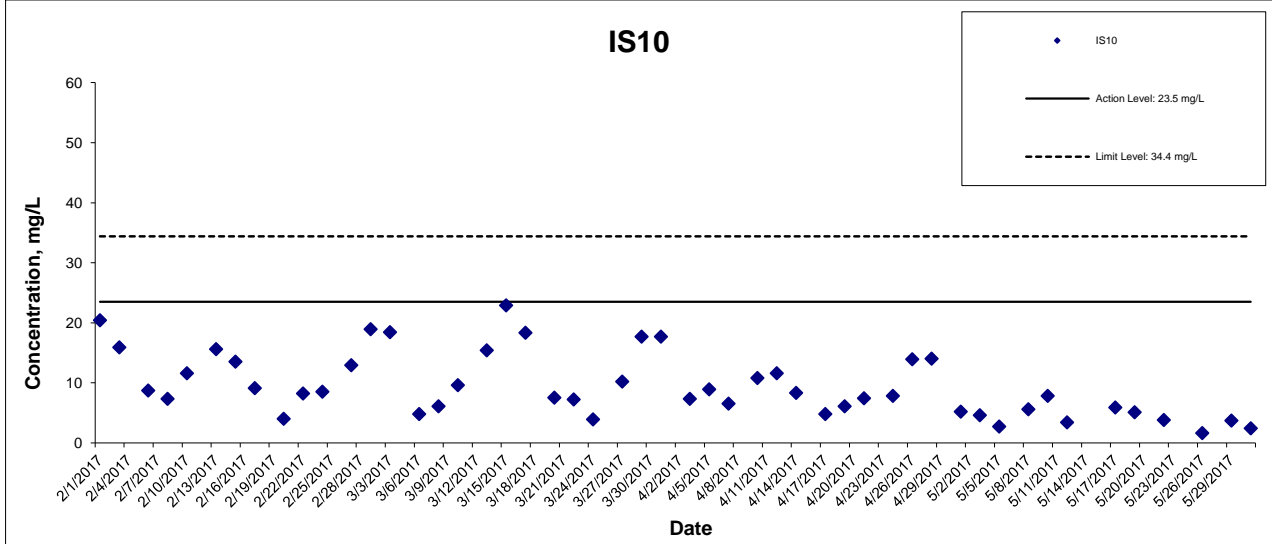
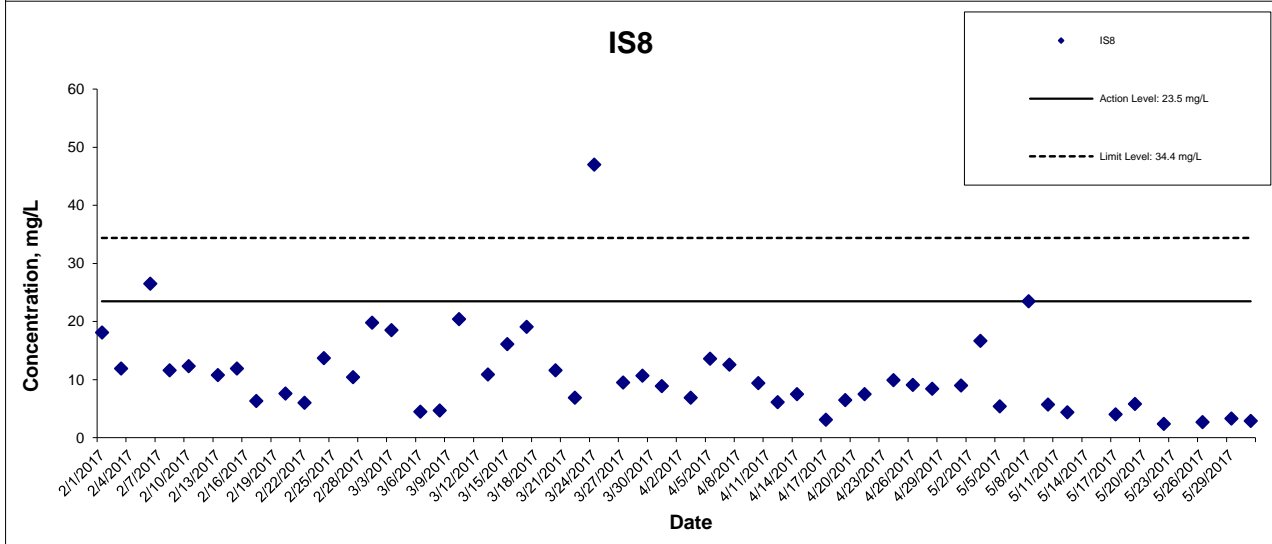
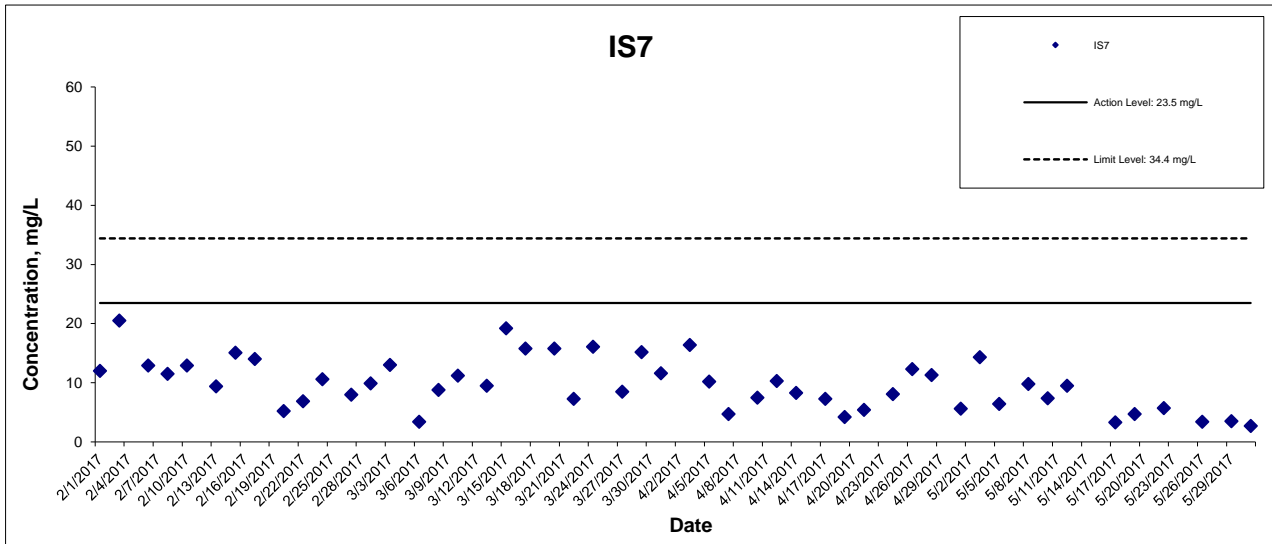


### Suspended Solids at Mid-Flood Tide



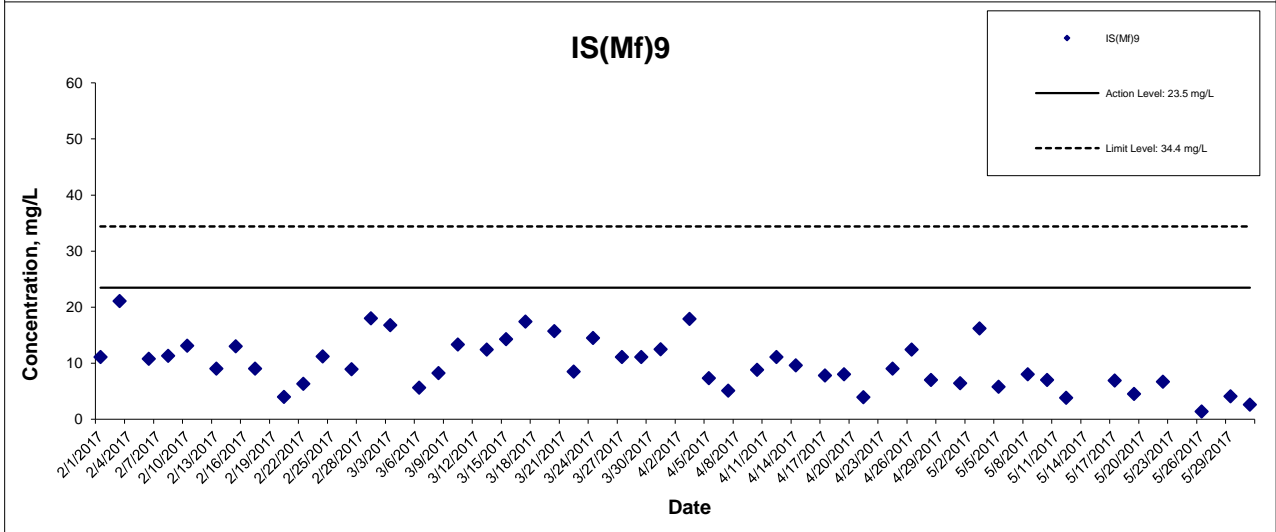
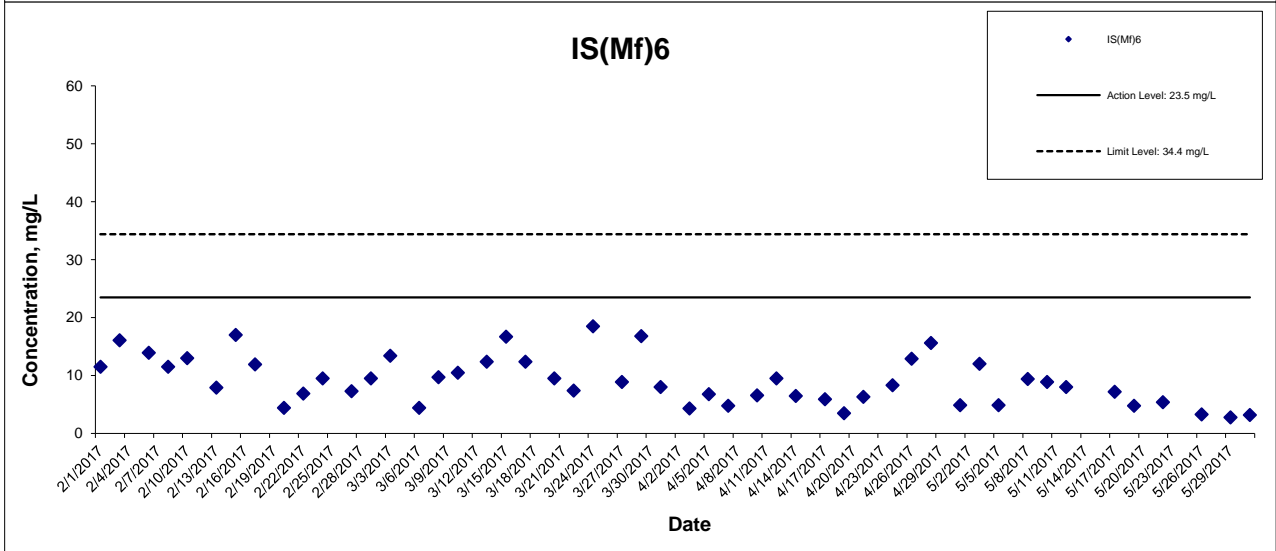
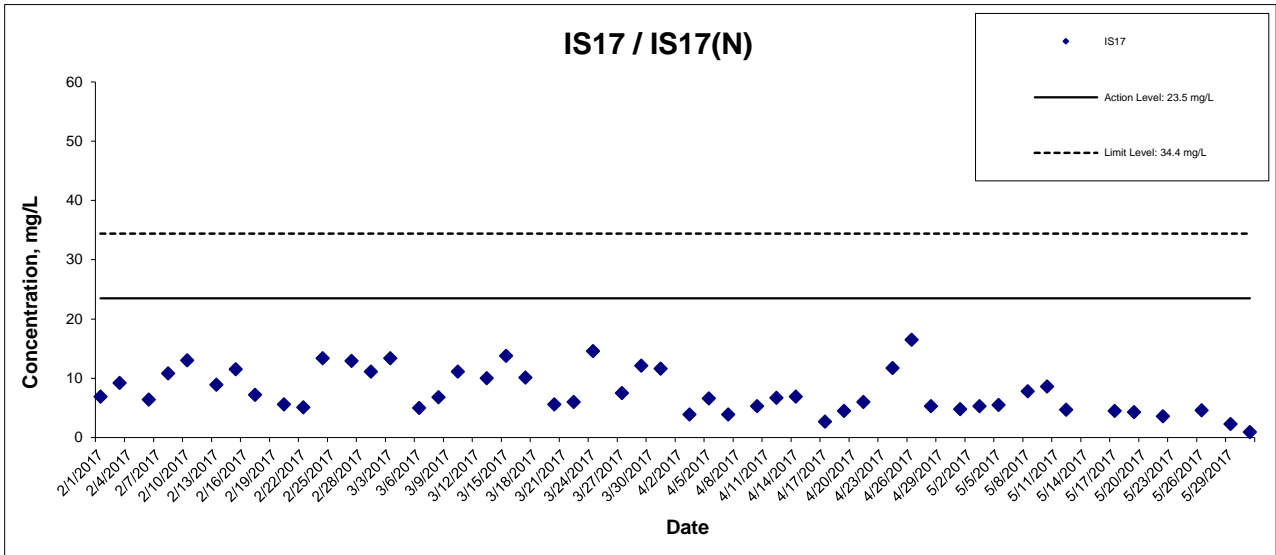
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Flood Tide



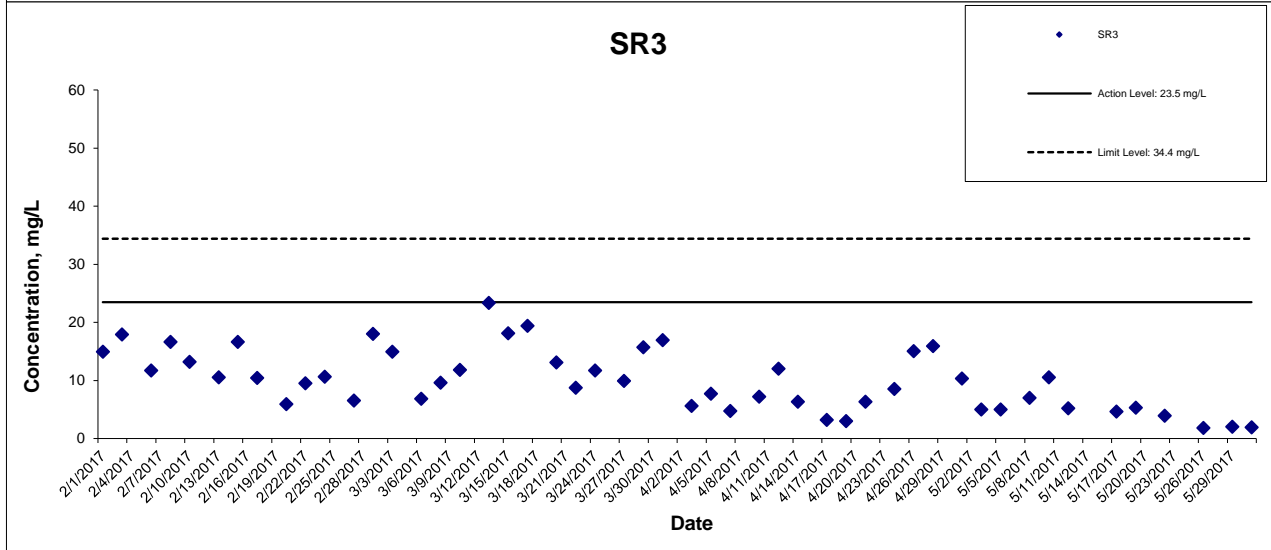
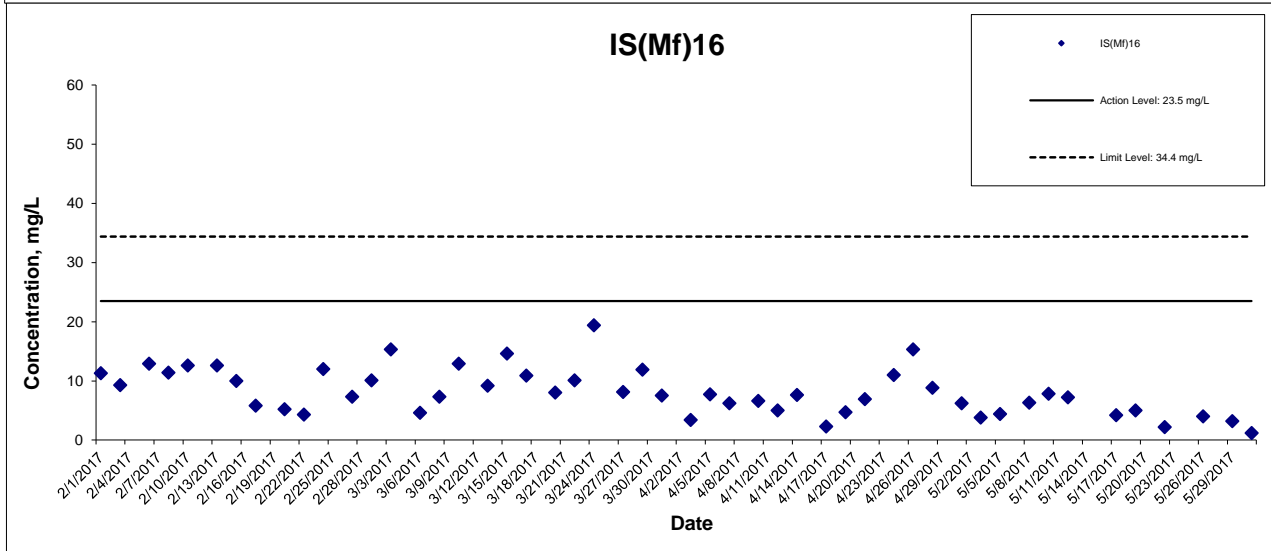
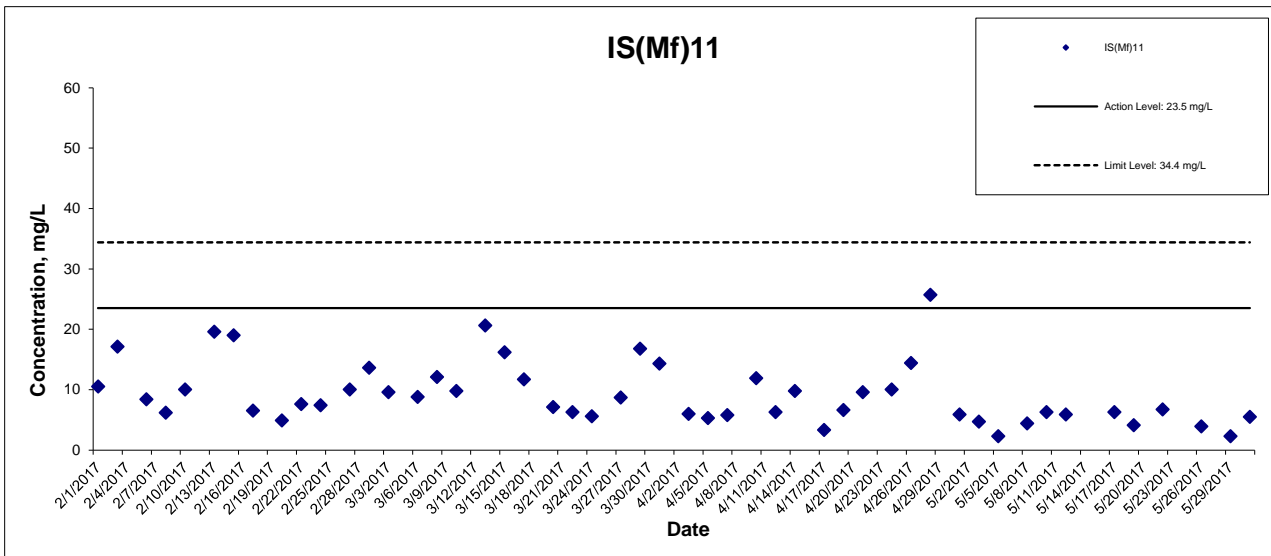
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Flood Tide



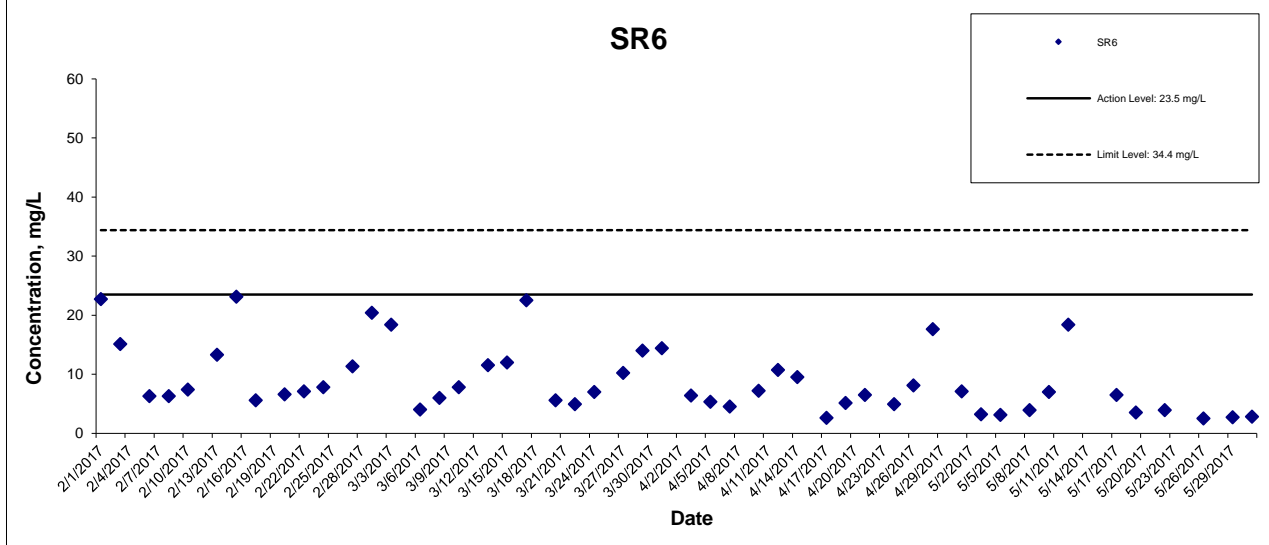
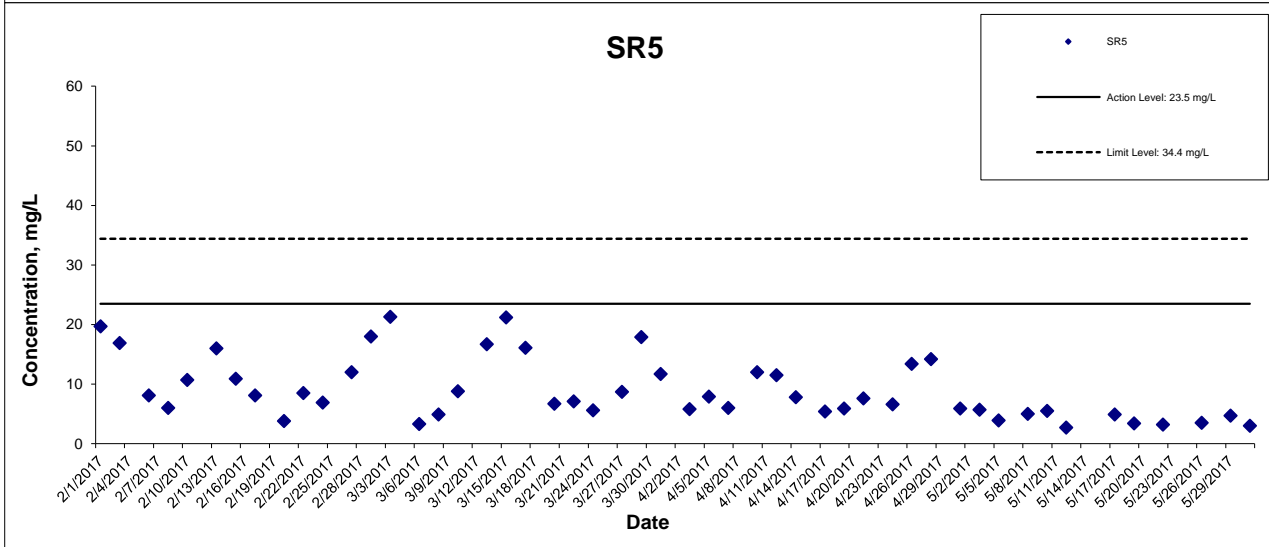
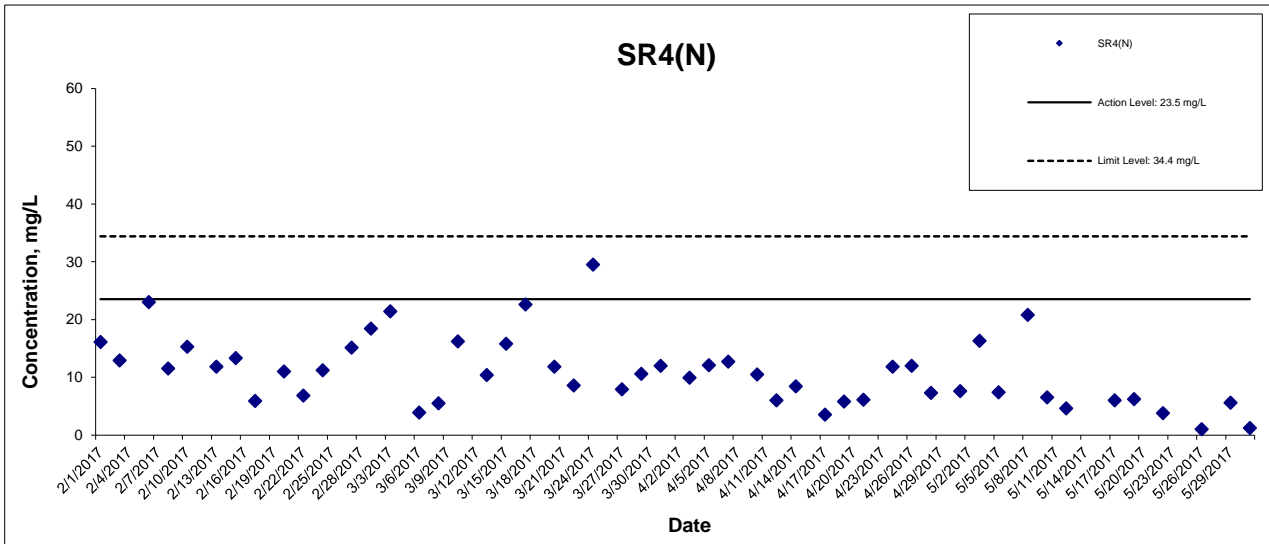
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Flood Tide



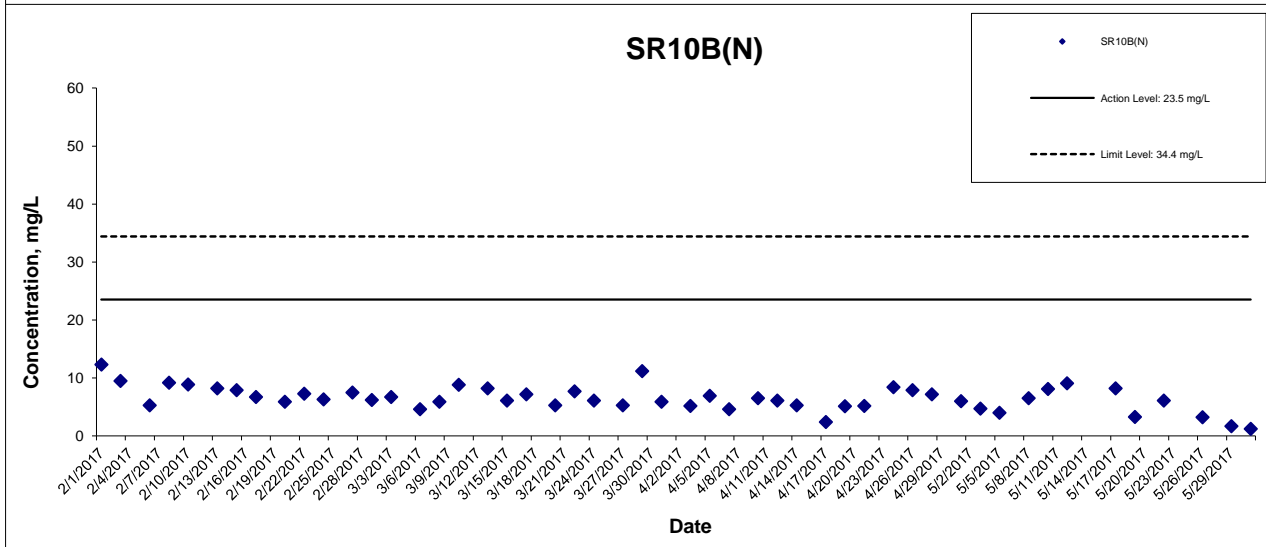
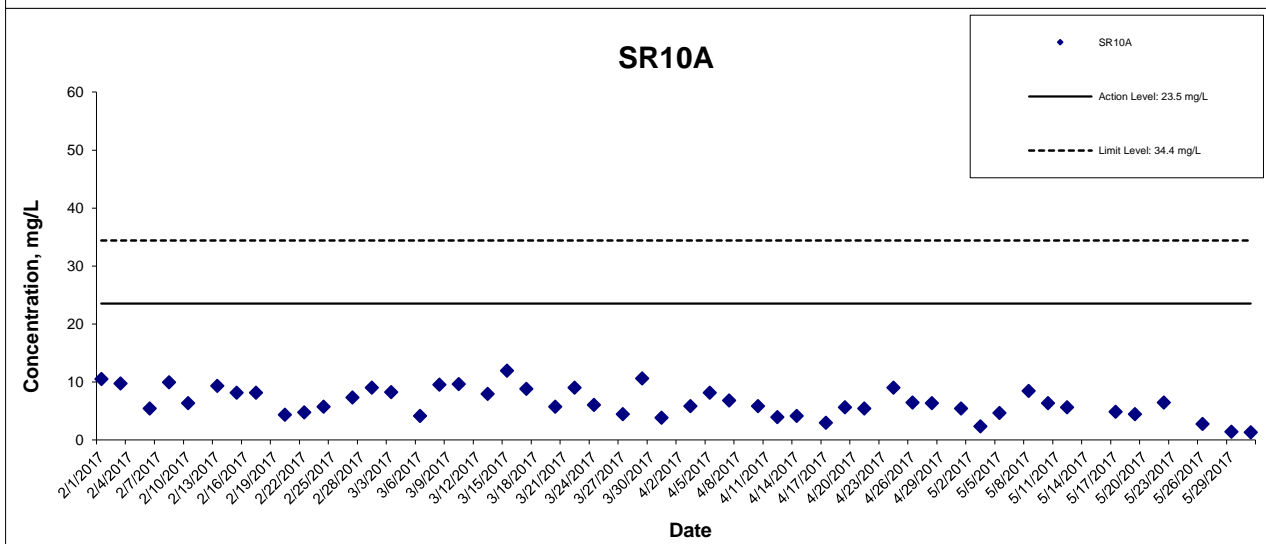
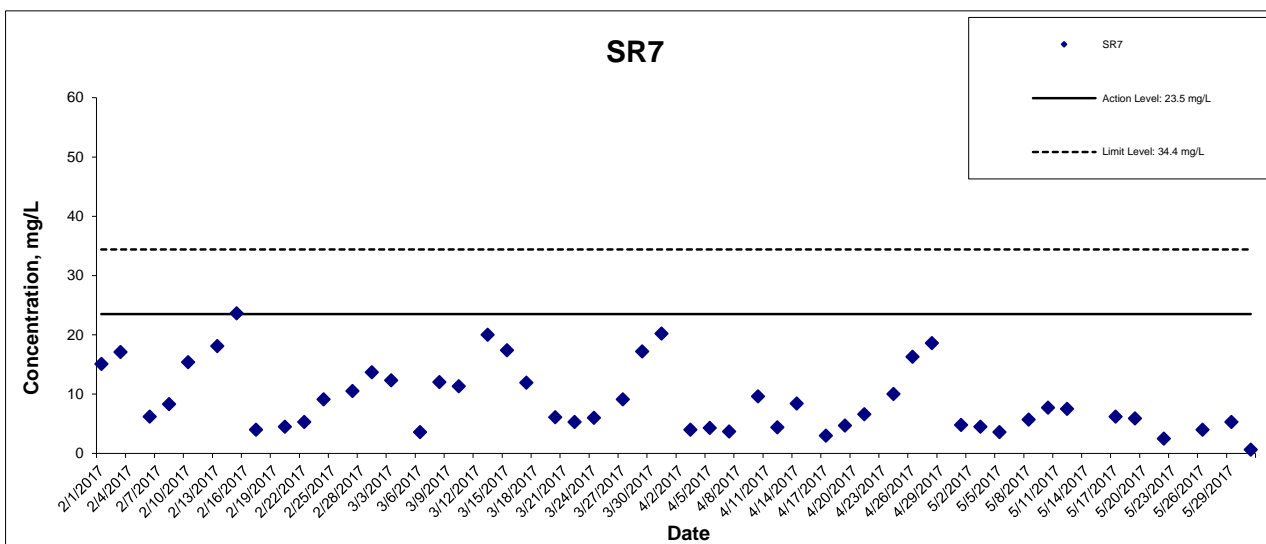
This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

## Suspended Solids at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

### Suspended Solids at Mid-Flood Tide



This Drawing has been prepared for the use of AECOM's client. It may not be used, modified, reproduced or relied upon by third parties, except as agreed by AECOM or as required by law. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that uses or relies on this drawing without AECOM's express written consent.

# Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing Facilities-Reclamation Works



**March – May 2017  
Quarterly Report**

**Dolphin Impact Monitoring**

## TABLE OF CONTENTS

<b>1. Introduction</b>	<b>1</b>
<b>2. Objectives and Methodology</b>	<b>2</b>
2.1. <i>Objectives of the Present Study</i>	2
2.2. <i>Line-transect Vessel Surveys</i>	2
2.2.1 Baseline Survey Data and Data from Impact Monitoring	3
2.3. <i>Photo-Identification</i>	8
2.4. <i>Data Analyses</i>	8
2.4.1. Distribution pattern analysis	8
2.4.2. Encounter rate analysis	8
2.4.3. Quantitative grid analysis on habitat use	8
2.4.4. Behavioural analysis	8
2.4.5. Ranging pattern analysis	9
<b>3. Results and Discussions</b>	<b>9</b>
3.1. <i>Summary of survey effort and dolphin sightings</i>	9
3.2. <i>Distribution</i>	11
3.3. <i>Encounter rate</i>	12
3.4. <i>Group size</i>	13
3.5. <i>Habitat use</i>	14
3.6. <i>Mother-calf pairs</i>	14
3.7 <i>Activities</i>	15
3.8. <i>Photo-identification work and individual range use</i>	15
<b>4. Conclusions</b>	<b>16</b>
<b>5. References</b>	<b>17</b>



**Tables**

Table 1	The Dolphin Monitoring Transect Co-Ordinates for HKBCF Monthly Monitoring (March-April 2017)	4
Table 2	The Dolphin Monitoring Transect Co-Ordinates for HKBCF Monthly Monitoring (May 2017)	6
Table 3	A Comparison of Total Sightings Recorded in NEL and NWL Areas During Sep – Nov 2011; March – May 2011; 2012; 2013; 2014, 2015, 2016 and 2017	10
Table 4	A Comparison of “On Effort” Sightings Recorded in NEL and NWL Combined During Sep – Nov 2011; March – May 2011; 2012; 2013; 2014, 2015, 2016 and 2017	11
Table 5	A Comparison of “On Effort” Sightings Recorded in NEL and NWL During Sep – Nov 2011; March – May 2011, 2012, 2013, 2014, 2015, 2016 and 2017	12
Table 6	A Comparison of Encounter Rates* in NEL and NWL Areas During Sep – Nov 2011; March – May 2011, 2012, 2013, 2014, 2015, 2016 and 2017	13
Table 7	A Comparison of Sightings Group Size Averages Recorded in NEL and NWL Areas During Baseline (Sept – Nov 2011); March – May 2011; 2012; 2013; 2014, 2015, 2016 and 2017	14
Table 8	Dolphins Frequently Recorded During Impact Monitoring Surveys.	15

**Figures**

Figure 1.	The Hong Kong Boundary Crossing (HKBCF) Reclamation Sites, North Lantau, Hong Kong	1
Figure 2	Location of the Transect Lines for Baseline and Impact Monitoring during HKBCF (modified to accommodate HKBCF)	5
Figure 3	Location of the Transect Lines for Baseline and Impact Monitoring during HKBCF (modified to accommodate 3RS)	7
Figure 4	Distribution of Sightings Recorded During Impact Monitoring Surveys for HKBCF (March 2017)	19
Figure 5	Distribution of Sightings Recorded During Impact Monitoring Surveys for HKBCF (May 2017)	20
Figure 6	Distribution of Sightings Recorded During Impact Monitoring Surveys for HKBCF (March – May 2017)	21
Figure 7.	The Location of Dolphin Groups Numbering 5 and Above Individuals (March – May 2017)	22
Figure 8	Sighting density SPSE (number of on-effort sightings per 100 units of survey effort) for March – May 2017	23

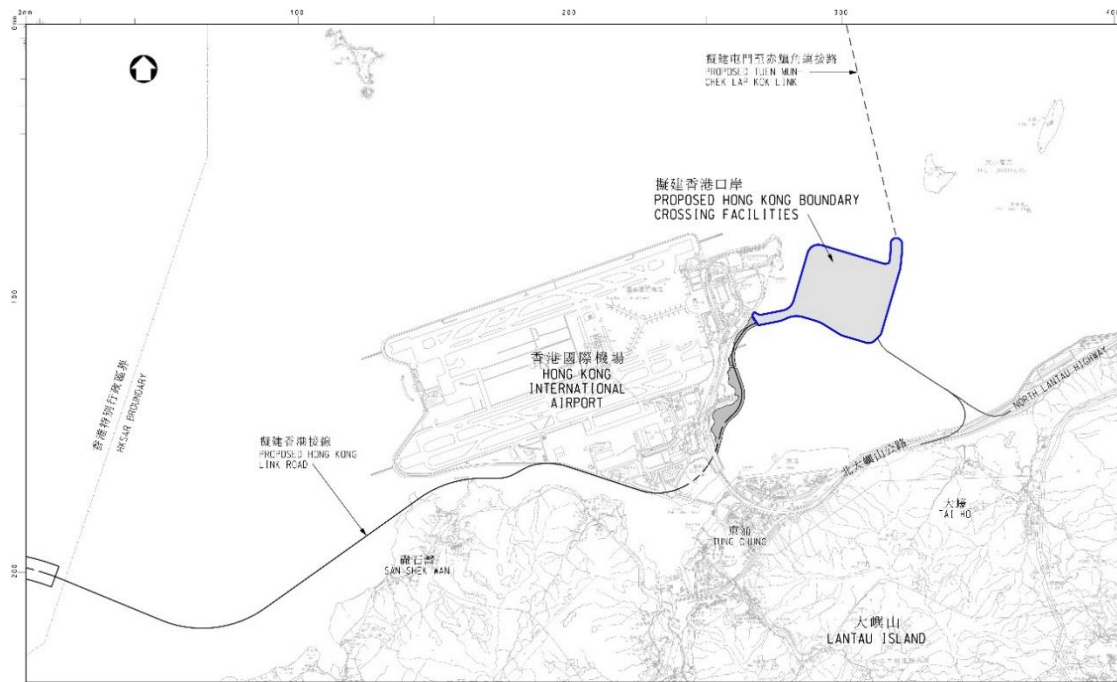
Figure 9	Dolphin density DPSE (number of dolphins per 100 units of survey effort) for March – May 2017	24
Figure 10	DPSE Shifts from NEL to NWL Waters during the Periods March – May, 2012 to 2017	25
Figure 11	SPSE Shifts from NEL to NWL Waters during the Periods March – May, 2012 to 2017	26
Figure 12	Activity Budget for Dolphin Behaviour March – May 2017	27
Figure 13	The Location of Different Behavioural Activities March – May 2017	28
Figure 14	Kernel density estimate and plot for HZMB 022 (March 2012-May 2017), using all sightings	29
Figure 15	Kernel density estimate and plot for HZMB 054 [CH34] (March 2012-May 2017), with comparison to AFCD data of dolphin KDE prior to HZMB construction (top left; where red dots indicate sightings made in 2010 & 2011 and yellow dots made prior to 2011) (AFCD 2012; AFCD and Guangdong Pearl River Estuary Chinese White Dolphin National Nature Reserve 2015).	30

## **ANNEXES**

Annex I	Impact Monitoring Survey Schedule and Details (March – May 2017)
Annex II	Impact Monitoring Survey Effort Summary (March – May 2017)
Annex III	Impact Monitoring Sighting Database (March – May 2017)
Annex IV	Photo ID Images (March 2012 – May 2017)

## 1. Introduction

In March 2012, construction for the Hong Kong-Zhuhai-Macao Bridge (HZMB) began in Hong Kong territorial waters. In Hong Kong, the HZMB comprises three projects; the Hong Kong Boundary Crossing Facilities (HKBCF) Project; the Hong Kong Link Road (HKLR) Project and; the Tuen Mun-Chek Lap Kok Link (TM-CLKL) Project. The HKBCF, the first of the HZMB projects to commence in Hong Kong, requires the total reclamation of approximately 149 hectares (ha); which consists of 130 ha for the HKBCF artificial island and 19 ha for the TM-CLKL southern landfall (Fig. 1).



**Figure 1. The Hong Kong Boundary Crossing (HKBCF) Reclamation Sites, North Lantau, Hong Kong ([http://www.hzmb.hk/eng/img/overview/about\\_overview03\\_p01l.jpg](http://www.hzmb.hk/eng/img/overview/about_overview03_p01l.jpg))**

The EM&A Manuals and Environmental Permits (EP) associated with all three projects have special provision for Chinese white dolphins (CWD) as they occur regularly in the waters which will be affected by the HZMB development. This report comprises the twenty first quarterly (March 2017 – May 2017) summary of data associated with the impact monitoring conducted for contract HY/2010/02, HKBCF-Reclamation Works. The format of this report follows as closely as possible the outline provided for the Baseline Monitoring Report. The baseline monitoring was conducted during a different season (the “autumn” months of September to November, 2011), however, some monitoring was conducted in the period March – May prior to HZMB project commencement therefore, March – May 2011, March – May 2012, March – May 2013, March – May 2014, March – May 2015 and March – May 2016 can be compared directly to this reporting period as well as referencing the baseline data. Where appropriate, information from previous reports, data provided by the Hong Kong Highways Department (HyD) and data from the Agriculture, Fisheries and Conservation Department (AFCD) Marine Mammal Annual Monitoring reports have also been incorporated<sup>1</sup>

<sup>1</sup>[http://www.afcd.gov.hk/english/conservation/con\\_mar/con\\_mar\\_chi/con\\_mar\\_chi\\_chi/con\\_mar\\_chi\\_chi.html](http://www.afcd.gov.hk/english/conservation/con_mar/con_mar_chi/con_mar_chi_chi/con_mar_chi_chi.html)

## 2. OBJECTIVES AND METHODOLOGY

### 2.1. Objectives of the Present Study

The EM&A Manual for HZMB states that “A dolphin monitoring programme at North Lantau and West Lantau waters, in particular the dolphin sighting hotspots (e.g. Brothers Islands) and areas where juveniles have been sighted (e.g. West Lantau waters), should be set up to verify the predictions of impacts and to ensure that there are no unforeseen impacts on the dolphin population during construction phase”. For HKBCF the study area known as West Lantau was not included in the site specific EM&A Manual for construction phase survey work. As such, for HKBCF, vessel-based dolphin surveys to monitor impact are conducted in the areas known as Northeast Lantau (NEL) and Northwest Lantau (NWL). These surveys are conducted twice monthly and for the duration of the construction phase of HKBCF. The HZMB baseline study (incorporating HKBCF, TM-CLK and HKLR phases of the bridge development), indicates that the data gathered from these surveys are intended to monitor impacts by;

- providing ongoing assessment of the spatial and temporal distribution patterns and habitat use of CWD during the construction phase of the HKBCF project.
- identifying individual CWD by their natural marks, coloration and scars for comparison with the baseline data and to assess individual distribution patterns and habitat use.
- comparing impact survey data to that gathered during the baseline data period so that any changes deemed to be of a significant nature can be assessed and mitigated appropriately.

The baseline monitoring report includes distribution analysis, encounter rate analysis, behavioural analysis, quantitative grid analysis and ranging pattern analysis. Protocols for data interpretation and analyses methods were provided in the baseline monitoring report and are used herein solely for comparative purposes.

### 2.2. Line-transect Vessel Surveys

The co-ordinates for the transect lines and layout map were provided by AFCD, however, as HZMB construction works have progressed, some transect lines have been blocked, temporarily or permanently, either by the working vessels or the bridge structure itself. These are detailed in monthly submissions to ENPO. For this reporting quarter, two sets of transect lines were surveyed; in March and April, 23 transects (totalling ~108km) were surveyed twice per month by boat (Table 1; Figure 2) and in May a shortened set of lines were travelled due to the blocking of the NWL area by the Third Runway System (3RS) construction site (Table 2, Figure 3). Line transect surveys should be conducted systematically (Buckland *et al* 2001). The survey conduct for each set of lines was identical and the same as that conducted since impact monitoring commenced and dataset integration is continuous. When the start of a transect line is reached, “on effort” survey begins. When the vessel is travelling between transect lines and to and from the study area, it is deemed to be “off effort”. As per EM&A protocols, the boat travels at a speed of 7-8 knots (13-15 km/hr), except during some periods when tide and current flow exceeds 7 knots and thus the vessel travels at the same speed as the current. A minimum of four marine mammal observers (MMOs) are present on each survey, rotating through four positions; observers (2), data recorder (1) and rest (1). Rotations occur every 30 minutes or at the end of dolphin sightings. The data recorder enters vessel effort, observer effort, weather and sightings information directly onto the programme Logger<sup>2</sup> and is not part of the observer team. This is not ideal line transect survey procedure, however, the

---

<sup>2</sup> Logger is purpose built software which automatically collects and stores GPS data and contains a user configurable interface for the manual entry of the data required for line transect and other cetacean research studies (Gillespie *et al* 2010).

baseline study was conducted this way thus it has been requested that only two observers be used for impact surveys.

When the boat is travelling along the transect line (“on effort”), observers search the area in front of the boat between 90° and 270° abeam (bow being 0°). When a group of dolphins is sighted, position, bearing and distance data are recorded immediately onto Logger and, after a short observation, an estimate is made of group size<sup>3</sup>. This is an “on effort” sighting. These input parameters are linked to the time-GPS-ships data which are automatically stored in Logger throughout the survey period. In this manner, information on heading, position, speed, weather, effort and sightings are stored in an interlinked database which can be subsequently used in a variety of analytical software packages.

Once the vessel leaves the transect line, it is deemed to be “off-effort”. The dolphins are approached with the purpose of taking high resolution images. Then the vessel returns to the transect line at the point of departure and is again “on effort”. If another group of dolphins is seen while travelling back to the transect line, or when with the first group of dolphins, the sightings are considered as “opportunistic” and noted accordingly.

### 2.2.1 Baseline Survey Data and Data from Impact Monitoring

Data from the baseline was provided by the Highways Department (January 2013). These data were extracted from the original baseline survey as the baseline survey encompassed a wider area than that stipulated in the EM&A Manual for the HKBCF Project, as such, a subset of the baseline data set was provided and appropriate rates and densities recalculated from the data provided. For impact monitoring, detailed datasets are available online via the ENPO website.

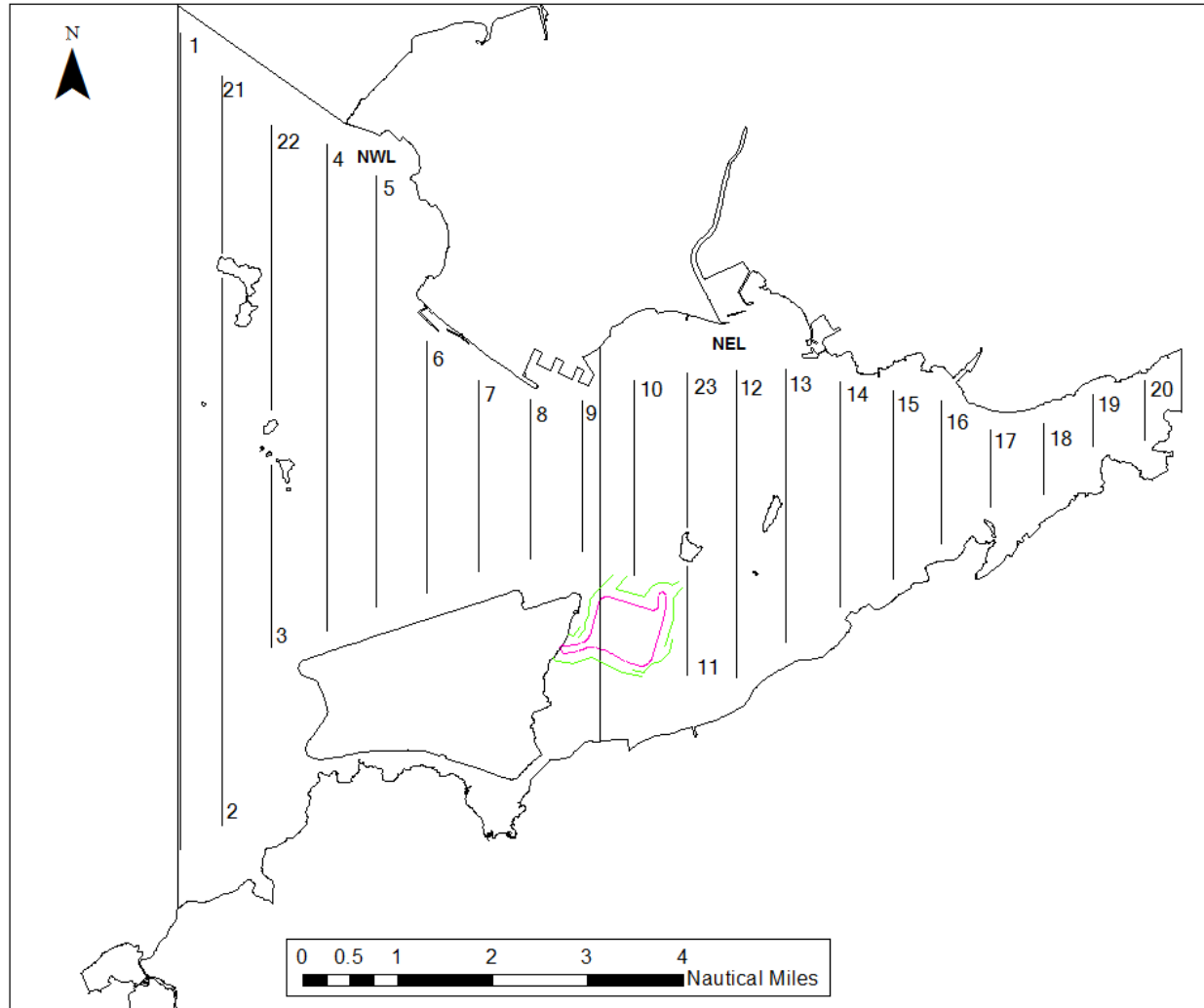
---

<sup>3</sup> Group size is defined as an aggregation of dolphins within 100m of each other involved in similar behaviour (Connor *et al* 1998).

**Table 1. The Dolphin Monitoring Transect Co-ordinates for HKBCF Monthly Monitoring (March-April 2017)**

ID	X	Y	Long	Lat	ID	X	Y	Long	Lat
1	804671	815456	113.87029	22.2777	12	815542	824882	113.97565	22.3630
1	804671	831404	113.86998	22.4217	13	816506	819480	113.98507	22.3142
2	805475	815913	113.87808	22.2818	13	816506	824859	113.98501	22.3628
2	805477	826654	113.87790	22.3788	14	817537	820220	113.99507	22.3209
3	806464	819435	113.88762	22.3136	14	817537	824613	113.99502	22.3606
3	806464	822911	113.88755	22.3450	15	818568	820735	114.00507	22.3256
4	807518	819771	113.89783	22.3167	15	818568	824433	114.00503	22.3589
4	807518	829230	113.89766	22.4021	16	819532	821420	114.01442	22.3317
5	808504	820220	113.90740	22.3208	16	819532	824209	114.01439	22.3569
5	808504	828602	113.90725	22.3965	17	820451	822125	114.02333	22.3381
6	809490	820466	113.91697	22.3230	17	820451	823671	114.02332	22.3521
6	809490	825352	113.91688	22.3671	18	821504	822371	114.03356	22.3404
7	810499	820880	113.92675	22.3268	18	821504	823761	114.03354	22.3529
7	810499	824613	113.92669	22.3605	19	822513	823268	114.04334	22.3485
8	811508	821123	113.93654	22.3290	19	822513	824321	114.04333	22.3580
8	811508	824254	113.93649	22.3572	20	823477	823402	114.05270	22.3497
9	812516	821303	113.94632	22.3306	20	823477	824613	114.05269	22.3606
9	812516	824254	113.94628	22.3573	21	805476	827081	113.87788	22.3827
10	813525	820827	113.95611	22.3263	21	805476	830562	113.87781	22.4141
10	813525	824657	113.95607	22.3609	22	806464	824033	113.88752	22.3552
11	814556	818853	113.96616	22.3049	22	806464	829598	113.88742	22.4054
11	814556	820992	113.96613	22.3278	23	814559	821739	113.96614	22.3346
12	815542	818807	113.97573	22.3081	23	814559	824768	113.96610	22.3619

The total transect length for NEL and NWL combined is 108km (approved 19-08-2015)



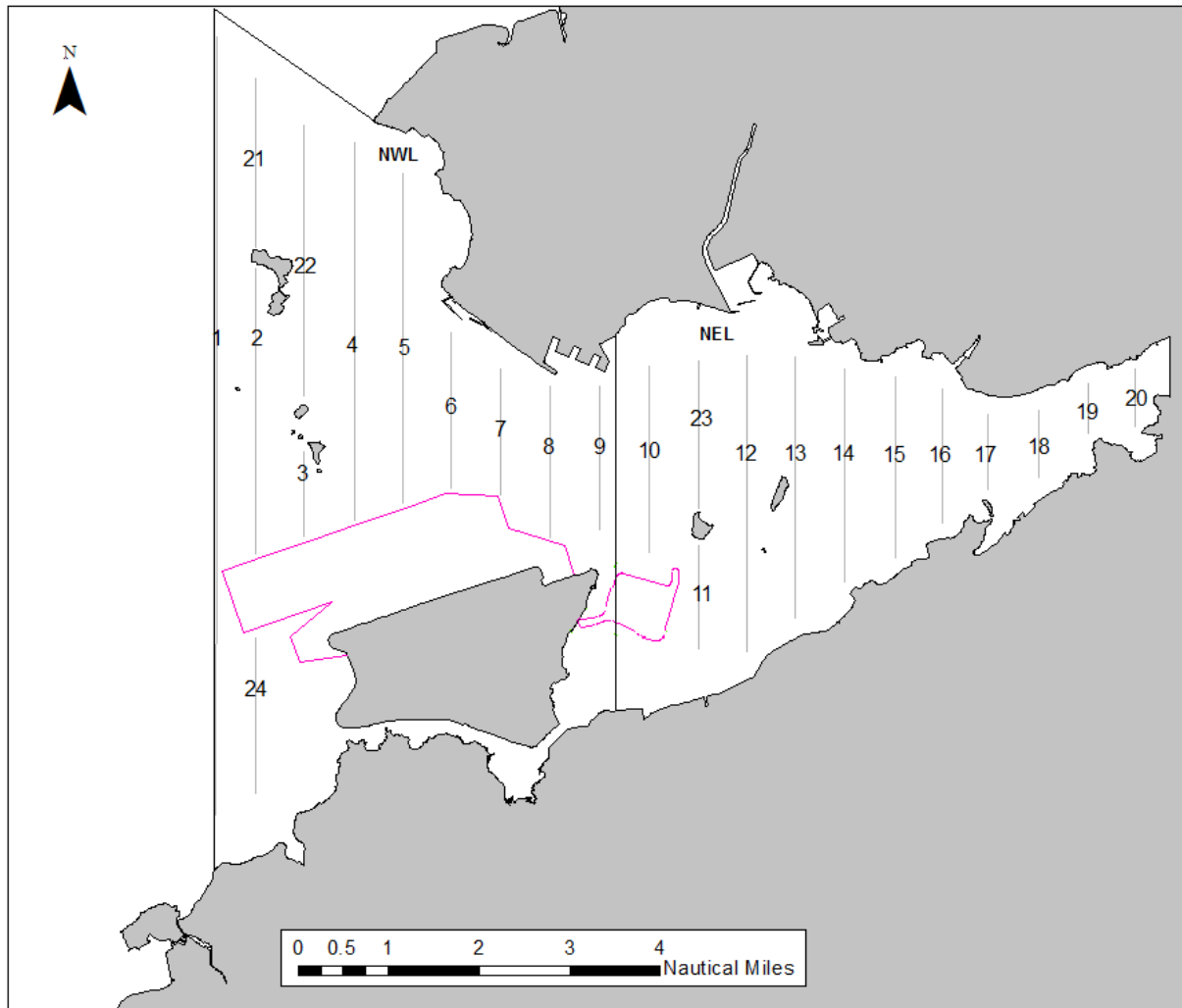
**Figure 2** Location of Transect Lines for Impact Monitoring during HKBCF (modified to accommodate HZMB)

**Table 2. The Dolphin Monitoring Transect Co-ordinates for HKBCF Monthly Monitoring (May 2017)**

ID	Easting	Northing	Latitude (DD.DDDD)	Longitude (DD.DDD)	ID	Easting	Northing	Latitude (DD.DDDD)	Longitude (DD.DDD)
1	804671	815456	22.27768	113.8703	13	816506	819480	22.31419	113.9851
1	804671	831404	22.42170	113.8700	13	816506	824859	22.36277	113.9850
2	805476	820800	22.32595	113.8780	14	817537	820220	22.32089	113.9951
2	805476	826654	22.37882	113.8779	14	817537	824613	22.36056	113.9950
3	806464	821150	22.32913	113.8876	15	818568	820735	22.32555	114.0051
3	806464	822911	22.34503	113.8875	15	818568	824433	22.35894	114.0050
4	807518	821500	22.33231	113.8978	16	819532	821420	22.33174	114.0144
4	807518	829230	22.40211	113.8977	16	819532	824209	22.35693	114.0144
5	808504	821850	22.33549	113.9074	17	820451	822125	22.33812	114.0233
5	808504	828602	22.39646	113.9073	17	820451	823671	22.35208	114.0233
6	809490	822150	22.33821	113.9169	18	821504	822371	22.34035	114.0336
6	809490	825352	22.36713	113.9169	18	821504	823761	22.35290	114.0335
7	810499	822000	22.33687	113.9267	19	822513	823268	22.34846	114.0433
7	810499	824613	22.36047	113.9267	19	822513	824321	22.35797	114.0433
8	811508	821123	22.32897	113.9365	20	823477	823402	22.34968	114.0527
8	811508	824254	22.35724	113.9365	20	823477	824613	22.36061	114.0527
9	812516	821303	22.33061	113.9463	21	805476	827081	22.38267	113.8779
9	812516	824254	22.35725	113.9463	21	805476	830562	22.41411	113.8778
10	813525	820827	22.32632	113.9561	22	806464	824033	22.35516	113.8875
10	813525	824657	22.36091	113.9561	22	806464	829598	22.40542	113.8874
11	814556	818853	22.30851	113.9662	23	814559	821739	22.33457	113.9661
11	814556	820992	22.32782	113.9661	23	814559	824768	22.36192	113.9661
12	815542	818807	22.30810	113.9757	24	805476	815900	22.28170	113.8781
12	815542	824882	22.36296	113.9756	24	805476	819100	22.31060	113.8780

The total transect length for NEL and NWL combined is 99km (approved 12-05-2017)





**Figure 3** Location of Transect Lines for Impact Monitoring during HKBCF (modified to accommodate 3RS)

### 2.3. Photo-identification

When a dolphin(s) is sighted, the vessel leaves the transect line and slowly approaches the group or individual. Attempts are made to photograph every individual sighted although close approaches to mother and calf pairs are not attempted. Digital SLR cameras (Nikon D750; D7100) using long lenses (Nikor 80-400mm and fixed length 300mm) are used to obtain high resolution images. Effort is made to ensure consistency of image quality, e.g., no shadow and at an angle perpendicular to the dorsal fin. Polarising filters are used to minimise glare. In this manner, the best image clarity is achieved and image sorting and matching is more consistent. Images are sorted according to clarity and presence/absence of identifying features (nicks /cuts/deformities/injury/pigmentation). Only images deemed to be of suitable quality and as containing sufficient markings for unambiguous identification are included in the photo-identification catalogue. A review of photo identification techniques has set a global standard for cataloguing protocols and the HZMB system was reviewed and conforms to these international best practises (Urian *et al* 2014).

### 2.4. Data Analyses

#### 2.4.1. Distribution pattern analysis

Dolphin sightings data were mapped in the Geographic Information System (GIS) ArcView© 10.3.

#### 2.4.2. Encounter rate analysis

For this report, the baseline encounter rates were re-calculated using the revised data provided rather than quoting directly from the baseline report. Calculation followed the EM&A Manuel methodology (“on-effort” sightings made during favourable weather and good visibility conditions).

#### 2.4.3. Quantitative grid analysis of habitat use

Quantitative grid analysis is performed by mapping both sighting and dolphin densities plotted onto 1kmx1km grid squares. Only “on effort” sightings made while on a transect line and under favourable conditions should be included in grid analyses. These densities are standardised by effort by calculating survey coverage in each line transect survey to determine the number of times the grid has been surveyed. Densities are calculated using the following formulae;

SPSE and DPSE:

$$SPSE = (S/E \times 100)/SA\%$$

$$DPSE = (D/E \times 100)/SA\%$$

Where;

S= total number “on effort” sightings

D = total number dolphins from “on effort” sightings

E = total number units survey effort

SA% = percentage of sea area

#### 2.4.4. Behavioural analysis

When dolphins are sighted during vessel surveys, their behaviour is observed. Different activities are categorised (i.e. feeding, traveling, surface active, associated with boats, unknown) and recorded in the sighting data form of Logger. The sightings form is integrated with survey effort and positional data and can be subsequently mapped to examine distribution and behavioural trends. All sightings data (“on-effort” and “opportunistic”) are used in this analysis.

#### 2.4.5. Ranging pattern analysis

In the baseline monitoring report, the program Animal Movement Analyst Extension, created by the Alaska Biological Science Centre, USGS was used in conjunction with ArcView© 3.1 and Spatial Analyst 2.0. Using the fixed kernel method, kernel density estimates and kernel density plots are created using all sightings. In the baseline monitoring, data from other studies and from outside the baseline monitoring period were used to map individual ranges. It is important to maximize the number of sightings used as there has been discussion on the number of independent resightings required to conduct kernel analyses before it has accuracy (Wauters *et al* 2007; Kauhala and Auttila 2010; de Faria Oshima and de Oliveira Santos, 2016). AFCD Annual Reports use a minimum of 15 resightings for kernel analyses (AFCD 2012). For the purposes of reporting on this project, 15 or more independent resightings per individual will be used to map utilisation densities using the fixed kernel method. Geographic Information System (GIS) ArcView© 10.3 was used to map ranging patterns. Geographic Information System (GIS) ArcView© 10.3. is the current GIS ArcView, that incorporates a spatial analysis module within the software, and this version can be used to perform ranging pattern analyses which outputs equivalent results to that obtained from ArcView© 3.1 and Spatial Analyst 2.0. Using the fixed kernel method, a kernel density plot was estimated, using all sightings, at 95% UD (utilisation density).

### 3. RESULTS AND DISCUSSIONS

#### 3.1. Summary of survey effort and dolphin sightings

From March – May 2017, 12 vessel surveys were conducted in NEL and NWL survey areas (Annex I). A total of 614.9 km of “on-effort” transect lines were conducted, 610.9 km (99%) of which were conducted under favourable conditions (Beaufort 3 or better) (Annex II). During March – May 2017, 5 groups of dolphins, numbering 16 (min 16: max 19<sup>4</sup>) individuals, were sighted from the vessel surveys. Of these, two groups were “on-effort” and the remaining three groups were “opportunistic” (Annex III).

All 5 sightings occurred while the NWL sector was being surveyed. The baseline report, conducted during September-November 2011, notes a total of 44 groups, 34 of which occurred in NWL and 10 in NEL. The baseline surveys were conducted outside the current period (March – May) and, as dolphin occurrence is known to change seasonally within Hong Kong waters, the same quarterly period for 2011, 2012, 2013, 2014, 2015 and 2016 are also included in this report for comparative purposes (Table 3). During March – May 2011 (the advanced monitoring period), 20 groups were seen in NWL and 9 in NEL. During March – May 2012, which was the first three months of the HKBCF works, 19 groups and a single group were recorded in NWL and NEL, respectively. For March – May 2013, 22 groups were seen in NWL and none in NEL. In March – May 2014, 15 groups were seen in NWL and, again, none, in NEL. In March – May 2015, ten groups were seen in NWL and none in NEL. And in March – May 2016, 15 groups were seen in NWL and none in NEL. For the periods March – May, from one year prior to HKBCF works to 2014, there have been approximately the same number of dolphin groups sighted in NWL (15 to 22 groups). March – May 2015 recorded only 10 groups sighted in NWL, followed by an increase in the 2016 period to 15 group sightings. This quarter, March – May 2017, has the lowest number of sightings recorded for this period, only 5, and for the first time, no sightings at all were made during one full month of surveys (April 2017). For NEL, there were fewer groups encountered during impact monitoring than during the same period the year before works started. These data have not been corrected for effort. Maps depicting location of sightings, also not corrected for effort, are included as Figs. 4;5;6.

---

<sup>4</sup> During sightings a minimum, maximum and best estimate of group size is noted; the range stated represents the minimum and maximum numbers estimated)

**Table 3. A Comparison of Total Sightings Recorded in NEL and NWL Areas During Sep – Nov 2011; March – May 2011; 2012; 2013; 2014; 2015, 2016 and 2017.**

Monitoring Period	Total Dolphin Sighting in NWL	Total Dolphin Sighting in NEL
	Number of Groups	Number of Groups
March – May 2011 (Advanced Monitoring)	20	9
Sep – Nov 2011 (Baseline Monitoring)	34	10
March – May 2012 (Impact Monitoring)	19	1
March – May 2013 (Impact Monitoring)	22	0
March – May 2014 (Impact Monitoring)	15	0
March – May 2015 (Impact Monitoring)	10	0
March – May 2016 (Impact Monitoring)	15	0
March – May 2017 (Impact Monitoring)	5	0

As per the EM&A manual, only “on effort” sightings can be used for some analyses therefore, the combined number of “on effort” sightings for the baseline and the months March – May 2011, 2012, 2013, 2014, 2015, 2016 and 2017 were compared. The baseline study had considerably more “on effort” sightings compared to the March to May period prior to works commencement as well as the following five March to May periods. It is noted, again, that seasonal patterns must be considered when assessing differences between years. When compared to baseline data, there is a general decrease in absolute numbers of “on effort” groups noted between the March to May periods from 2012 to 2017. It is noted that the advanced monitoring period (the year prior to works commencement) also records a lower number of dolphin groups, although surveys were not conducted at the same frequency during this period so, overall, the trend is not consistent (Table 4). No correction for effort is made with these numbers, this is calculated in section 3.3.

**Table 4. A Comparison of “On Effort” Sightings Recorded in NEL and NWL Combined During Sep – Nov 2011; March – May 2011; 2012; 2013; 2014, 2015, 2016 and 2017**

<b>Monitoring Period</b>	<b>Groups of Dolphin sighted in NEL and NWL</b>
March – May 2011 (Advanced Monitoring)	22
Sep - Nov 2011 (Baseline Monitoring)	44
March – May 2012 (Impact Monitoring)	12
March – May 2013 (Impact Monitoring)	17
March – May 2014 (Impact Monitoring)	11
March – May 2015 (Impact Monitoring)	7
March – May 2016 (Impact Monitoring)	6
March – May 2017 (Impact Monitoring)	2

### *3.2. Distribution*

During the baseline survey, ~77% of all “on effort” sightings were made in NWL. During March – May 2011, 68% of “on effort” sightings occurred in NWL and for the same quarterly period from 2012 to 2017, inclusive, 100% of “on effort” sightings occurred in NWL. Between Advanced and Baseline monitoring, prior to construction at HKBCF, there was a trend for an increased use of NWL habitat. An increase in use of habitat over the winter months is a previously documented trend in the long-term monitoring of this population (AFCD 2010; 2011; 2012). After construction activities commenced, for the period March – May, there was a slight increase in the first two years followed by a more marked decrease in absolute number of “on effort” encounters with dolphins. Again, there is no correction for effort for these group sightings (Table 5). The two on effort sightings were located adjacent to the Sha Chau Lung Kwu Chau Marine Park (SCLKCMP) and the three opportunistic sightings were located near Tai O. Since 1995, both of these areas have been consistently highlighted as important to some, but not all, of the dolphins which frequent Hong Kong waters (Fig. 6).

**Table 5. A Comparison of “On Effort” Sightings Recorded in NEL and NWL During Sep – Nov 2011; March – May 2011, 2012, 2013, 2014, 2015, 2016 and 2017.**

Monitoring Period	No. of Dolphin Groups sighted in NWL	No. of Dolphin Groups sighted in NEL
March-May 2011 (Advanced Monitoring)	15	7
Sep - Nov 2011 (Baseline Monitoring)**	34	10
March-May 2012 (Impact Monitoring)	12	0
March-May 2013 (Impact Monitoring)	17	0
March-May 2014 (Impact Monitoring)	11	0
March-May 2015 (Impact Monitoring)	7	0
March-May 2016 (Impact Monitoring)	6	0
March-May 2017 (Impact Monitoring)	2	0

### 3.3. Encounter rate

As some of the survey periods have different transect lengths, variation in sightings occurrence was quantified by correcting for effort (distance of transect lines surveyed, i.e., km spent “on-effort”), to obtain an encounter rate. The baseline study (Sep-Nov 2011) reports that a total of 545.6km<sup>5</sup> of survey effort was conducted under favourable conditions in the NEL and NWL survey areas. In NEL, a decrease in encounter rates has been documented prior to the start of construction activities at HKBCF and this has been attributed, largely, to the fast ferries which traverse this area (Marcotte *et al* 2015). Since commencement of the HKBCF, a marked decrease has been noted in dolphin occurrence in NEL for the periods March – May. In NWL, looking only at the period March – May, a decrease is also noted in encounter rates. The baseline monitoring encounter rate is the highest calculated, although this rate was obtained in a different season to the quarter covered by this report. This quarter notes the most dramatic reduction in encounter rate, for NWL in the March-May period, since impact monitoring began (Table 6).

<sup>5</sup> Updated data set provided April 2013

**Table 6. A Comparison of Encounter Rates\* in NEL and NWL Areas During Sep – Nov 2011; March – May 2011, 2012, 2013, 2014, 2015, 2016 and 2017.**

Monitoring Period	Encounter Rate NEL	Encounter Rate NWL
March - May 2011* (Advanced Monitoring)	7.5	8.8
Sept-Nov 2011 (Baseline Monitoring)	5.4	9.5
March - May 2012 (Impact Monitoring)	0.0	5.8
March - May 2013 (Impact Monitoring)	0.0	3.1
March - May 2014 (Impact Monitoring)	0.0	2.5
March - May 2015 (Impact Monitoring)	0.0	1.6
March - May 2016 (Impact Monitoring)	0.0	1.4
March - May 2017 (Impact Monitoring)	0.0	0.5

\* Survey conducted once per month

The AFCD Annual Reports describe variation in spatial distribution between areas and between seasons in both NEL and NWL. For years prior to the HZMB construction, it is reported that overall **annual encounter rate** for NEL varies between 1.6 and 6.2 and the **annual encounter rate** for NWL varies between 5.8 and 17.0. The encounter rate for NWL for the spring period during the first year of construction (March – May 2012) is within the annual limits recorded for this area previously, however, for the subsequent five years (March – May 2013; 2014; 2015, 2016 and 2017), the encounter rate falls below the lowest previously recorded annual encounter rate in AFCD records. For NEL, all encounter rates in the March-May period from 2012 to date are below the annual average for this area. Historically, there have been both up and down movements within these limits, however, the general trend in yearly encounter rate for dolphins in all areas of Hong Kong is that of significant decline over the last decade and prior to new development projects in the Lantau area (AFCD 2013; 2014; 2015). As the impact of the work at HKBCF continues, other works associated with the bridge have increased both in intensity and in geographical extent. Other projects not associated with the HZMB have also been ongoing in NEL and NWL, and other, adjacent areas. In particular, extensive in water works for the Third Runway System (3RS) have dramatically reduced the amount of habitat available to dolphins within NWL.

#### 3.4. Group size

During March – May 2017, group size of all sightings varied from 1 to 6 individuals with an average of 3.2 in NWL. For baseline monitoring, average group size was 4.5 and 3.5, in NWL and NEL. For the periods March – May 2011, 2012, 2013; 2014, 2015, 2016 and 2017 the group size in NWL is approximately the same, varying between 3.1 and 3.8 individuals. The group size in this quarter lies within previous yearly averages when compared to both advanced and previous quarters of impact monitoring. The NWL group size was highest during baseline, however, this was a different season (4.5). No groups have been noted in NEL in the periods March – May 2013, 2014, 2015, 2016 and 2017 (Table 7). There is no particular habitat preference for larger (>5) group sizes (Fig. 7). It has been noted previously that significantly larger groups are noted behind active fishing trawlers (Jefferson 2000). As trawlers no longer operate in Hong Kong waters, group size averages may have decreased due to this.

**Table 7. A Comparison of Sightings Group Size Averages Recorded in NEL and NWL Areas During Baseline (Sept – Nov 2011); March – May 2011; 2012; 2013; 2014, 2015, 2016 and 2017**

Monitoring Period	Average Group Size (NWL)	Average Group Size (NEL)
March-May 2011 (Advanced Monitoring)	3.1	2.3
Sept – Nov 2011 (Baseline Monitoring)	4.5	3.5
March-May 2012 (Impact Monitoring)	3.2	1
March-May 2013 (Impact Monitoring)	3.3	0
March-May 2014 (Impact Monitoring)	3.1	0
March-May 2015 (Impact Monitoring)	3.1	0
March-May 2016 (Impact Monitoring)	3.8	0
March-May 2017 (Impact Monitoring)	3.2	0

### 3.5. Habitat use

Quantitative grid analyses, noting the limitation of having only two sightings, show that in NWL, the area adjacent to the SCLKCMP was the site of both sightings. The southern portion of NWL, noted as a dolphin hotspot previously, had no “on-effort” dolphin sightings this quarter (Figs. 8; 9). SCLKCMP has been consistent in the long term and continues to be so. Habitat use between March – May 2012 to 2017, the first six years of construction at HKBCF, were compared. The density of individual dolphins (DSPE) using the NEL and NWL habitat in 2012, the first year of HKBCF construction, shows relatively widespread use with areas along the northeast of the airport platform, northeast Lung Kwu Chau, south west Sha Chau, the western maritime border and Tai O all as areas of use, although not high density use. In 2013, year two HKBCF, the area of highest use was the marine park area at SCLKC and the density of dolphins was higher when compared with the first year of monitoring. In 2014, the area usage is the same as 2013, however, the density of dolphins using the habitat has decreased. In 2015, there is a higher density use of the northern section of NWL and in 2016, two higher density areas are calculated to the south and west of SCLKC. In 2017, the habitat is infrequently visited by dolphins and then, in NWL, only adjacent to SCLKCMP (Figure 10). For groups of dolphins (SPSE), there are obvious parallels with DSPE, however, it is noted the density of individuals using the habitat of SCLKCMP increased between year 2012 and 2013. The density of individual use remained similar between 2013 and 2014 but then increased in 2015. Fewer areas of high density use are noted between 2015 and 2017. This indicates that, in general, the dolphins overall habitat use has decreased, then dolphins used certain areas, i.e., SCLKCMP environs, more intensively than previously and now, in 2017, both spatial use and intensity of use is much decreased (Fig. 11). In summary, during the first year of HKBCF work, there was widespread use of the NWL habitat in a lower density compared to the higher, more concentrated habitat use calculated for 2013 onwards, and, in 2017, there is an overall reduction in all habitat use, both in absolute number of encounters and group density.

### 3.6. Mother-calf pairs

No mother and calf pairs were noted. The same season last year (March - May 2016) recorded one mother and newborn calf pair.



### 3.7. Activities

Of the 5 groups sighted (using all sightings), two (60%) were engaged in feeding activities and three (40%) were travelling (Fig 13). There is little meaning in comparing so few sightings with previous activity budgets. Both feeding and travelling activities were noted near the SCLKCMP and the opportunistic sightings adjacent to the south of NWL also were engaged in travelling and feeding activities (Fig. 14).

### 3.8. Photo-identification work and individual range use

The photo-identification catalogue was regularly updated and re-sightings of dolphins previously identified were recorded. The project specific photo-identification catalogue for the impact monitoring period is presented in Annex IV. All dolphins including those sighted only in the baseline are included. Not all dolphins sighted have sufficient scarring, injury or pigmentation uniqueness to be unambiguously identified. During the baseline survey, 96 individuals were noted in the NEL, NWL and WL areas. Of these, 57 were noted in the NEL and NWL area. No new dolphins have been identified in the last quarter and the catalogue stands at 122 individuals. The HZMB catalogue has identified 14 dolphins that were seen in both baseline and impact monitoring period. Two further dolphins have been identified during impact monitoring which have been matched to the AFCD photo ID data held on the AFCD website<sup>6</sup>.

There are 16 dolphins which have been sighted on six days or more during impact monitoring, nine (9) of which are known from the AFCD catalogue (HZMB 001 [WL46]; HZMB 002 [WL111]; HZMB 011 [EL01]; HZMB 041 [NL24]; HZMB 044 [NL98]; HZMB 51 [NL213]; HZMB 054 [CH34]; HZMB 083 [NL136]; HZMB 098 [NL104]) (Table 7). The highest number of re-sightings recorded during impact monitoring surveys is 15 (HZMB 022), excluding multiple sightings made on the same day (Annex IV).

**Table 8. Dolphins Frequently Recorded During Impact Monitoring Surveys.**

HZMB ID	AFCD ID	SEEN IN BASELINE	No. DAYS SIGHTED IMPACT MONITORING
HZMB 022	unknown	N	15
HZMB 054	CH34	Y	15
HZMB 044	NL98	Y	13
HZMB 023	unknown	*	12
HZMB 002	WL111	Y	12
HZMB 098	NL104	Y	10
HZMB 083	NL136	Y	9
HZMB 001	WL46	N	8
HZMB 051	NL213	N	7
HZMB 005	unknown	*	7
HZMB 041	NL24	Y	7
HZMB 094	unknown	*	7
HZMB 011	EL01	Y	6
HZMB 040	unknown	*	6
HZMB 064	unknown	*	6
HZMB 074	unknown	*	5

\* cannot be determined

<sup>6</sup>[www.afcd.gov.hk/english/conservation/con\\_mar/con\\_mar\\_chi/con\\_mar\\_chi\\_chi\\_chi/files/Photoid\\_Booklet.pdf](http://www.afcd.gov.hk/english/conservation/con_mar/con_mar_chi/con_mar_chi_chi/files/Photoid_Booklet.pdf)

### 3.9 Ranging Pattern Analyses

Both HZMB 022 and HZMB 054 have been sighted on 15 different *days* since HKBCF dolphin monitoring began. HZMB 022 is regularly sighted within and adjacent to northern Sha Chau Lung Kwu Chau Marine Park (SCLKCMP). Over 6 years, this relatively small area within the NEL and NWL area appears to be preferred by this individual (Fig. 14). As it is not known what the AFCD ID number is for this dolphin, it is not possible to compare this range to a pre-construction time period. HZMB 054 is also known as CH34. This dolphin is a well known individual that AFCD's long term monitoring programme has recorded in NEL, NWL, WL and adjacent mainland Chinese waters. The impact monitoring for the HKBCF project is restricted to NEL and NWL waters and kernel range analysis for HZMB 054 [CH34] indicates core habitat use in both areas. The area calculated for impact range monitoring is incorporated within that calculated for the wider analyses of this individual's ranging patterns in Hong Kong and mainland Chinese waters (using data to 2013 as this is all that is available from the AFCD website<sup>7</sup>) (Fig 15).

## 4. CONCLUSION

The data from March – May 2017, shows some consistencies with the baseline data (conducted during a different season) and with the same periods in 2011, 2012, 2013, 2014, 2015 and 2016, although it is challenging to draw meaningful conclusions from so few sightings. In general, habitat use falls within those reported in AFCD Long Term Monitoring reports although as sightings numbers decrease, such patterns are difficult to compare. The quarterly encounter rates for both NEL and NWL are much lower than that reported for **annual** rates published previously and the seasonal trend for these two areas is of a declining encounter rate, which is more marked in this quarter than previous years. Density distribution maps depict key areas of habitat use within NWL, in particular, areas adjacent to SCLKCMP. Areas to the south of SCLKCMP and Tai O have seen diminished use since 2013 and this trend continues to date. No large groups were encountered and no new calves, or indeed any one year cohorts, were noted in this quarter. It is noted that habitat use, as indicated by dolphin density, is decreased all over the northern Lantau habitat. And, other than one sighting made during mitigation monitoring at the HKBCF site, no dolphins have been sighted in NEL during this quarter or the same quarters in the past few years. These observations are only for the period March to May, however, these trends are apparent year round now.

The dramatic decrease in encounter rate in NWL is noted. HKBCF monthly reporting notes that the conditions of EM&A Manuel have been consistently upheld and that all measures stipulated to minimise disturbance to dolphins remain in place. HKBCF activities are now minimal with all in water works ceasing in May 2017. Recent and extensive marine works that are not part of HKBCF, have been ongoing in NEL and also throughout a large portion of NWL habitat throughout this quarter period. In particular, the new works for 3RS are a magnitude greater in size than that of the HKBCF and are anticipated to have a much higher impact than HKBCF on dolphin behaviour and distribution. This may, in part, be apparent in this quarters unusually low encounter rates and complete absence of sightings in April 2017.

Some collaboration continues with cross border authorities, with regards to sharing photo ID catalogues. At recent meetings held between all environmental teams for HZMB, it was noted that some of the dolphins previously recorded in Hong Kong waters but which have been absent in the past few years, have been recorded, at least occasionally, in adjacent waters. An additional study initiated by ENPO and conducted in the Southwest Lantau (reported separately by others on the ENPO website) details further individual dolphin movement in Hong Kong waters, however, sightings in this area have dropped dramatically in recent months as well.

At the end of this quarter, all in water marine works associated with the HKBCF were completed. Some work on the sea wall of the reclamation will continue in the next

---

<sup>7</sup> [https://www.afcd.gov.hk/english/conservation/con\\_mar/con\\_mar\\_chi/con\\_mar\\_chi\\_chi/files/Photoid\\_Booklet.pdf](https://www.afcd.gov.hk/english/conservation/con_mar/con_mar_chi/con_mar_chi_chi/files/Photoid_Booklet.pdf)

few months, however, most silt curtain has been removed and the habitat surrounding HKBCF is no longer confined. It is noted that the drivers behind the population decline stated in the AFCD long term monitoring programme for Hong Kong waters and independent studies for adjacent Pearl River Estuary (PRE) waters (Huang *et al* 2012) remain uncertain and, with the commencement of 3RS, high impact construction activities have increased in large portions of the dolphins preferred habitat. Recent work indicates that habitat abandonment of NEL waters prior to HKBCF initiation was partially driven by the increase in high speed ferry (HSF) traffic (Marcotte *et al* 2015). The recent re-routing of HSF to the area north of SCLKMP is therefore also a cause for concern. Further, toxin burden in dolphin tissues and organs may have a greater impact than initially predicted (Gui *et al.* 2014). Therefore, the HZMB Project was initiated at a time when there was already a widespread and long term reduction in the number of dolphins within what is believed to be their entire range of the PRE. The strict mitigation initiatives at HKBCF aim to minimize the localised impact of HKBCF construction, however, this in itself will not be sufficient to ameliorate the myriad of other impacts throughout the dolphins habitat, in particular as new in-water projects commence and increase in activities.

## References

Agriculture, Fisheries and Conservation Department (AFCD) 2010. *Annual Marine Mammal Monitoring Programme April 2009-March 2010* The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR.

Agriculture, Fisheries and Conservation Department (AFCD) 2011. *Annual Marine Mammal Monitoring Programme April 2010-March 2011* The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR.

Agriculture, Fisheries and Conservation Department (AFCD) 2012. *Annual Marine Mammal Monitoring Programme April 2011-March 2012* The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR.

Agriculture, Fisheries and Conservation Department (AFCD) 2013. *Annual Marine Mammal Monitoring Programme April 2012-March 2013* The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR.

Agriculture, Fisheries and Conservation Department (AFCD) 2014. *Annual Marine Mammal Monitoring Programme April 2013-March 2014*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR

Agriculture, Fisheries and Conservation Department (AFCD) 2015. *Annual Marine Mammal Monitoring Programme April 2014-March 2015*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR

Agriculture, Fisheries and Conservation Department (AFCD) and Guangdong Pearl River Estuary Chinese White Dolphin National Nature Reserve 2015. *The Chinese White Dolphin: The Ambassador who traverse Guangdong and Hong Kong Waters*. Hong Kong: AFCD 13pp [https://www.afcd.gov.hk/english/conservation/con\\_mar/con\\_mar\\_chi/con\\_mar\\_chi\\_chi/files/PhotoID\\_Booklet.pdf](https://www.afcd.gov.hk/english/conservation/con_mar/con_mar_chi/con_mar_chi_chi/files/PhotoID_Booklet.pdf)

Agriculture, Fisheries and Conservation Department (AFCD) 2016. *Annual Marine Mammal Monitoring Programme April 2014-March 2015*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR

Buckland, S., Burnham, K., Laake, J., Borchers, D. and Thomas, L. 2001. *Introduction to Distance Sampling*. Oxford University Press.

Connor, R. Mann, J., Tyack, P. and Whitehead, H. 1998. Social Evolution in Toothed Whales. *Trends in Ecology and Evolution* 13, 228-232

de Faria Oshima, J. E., & de Oliveira Santos, M. C. 2016. Guiana dolphin home range analysis based on 11 years of photo-identification research in a tropical estuary. *Journal of Mammalogy*, (4) p207.

Gillespie, D., Leaper, R., Gordon, J. and Macleod, K. 2010. An integrated data collection system for line transect surveys. *J. Cetacean Res. Manage.* 11(3): 217–227.

Huang, S., Karczarski, Chen, J, Zhou, R, Lin, W., Zhang, H., Li., H. and Wu, Y. 2012 Demography and Population Trends of the Largest Population of Indo-Pacific Humpback Dolphins. *Biological Conservation* 147: 234-242

Kauhala, K. & Auttila, M. 2010: Estimating habitat selection of badgers - a test between different methods. - *Folia Zoologica* 59: 16-25.

Marcotte, D., Hung, S. K., & Caquard, S. 2015. Mapping cumulative impacts on Hong Kong's pink dolphin population. *Ocean & Coastal Management*, 109, 51-63.

Wauters, L., Preatoni, D., Molinari, A. and Tosi, G. 2007. Radio-tracking squirrels: Performance of home range density and linkage estimators with small range and sample size. *Ecological Modelling* 202(10):333-44

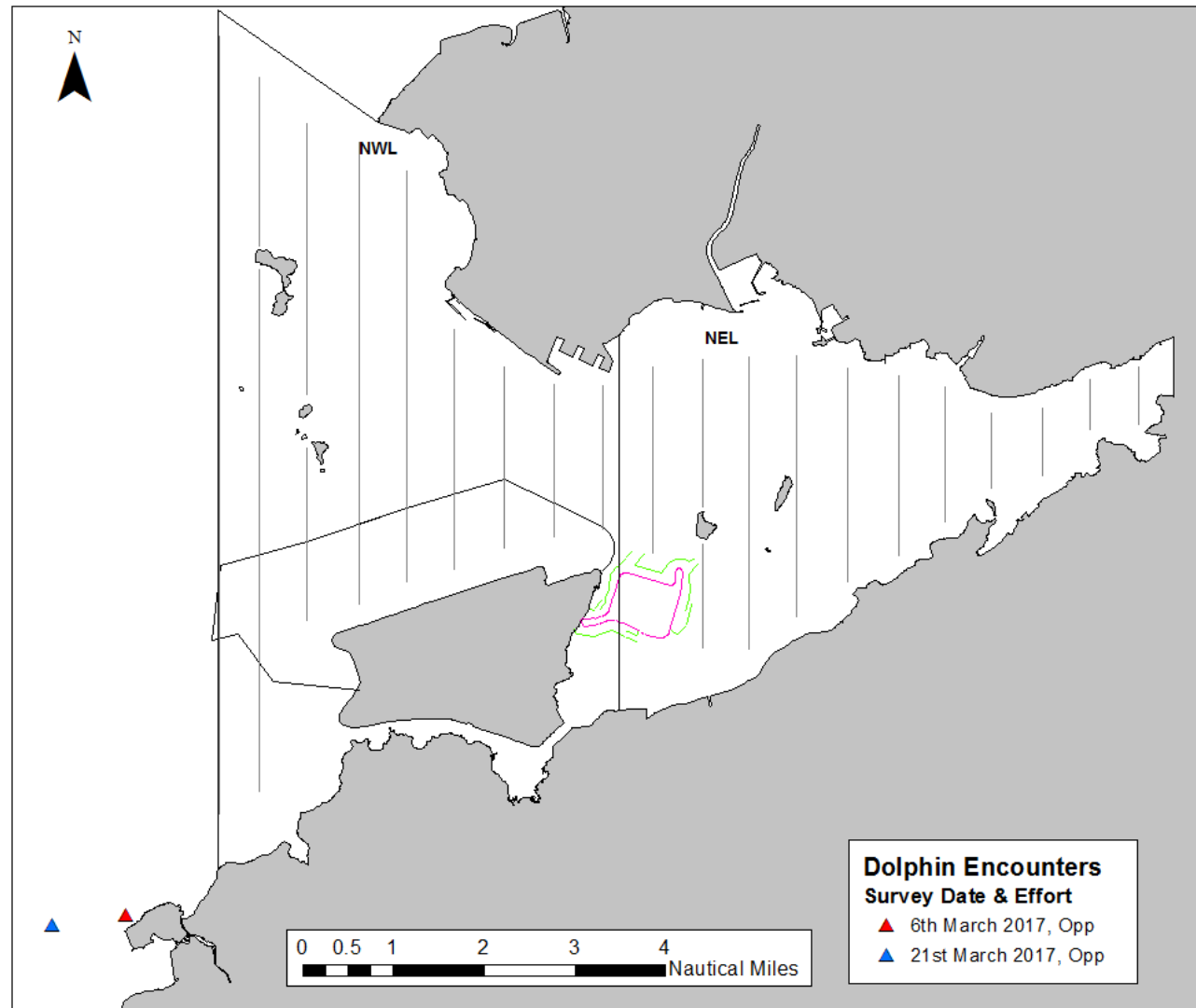


Figure 4. Distribution of Sightings Recorded During Impact Monitoring Surveys for HKBCF (March 2017)

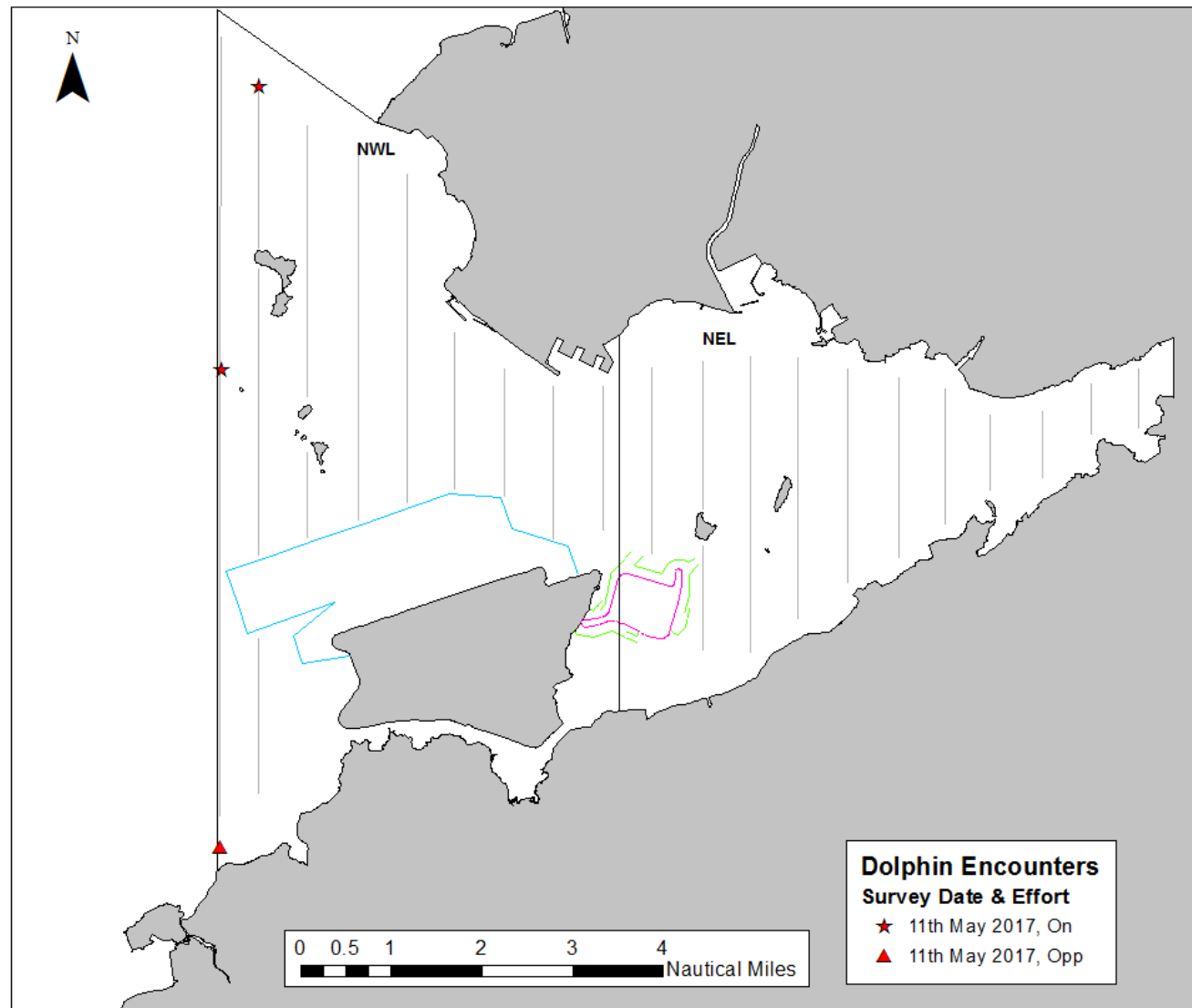


Figure 5. Distribution of Sightings Recorded During Impact Monitoring Surveys for HKBCF (May 2017)

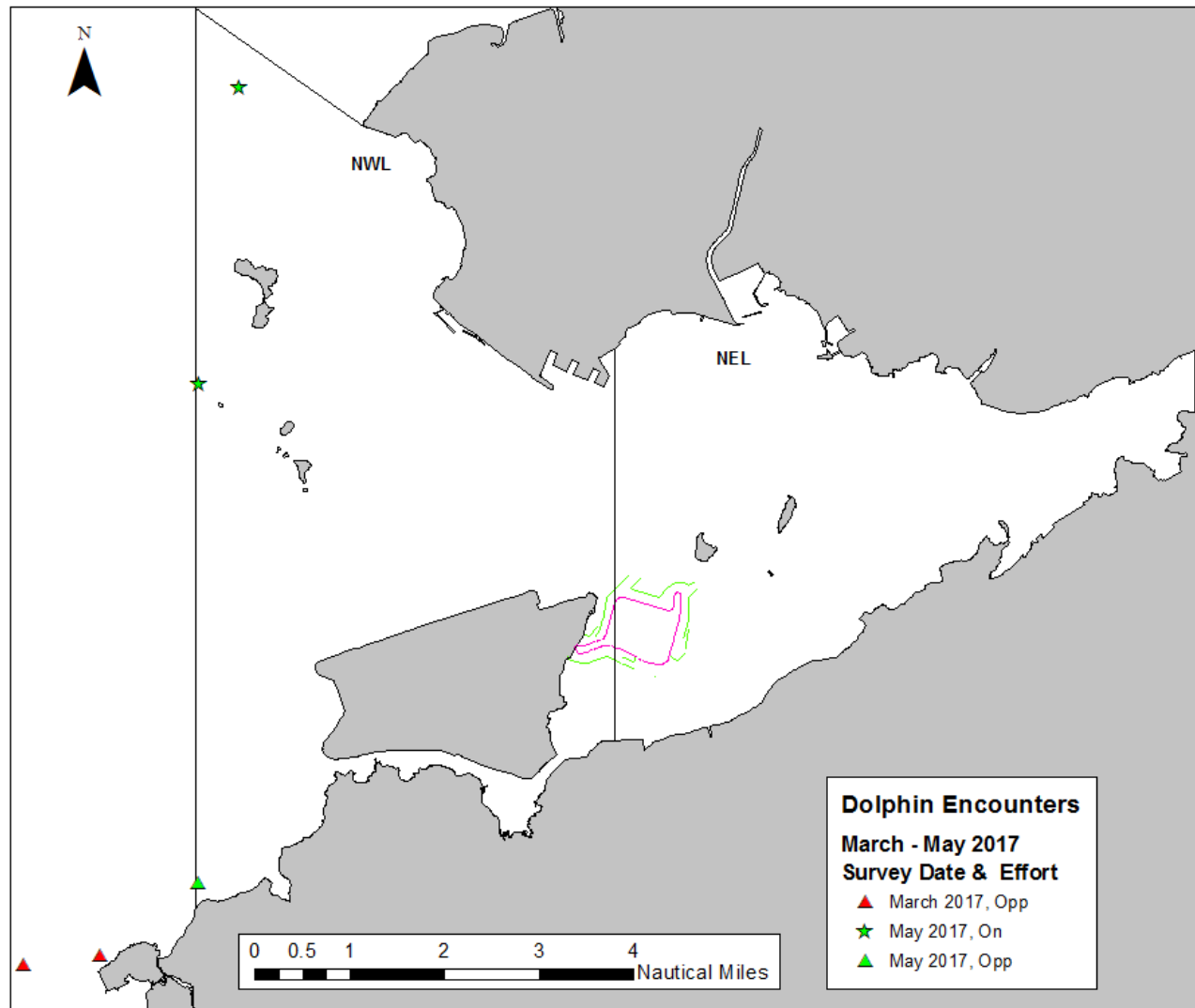


Figure 6. Distribution of Sightings Recorded During Impact Monitoring Surveys for HKBCF (March – May 2017)



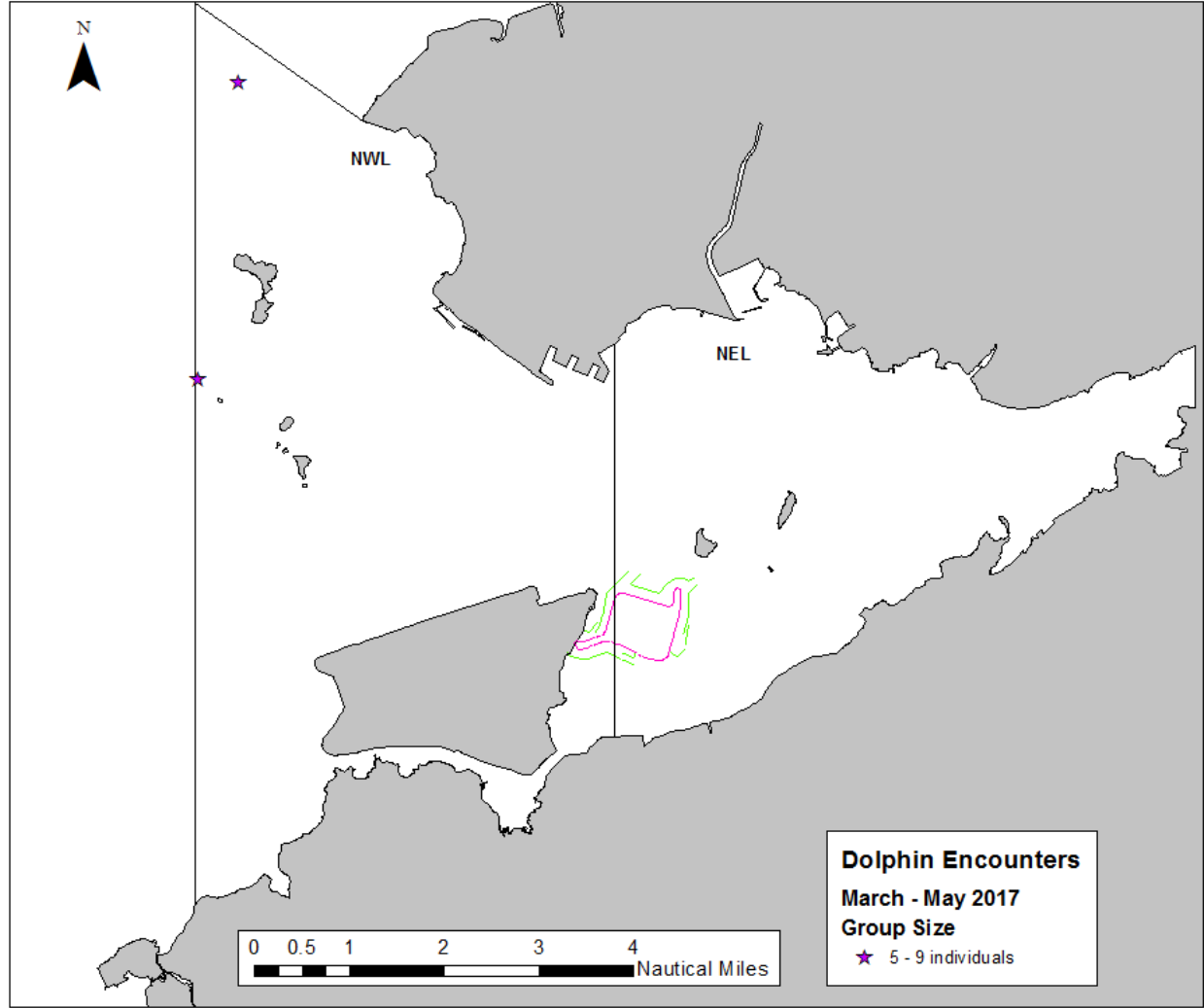


Figure 7. The Location of Dolphin Groups Numbering Five and Above Individuals (March – May 2017)

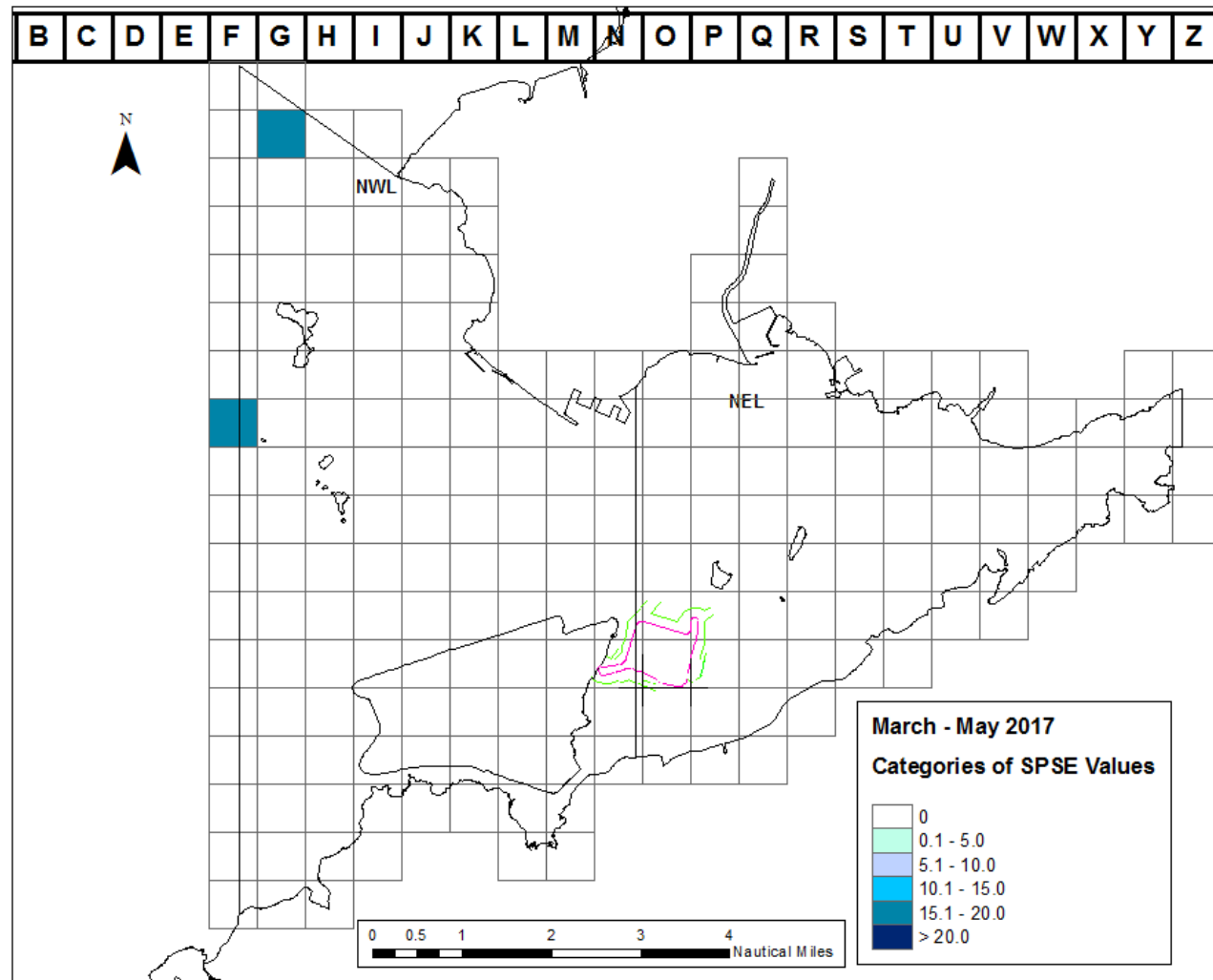


Figure 8. Sighting density SPSE (number of on-effort sightings per 100 units of survey effort) for March – May 2017

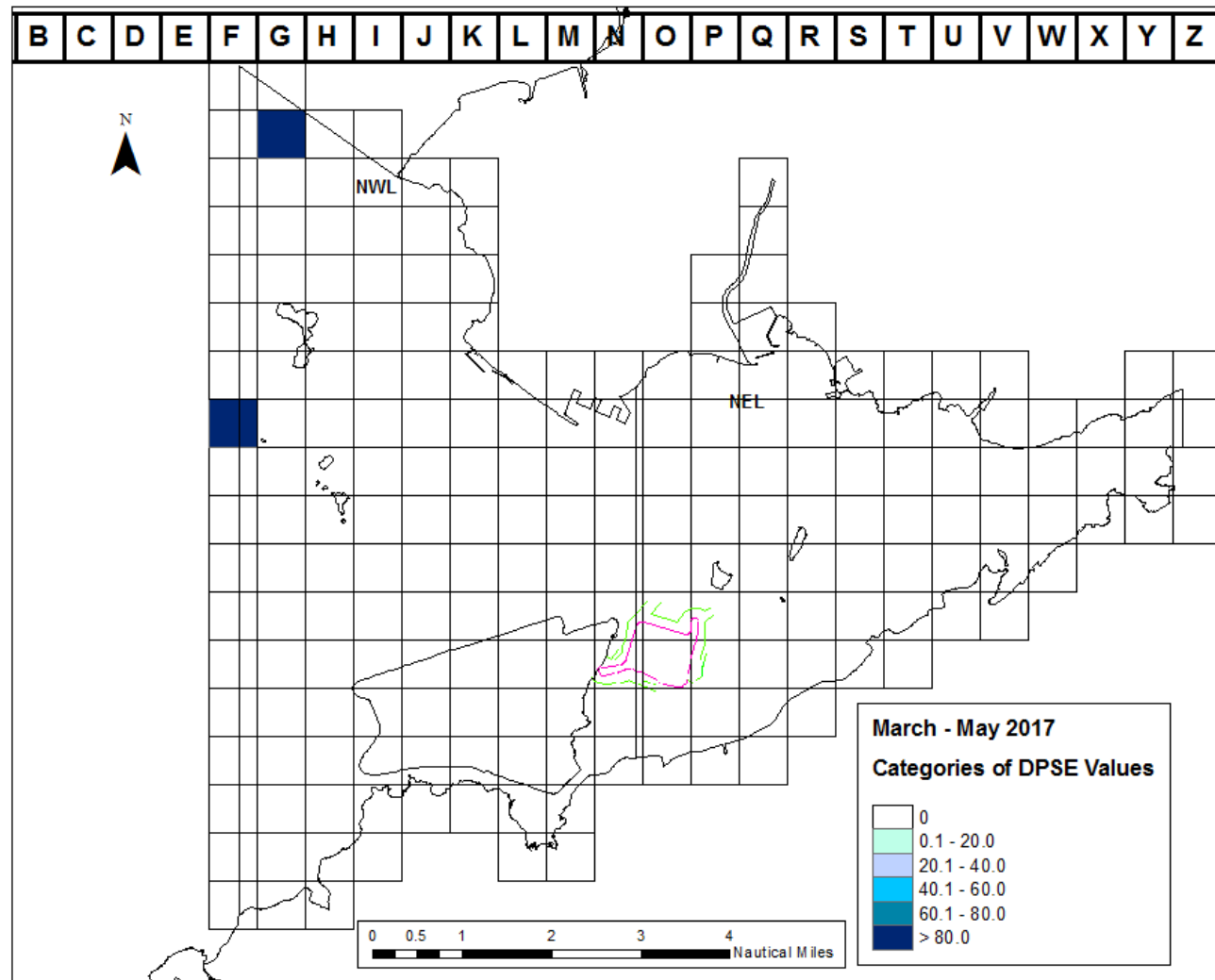


Figure 9. Dolphin density DPSE (number of dolphins per 100 units of survey effort) for March – May 2017.

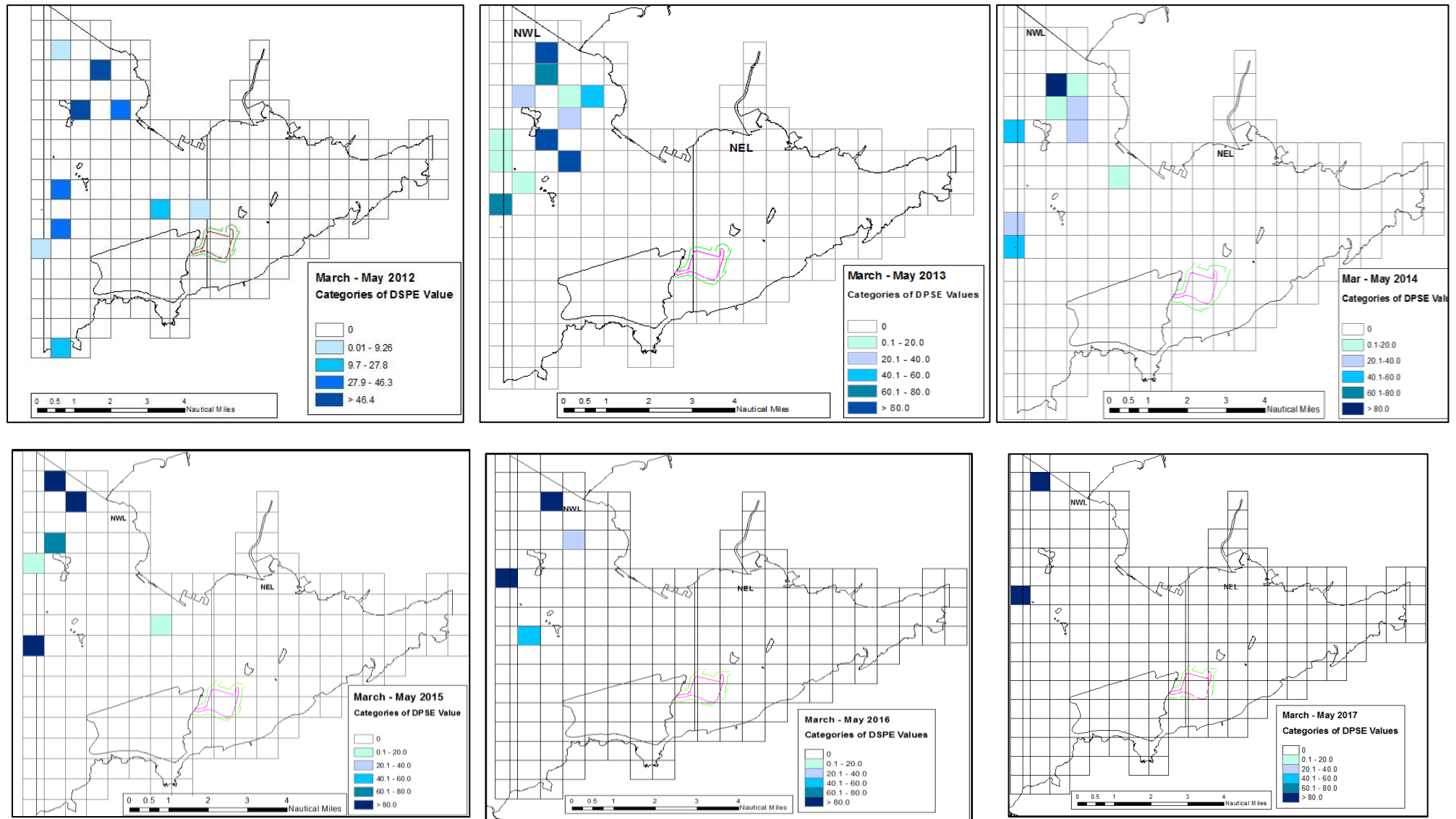


Figure 10. DPSE Shifts from NEL to NWL Waters during the Periods March – May 2012 - 2017

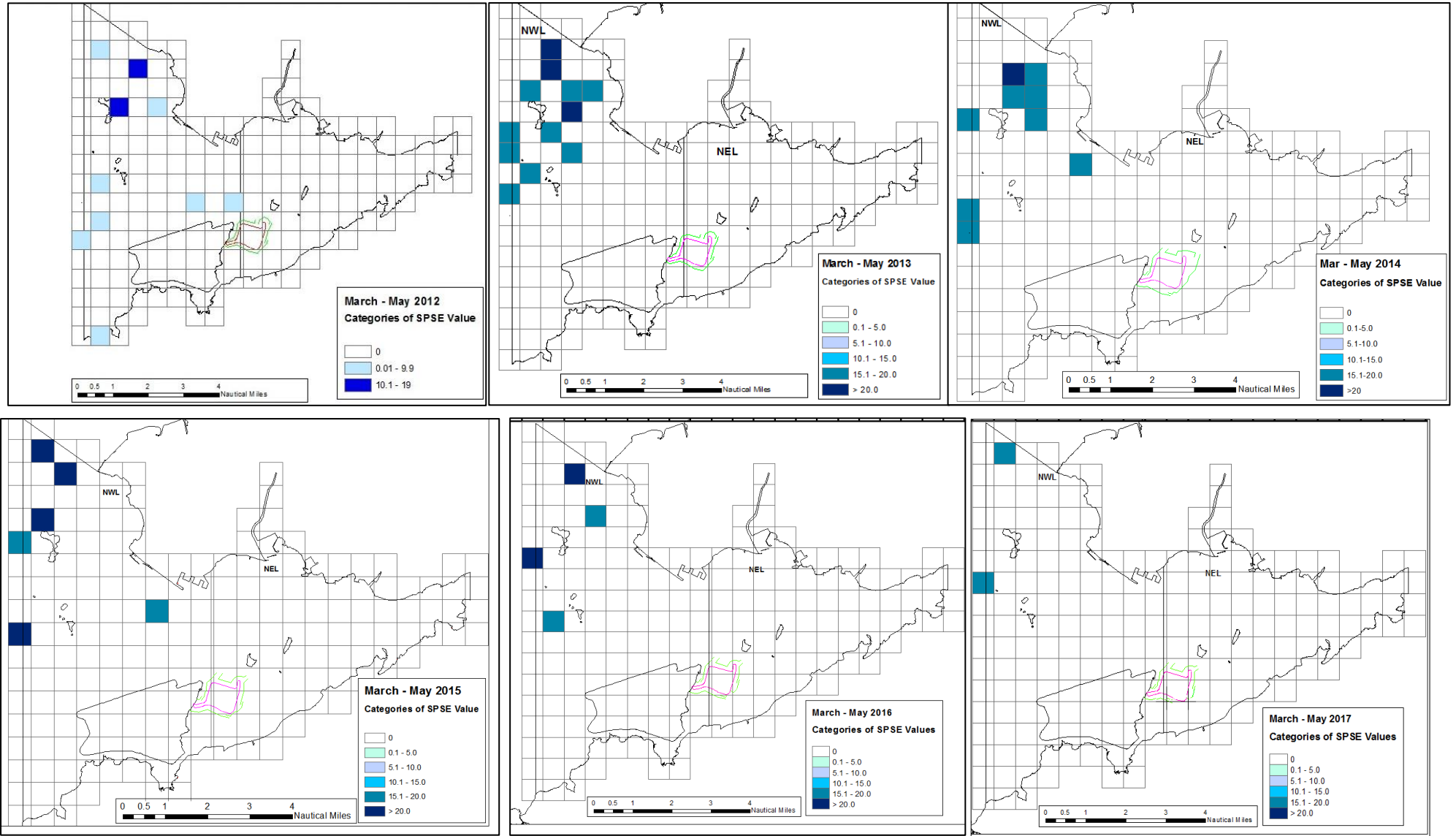
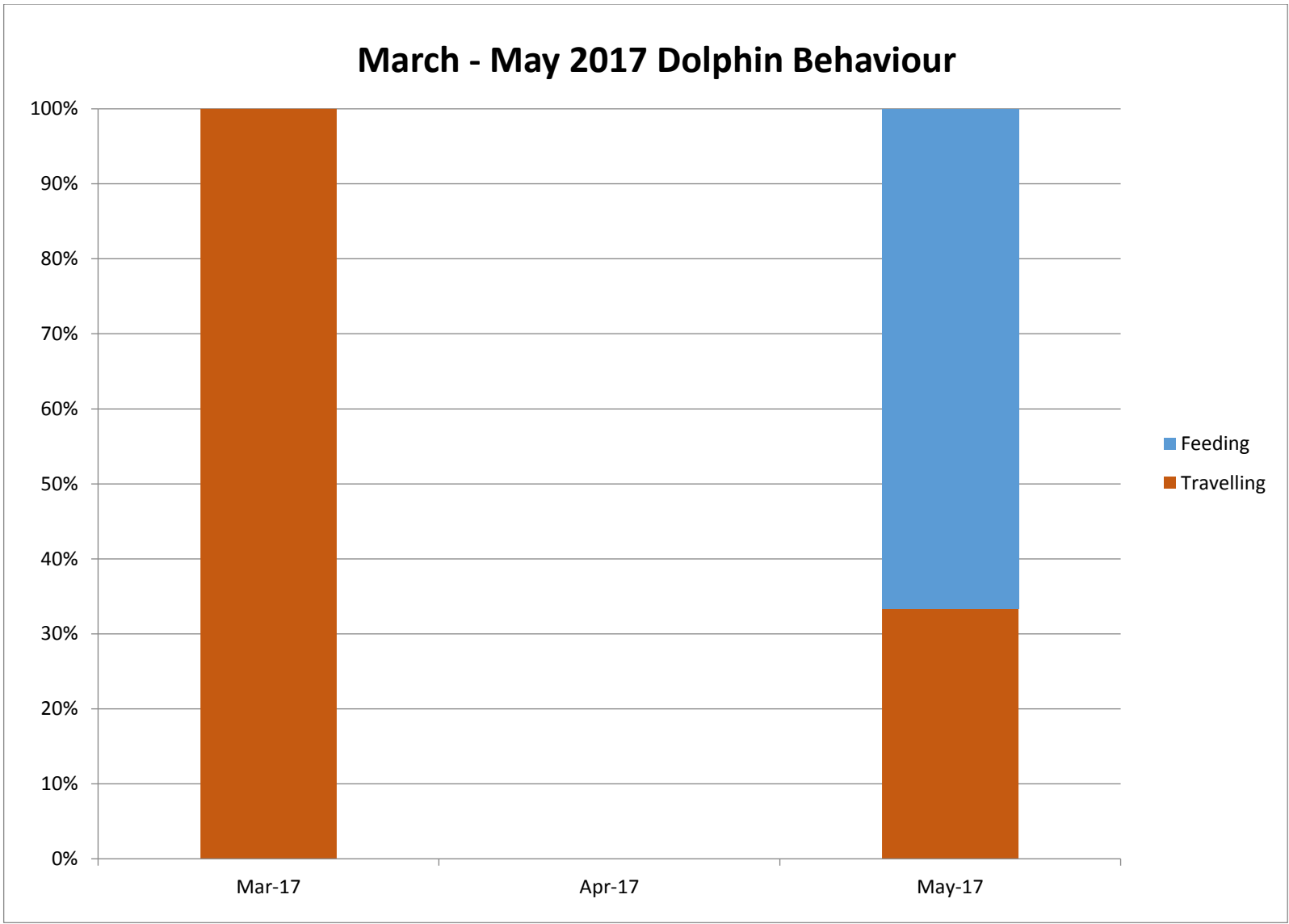


Figure 11. SPSE Shifts from NEL to NWL Waters during the Periods March – May 2012 - 2017



**Figure 12. Activity Budget for Dolphin Behaviour March – May 2017.**

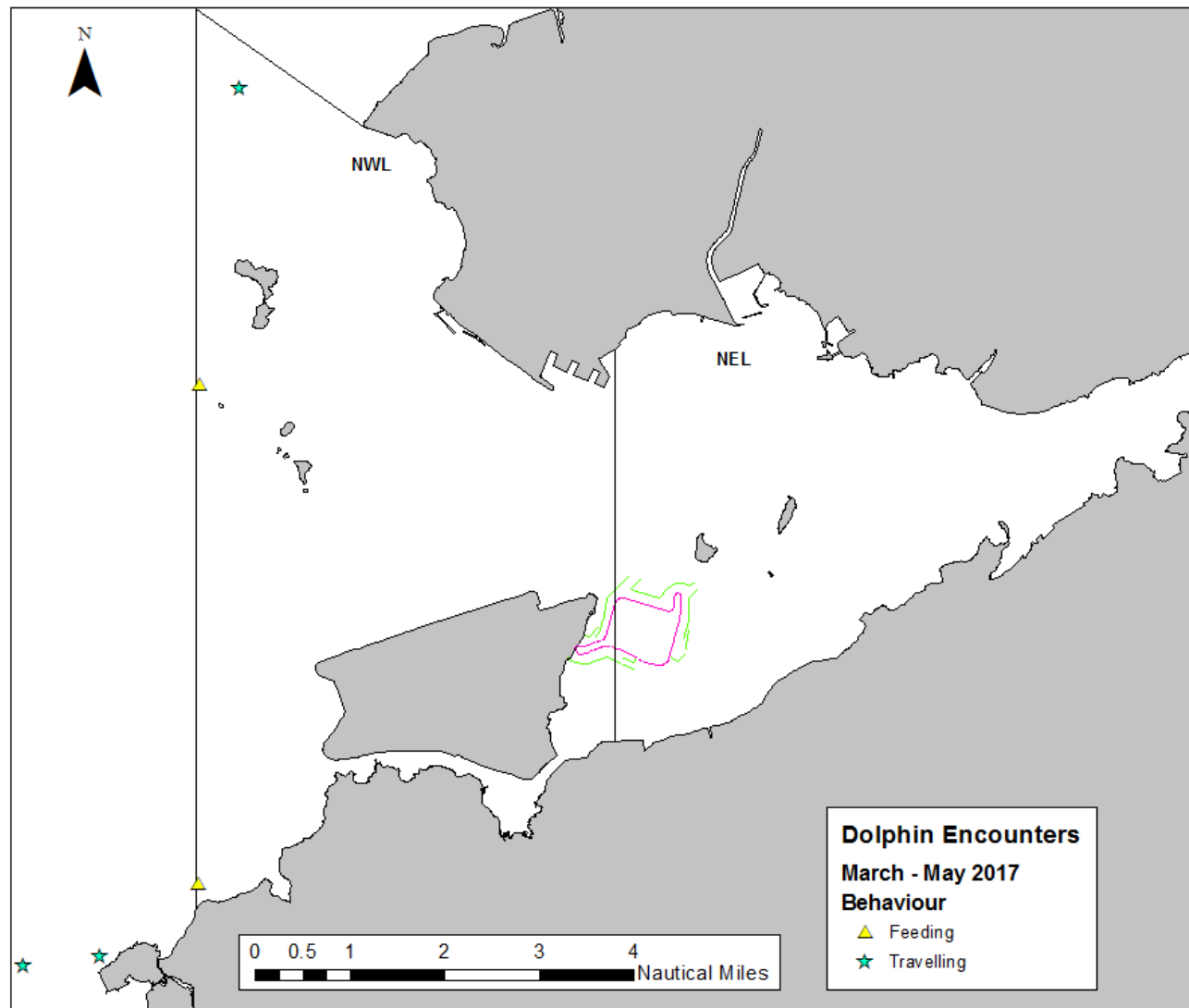


Figure 13. The Location of Different Behavioural Activities March – May 2017

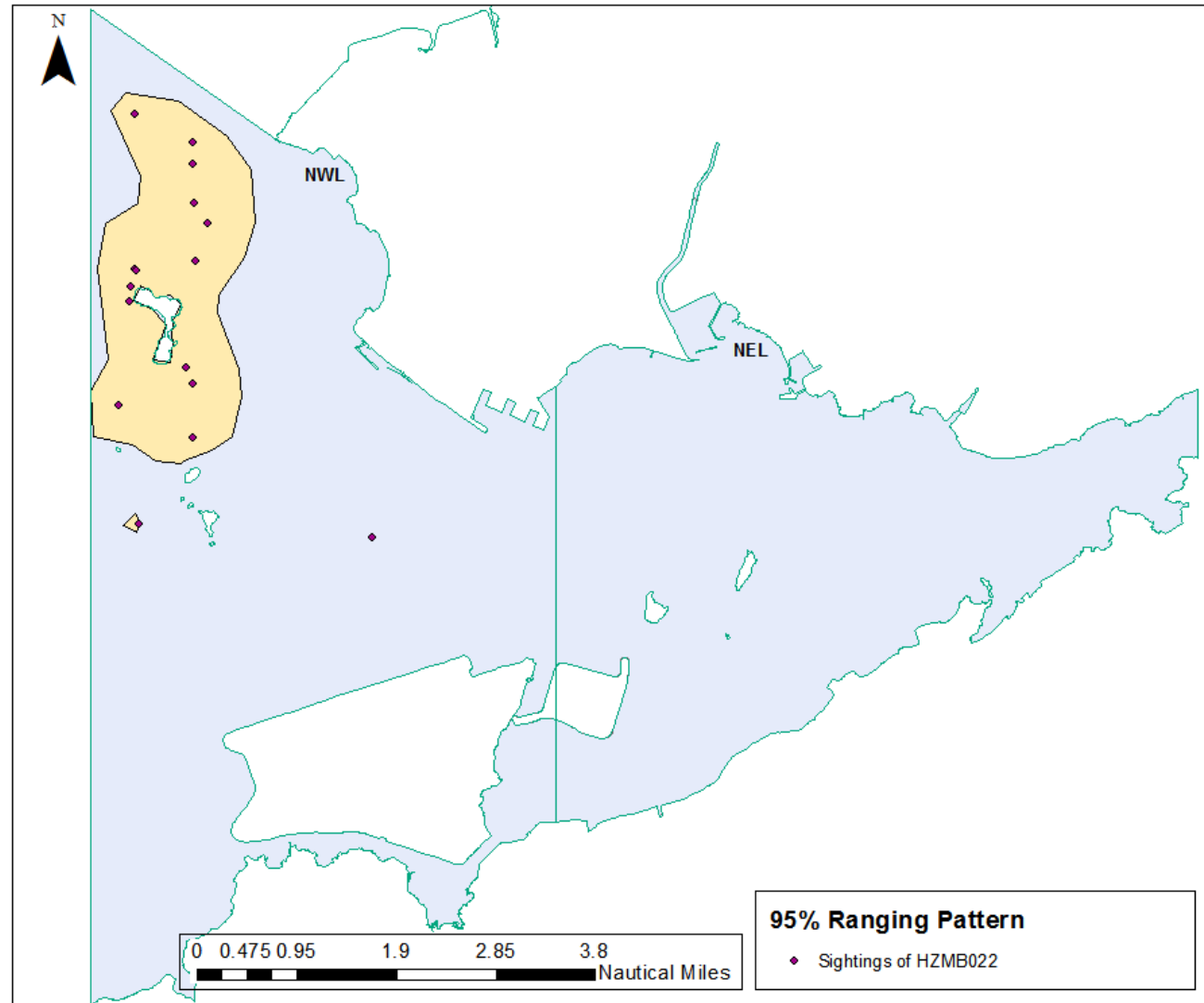


Figure 14. Kernel density estimate and plot for HZMB 022 (March 2012-May 2017), using all sightings



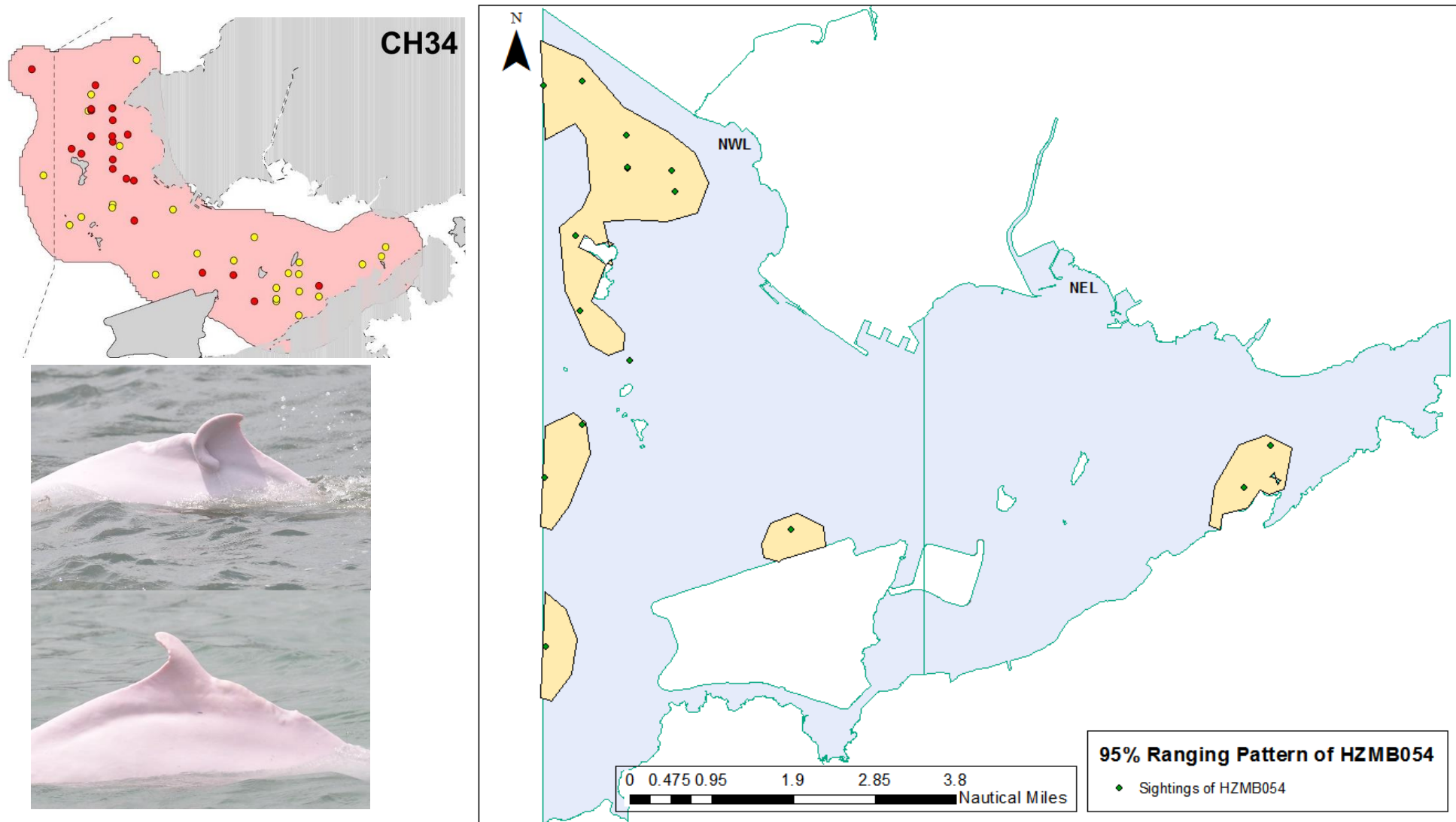


Figure 15. Kernel density estimate and plot for HZMB 054 [CH34] (March 2012-May 2017), with comparison to AFCD data of dolphin KDE prior to HZMB construction (top left; where red dots indicate sightings made in 2010 & 2011 and yellow dots made prior to 2011) (AFCD 2012; AFCD and Guangdong Pearl River Estuary Chinese White Dolphin National Nature Reserve 2015).

## Annex I. Impact Monitoring Survey Schedule and Details (March – May 2017)

Date	Location of Survey	No. Sightings ON	No. Sightings Opp	Total km ON EFFORT (favourable conditions)
03/06/2017	NWL (1-6,21,22)	0	1	58.2
03/07/2017	NE and NW Lantau(7-20, 23)	0	0	45.7
03/20/2017	NE and NW Lantau(5-20, 23)	0	0	55.2
03/21/2017	NWL (1-4,21,22)	0	1	48.2
04/05/2017	NE and NW Lantau (6-20, 23)	0	0	47.9
04/06/2017	NWL (1-5,21,22)	0	0	54.4
04/18/2017	NE and NW Lantau (1-10, 21,22)	0	0	69.4
04/19/2017	NEL (11-20,23)	0	0	33.0
05/11/2017	NWL (1-6,21,22,24)	2	1	55.7
05/12/2017	NE and NW Lantau(7-20, 23)	0	0	44.5
05/17/2017	NWL (1-7,21,22,24)	0	0	56.6
05/18/2017	NE and NW Lantau(8-20, 23)	0	0	42.1

## Annex II. Impact Monitoring Survey Effort Summary (March – May 2017)

Date	Area	Sea State (on effort)	Effort (km)	Season	Vessel	Type
03/06/2017	NWL	1	11.5	SPRING	HKDW	IMPACT
03/06/2017	NWL	2	38.5	SPRING	HKDW	IMPACT
03/06/2017	NWL	3	8.2	SPRING	HKDW	IMPACT
03/07/2017	NWL	1	8.6	SPRING	HKDW	IMPACT
03/07/2017	NWL	4	4	SPRING	HKDW	IMPACT
03/07/2017	NEL	1	37.1	SPRING	HKDW	IMPACT
03/20/2017	NWL	1	11.7	SPRING	HKDW	IMPACT
03/20/2017	NWL	2	6.6	SPRING	HKDW	IMPACT
03/20/2017	NEL	1	19.1	SPRING	HKDW	IMPACT
03/20/2017	NEL	2	17.8	SPRING	HKDW	IMPACT
03/21/2017	NWL	1	40.7	SPRING	HKDW	IMPACT
03/21/2017	NWL	2	7.5	SPRING	HKDW	IMPACT
04/05/2017	NWL	1	2	SPRING	HKDW	IMPACT
04/05/2017	NWL	2	7.3	SPRING	HKDW	IMPACT
04/05/2017	NWL	3	1.3	SPRING	HKDW	IMPACT
04/05/2017	NEL	1	1.1	SPRING	HKDW	IMPACT
04/05/2017	NEL	2	28.7	SPRING	HKDW	IMPACT
04/05/2017	NEL	3	7.5	SPRING	HKDW	IMPACT
04/06/2017	NWL	1	30.2	SPRING	HKDW	IMPACT
04/06/2017	NWL	2	24.2	SPRING	HKDW	IMPACT
04/18/2017	NWL	1	31.9	SPRING	HKDW	IMPACT
04/18/2017	NWL	2	33.8	SPRING	HKDW	IMPACT
04/18/2017	NEL	1	3.7	SPRING	HKDW	IMPACT
04/19/2017	NEL	1	5.3	SPRING	HKDW	IMPACT
04/19/2017	NEL	2	13.7	SPRING	HKDW	IMPACT
04/19/2017	NEL	3	14	SPRING	HKDW	IMPACT
05/11/2017	NWL	1	50.2	SPRING	HKDW	IMPACT
05/11/2017	NWL	2	5.5	SPRING	HKDW	IMPACT
05/12/2017	NWL	1	1.8	SPRING	HKDW	IMPACT
05/12/2017	NWL	2	5.5	SPRING	HKDW	IMPACT
05/12/2017	NEL	1	30.1	SPRING	HKDW	IMPACT
05/12/2017	NEL	2	7.1	SPRING	HKDW	IMPACT
05/17/2017	NWL	1	43.4	SPRING	HKDW	IMPACT
05/17/2017	NWL	2	13.2	SPRING	HKDW	IMPACT
05/18/2017	NWL	2	5.1	SPRING	HKDW	IMPACT
05/18/2017	NEL	1	25.6	SPRING	HKDW	IMPACT
05/18/2017	NEL	2	11.4	SPRING	HKDW	IMPACT

### Annex III. Impact Monitoring Sighting Database (March – May 2017)

Project	Contract	Date	Sighting No.	Time	Group Size	Area	Beaufort	PSD	Effort	Type	Latitude	Longitude	Season	Boat Association
HKBCF	HY/2010/02	06-Mar-17	1374	9:48:42 AM	3	NWL	1	N/A	Opp	Impact	22.25900	113.8519	Spring	No
HKBCF	HY/2010/02	21-Mar-17	1379	1:28:05 PM	1	NWL	1	N/A	Opp	Impact	22.25717	113.8374	Spring	No
HKBCF	HY/2010/02	11-May-17	1391	9:11:55 AM	1	NWL	1	N/A	Opp	Impact	22.27190	113.8706	Spring	No
HKBCF	HY/2010/02	11-May-17	1392	10:21:52 AM	6	NWL	1	171	On	Impact	22.36010	113.8706	Spring	No
HKBCF	HY/2010/02	11-May-17	1393	11:09:34 AM	5	NWL	1	265	On	Impact	22.41251	113.8780	Spring	No

**Annex IV**  
**March 2012– May 2017**  
**(and Baseline September – November 2011)**  
**Photo Identification Information**

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 134		2016/05/23	1251	NWL
HZMB 132		2016/05/23	1244	NWL
HZMB 131		2016/03/22	1215	NWL
HZMB 130		2016/09/05	1301	NWL
		2016/02/04	1199	NWL
HZMB 129		2017/01/05	1354	NWL
		2017/01/05	1353	NWL
		2016/01/07	1189	NWL
		2015/10/22	1156	NWL
		2015/09/07	1143	NWL
		2015/08/25	1138	NWL
HZMB 128		2015/01/03	1056	NWL
HZMB 127		2015/01/03	1056	NWL
HZMB 126		2016/05/23	1244	NWL
		2015/02/23	1068	NWL
		2015/01/03	1054	NWL
HZMB 125		2016/05/23	1249	NWL
		2016/03/07	1208	NWL
		2014/10/13	1019	NWL
HZMB 124		2014/09/22	1005	NWL
HZMB 123		2014/08/25	998	NWL
HZMB 122		2015/10/22	1156	NWL
		2014/08/04	989	NWL
HZMB 121		2016/07/18	1276	NWL
		2014/07/14	968	NWL
HZMB 120		2014/05/31	951	NWL
HZMB 119		2014/04/19	940	NWL
HZMB 118		2014/01/06	890	NWL
HZMB 117		2014/06/17	964	NWL
		2014/01/06	888	NWL
HZMB 116		2014/08/25	999	NWL
HZMB 115		2014/07/14	972	NWL
		2014/07/14	971	NWL
		2013/12/26	879	NWL
		2013/12/26	879	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 114		2017/01/05	1351	NWL
		2016/11/03	1328	NWL
		2016/06/06	1261	NWL
		2015/11/05	1162	NWL
		2013/10/24	827	NWL
HZMB 113		2013/10/24	827	NWL
HZMB 112		2013/10/15	815	NWL
HZMB 111		2013/10/15	815	NWL
HZMB 110		2016/01/18	1193	NWL
		2013/10/15	812	NWL
HZMB 108		2015/06/11	1118	NWL
		2013/08/30	780	NEL
HZMB 107		2015/07/28	1126	NWL
		2014/10/13	1019	NWL
		2014/05/31	951	NWL
		2013/08/21	770	NWL
HZMB 106		2013/08/21	769	NWL
HZMB 105		2014/05/31	951	NWL
		2013/07/08	711	NWL
HZMB 104		2013/07/08	711	NWL
HZMB 103		2013/07/08	711	NWL
HZMB 102		2013/07/08	706	NWL
HZMB 101		2013/07/08	706	NWL
HZMB 100		2013/07/08	706	NWL
HZMB 099		2013/06/13	681	NWL
		2013/06/13	680	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 098	NL104	2017/05/11	1393	NWL
		2017/01/05	1353	NWL
		2015/02/23	1077	NWL
		2014/12/18	1044	NWL
		2014/08/04	992	NWL
		2014/01/06	888	NWL
		2013/11/02	849	NWL
		2013/11/02	845	NWL
		2013/10/24	831	NWL
		2013/07/08	711	NWL
		2013/05/24	659	NWL
		2011/11/07	Baseline	NWL
		2011/11/05	Baseline	NWL
		2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/10/28	Baseline	NWL
		2011/09/23	Baseline	NWL
2011/09/16	Baseline	NWL		
HZMB 097		2013/05/09	647	NWL
HZMB 096		2013/04/01	621	NWL
HZMB 095		2013/08/30	780	NEL
		2013/06/25	697	NWL
		2013/06/13	682	NWL
		2013/04/01	621	NWL
HZMB 094		2016/08/30	1299	NWL
		2014/10/13	1019	NWL
		2014/05/31	954	NWL
		2014/02/17	910	NWL
		2013/06/26	703	NWL
		2013/06/25	698	NWL
		2013/03/18	601	NWL
HZMB 093		2013/05/24	657	NWL
		2013/02/21	587	NWL
HZMB 092		2015/04/20	1097	NWL
		2013/02/21	589	NWL
		2013/02/15	581	NWL



Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 091		2013/02/15	579	NWL
HZMB 090		2013/06/25	697	NWL
		2013/06/13	682	NWL
		2013/02/15	579	NWL
HZMB 089		2013/02/15	579	NWL
HZMB 088		2013/02/15	579	NWL
HZMB 087		2013/02/15	579	NWL
HZMB 086	NL242	2015/03/19	1086	NWL
		2013/05/09	642	NWL
		2013/02/15	579	NWL
		2011/10/10	Baseline	NWL
HZMB 085		2014/10/13	1019	NWL
		2014/05/31	954	NWL
HZMB 084		2013/06/26	703	NWL
		2013/02/15	579	NWL
		2013/02/14	575	NWL
HZMB 083	NL136	2016/11/03	1332	NWL
		2016/08/30	1298	NWL
		2015/12/01	1180	NWL
		2015/05/11	1104	NWL
		2013/12/19	863	NWL
		2013/03/28	607	NWL
		2013/02/15	579	NWL
		2013/01/28	568	NWL
		2013/01/28	564	NWL
		2012/04/19	267	NWL
		2011/10/28	Baseline	NWL
		2011/10/28	Baseline	NWL
		2011/10/10	Baseline	NEL
2011/09/06	Baseline	NWL		
HZMB 082		2014/10/20	1024	NWL
		2013/02/21	587	NWL
		2013/02/15	579	NWL
		2013/01/28	563	NWL
HZMB 081		2013/01/28	559	NWL
		2013/01/28	557	NWL
HZMB 080		2013/01/28	556	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 079		2013/01/28	556	NWL
HZMB 078		2013/02/15	579	NWL
		2013/01/08	552	NWL
HZMB 077		2013/12/26	878	NWL
		2013/07/08	706	NWL
		2012/12/11	541	NWL
HZMB 076		2013/07/08	706	NWL
		2012/12/11	541	NWL
HZMB 075		2012/12/06	525	NEL
HZMB 074		2013/05/09	647	NWL
		2013/04/01	623	NWL
		2013/04/01	621	NWL
		2013/02/21	594	NEL
		2012/12/10	529	NEL
		2012/12/06	525	NEL
HZMB 073		2013/05/09	647	NWL
		2013/04/01	623	NWL
		2013/04/01	621	NWL
		2013/02/21	594	NEL
		2012/12/10	529	NEL
		2012/12/06	525	NEL
HZMB 072		2012/10/24	476	NWL
HZMB 071		2012/10/24	475	NWL
		2012/10/12	466	NWL
HZMB 070		2012/10/24	476	NWL
HZMB 069		2015/06/04	1116	NWL
		2013/08/21	774	NWL
		2013/07/08	711	NWL
		2012/10/24	476	NWL
HZMB 068		2014/10/20	1025	NWL
		2013/11/01	839	NWL
		2012/10/24	476	NWL
HZMB 067		2012/10/24	475	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 066	NL93	2013/01/28	559	NWL
		2012/12/11	537	NWL
		2012/10/24	475	NWL
		2012/10/12	466	NWL
		2011/11/07	Baseline	NWL
		2011/11/05	Baseline	NWL
HZMB 064		2015/03/19	1086	NWL
		2014/06/17	964	NWL
		2013/05/09	647	NWL
		2013/01/28	561	NWL
		2012/10/24	475	NWL
		2012/10/12	466	NWL
HZMB 063		2013/05/09	647	NWL
		2012/10/12	466	NWL
HZMB 062		2012/12/06	525	NEL
		2012/10/11	457	NWL
HZMB 060		2012/09/18	447	NWL
HZMB 059		2013/02/21	591	NWL
		2012/09/18	445	NWL
HZMB 057		2012/09/18	440	NWL
HZMB 056		2012/09/18	442	NWL
		2012/09/05	433	NEL
HZMB 055		2012/09/04	425	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 054	CH34	2017/05/11	1393	NWL
		2016/11/03	1331	NWL
		2016/05/12	1238	NWL
		2015/12/01	1180	NWL
		2015/04/20	1097	NWL
		2015/01/15	1062	NWL
		2014/05/31	953	NWL
		2014/01/06	888	NWL
		2013/11/07	854	NWL
		2013/11/02	845	NWL
		2013/10/24	831	NWL
		2013/08/30	780	NEL
		2013/07/08	711	NWL
		2013/09/18	448	NWL
		2012/09/05	432	NEL
		2011/11/07	Baseline	NWL
		2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/11/01	Baseline	NEL
2011/11/01	Baseline	NEL		
2011/10/28	Baseline	NWL		
2011/10/06	Baseline	NWL		
HZMB 053		2012/09/04	425	NWL
HZMB 052		2012/09/04	423	NWL
HZMB 051	NL213	2015/05/11	1104	NWL
		2014/08/04	989	NWL
		2013/05/09	644	NWL
		2013/04/01	622	NWL
		2013/02/15	582	NWL
		2013/02/15	581	NWL
		2013/01/28	559	NWL
		2013/01/28	556	NWL
		2012/09/04	422	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 050		2014/07/14	971	NWL
		2014/01/10	900	NWL
		2014/01/06	888	NWL
		2013/02/15	579	NWL
		2012/09/04	421	NWL
HZMB 049		2015/10/09	1151	NWL
		2014/07/29	982	NWL
		2012/09/03	419	NWL
HZMB 048		2012/09/03	419	NWL
HZMB 047		2015/04/28	1100	NWL
		2012/09/03	412	NWL
HZMB 046		2012/09/03	412	NWL
HZMB 045		2016/05/23	1249	NWL
		2014/02/17	910	NWL
		2013/06/13	682	NWL
		2013/02/15	579	NWL
		2012/11/01	495	NWL
HZMB 044	NL98	2017/01/05	1350	NWL
		2016/05/23	1247	NWL
		2016/01/18	1194	NWL
		2014/10/13	1019	NWL
		2014/02/17	910	NWL
		2013/12/19	864	NWL
		2013/11/02	845	NWL
		2013/11/01	842	NWL
		2013/10/15	819	NWL
		2013/05/09	648	NWL
		2013/05/09	647	NWL
		2013/04/01	623	NWL
		2013/04/01	621	NWL
		2013/02/15	579	NWL
		2012/11/01	495	NWL
		2011/11/07	Baseline	NWL
		2011/11/06	Baseline	NEL
2011/11/01	Baseline	NEL		
2011/10/06	Baseline	NEL		
HZMB 043		2012/09/03	407	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 042	NL260	2015/10/22	1156	NWL
		2013/12/19	863	NWL
		2012/11/01	495	NWL
		2011/11/07	Baseline	NWL
HZMB 041	NL24	2014/06/05	960	NEL
		2014/02/17	910	NWL
		2013/11/02	845	NWL
		2013/05/09	648	NWL
		2013/05/09	647	NWL
		2013/04/01	623	NWL
		2013/04/01	621	NWL
		2013/02/15	579	NWL
		2012/11/01	495	NWL
		2011/11/06	Baseline	NEL
		2011/11/05	Baseline	NWL
		2011/11/05	Baseline	NWL
		2011/10/10	Baseline	NWL
HZMB 040		2014/02/17	910	NWL
		2014/01/06	893	NWL
		2013/10/15	821	NWL
		2013/07/08	714	NWL
		2013/07/08	711	NWL
		2013/02/21	589	NWL
		2012/11/01	493	NWL
HZMB 038		2016/05/23	1246	NWL
		2012/11/01	490	NWL
HZMB 037		2012/11/01	490	NWL
HZMB 036		2017/01/05	1351	NWL
		2017/01/05	1350	NWL
		2012/09/03	407	NWL
		2012/11/01	490	NWL
HZMB 035		2013/02/15	579	NWL
		2012/11/01	490	NWL
HZMB 034		2012/11/01	493	NWL
HZMB 028		2014/11/17	1035	NWL
		2013/04/01	625	NWL
		2012/08/06	373	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 027		2013/12/19	863	NWL
		2013/02/15	579	NWL
		2013/01/28	568	NWL
		2013/01/28	564	NWL
		2012/06/14	299	NWL
HZMB 026		2014/10/13	1018	NWL
		2013/06/25	697	NWL
		2013/05/09	642	NWL
		2013/01/28	561	NWL
		2012/06/13	295	NEL
HZMB 025		2013/02/22	596	NEL
		2013/02/21	591	NWL
		2012/12/06	525	NEL
		2012/10/11	457	NWL
		2012/06/13	295	NEL
HZMB 024		2013/03/18	601	NWL
		2012/06/13	295	NEL
HZMB 023		2017/01/05	1353	NWL
		2016/11/03	1330	NWL
		2015/10/09	1153	NWL
		2015/10/09	1152	NWL
		2015/04/20	1097	NWL
		2014/12/18	1044	NWL
		2014/11/17	1035	NWL
		2014/01/06	888	NWL
		2013/07/08	715	NWL
		2013/07/08	711	NWL
		2013/04/01	619	NWL
		2013/02/21	589	NWL
		2013/02/15	579	NWL
2012/07/10	330	NWL		

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 022		2017/01/05	1353	NWL
		2016/11/03	1330	NWL
		2016/04/21	1219	NWL
		2015/09/07	1143	NWL
		2015/04/20	1097	NWL
		2014/12/18	1044	NWL
		2014/11/17	1035	NWL
		2014/08/04	991	NWL
		2014/01/06	888	NWL
		2013/10/24	827	NWL
		2013/07/08	715	NWL
		2013/07/08	711	NWL
		2013/04/01	619	NWL
		2013/02/21	589	NWL
		2013/02/15	579	NWL
2012/07/10	330	NWL		
HZMB 021	NL37	2016/03/22	1215	NWL
		2012/07/10	330	NWL
		2011/09/16	Baseline	NWL
HZMB 020		2012/07/10	330	NWL
HZMB 019		2012/07/10	330	NWL
HZMB 018		2014/02/17	910	NWL
		2013/05/09	647	NWL
		2013/02/21	594	NEL
		2012/12/10	529	NEL
		2012/07/10	330	NWL
HZMB 017		2012/07/10	330	NWL
HZMB 016		2013/07/08	706	NWL
		2012/12/11	539	NWL
		2012/09/18	446	NWL
		2012/09/04	421	NWL
		2012/07/10	330	NWL
HZMB 015		2012/07/10	330	NEL



Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 014	NL176	2015/08/25	1139	NWL
		2013/12/26	880	NWL
		2012/08/06	373	NWL
		2012/06/13	295	NEL
		2011/11/06	Baseline	NEL
		2011/11/01	Baseline	NEL
		2011/11/01	Baseline	NEL
HZMB 013		2012/05/28	281	NWL
HZMB 012		2012/05/28	281	NWL
HZMB 011	EL01	2013/02/22	597	NEL
		2013/02/21	592	NEL
		2013/02/14	572	NEL
		2012/11/06	517	NEL
		2012/09/19	452	NWL
		2012/03/31	261	NEL
		2011/11/02	Baseline	NWL
		2011/11/01	Baseline	NEL
HZMB 009		2015/03/19	1084	NWL
		2012/05/28	281	NWL
HZMB 008		2015/07/06	1122	NWL
		2012/05/28	281	NWL
HZMB 007	NL246	2012/12/10	529	NEL
		2011/11/06	Baseline	NEL
		2011/09/16	Baseline	NWL
HZMB 006		2015/10/22	1158	NWL
		2013/02/21	594	NEL
		2012/12/11	539	NWL
		2012/11/01	495	NWL
		2012/03/29	250	NWL
HZMB 005		2015/02/09	1070	NWL
		2015/02/09	1069	NWL
		2013/11/09	860	NWL
		2013/11/07	858	NWL
		2013/10/15	813	NWL
		2012/12/10	532	NWL
		2012/08/06	374	NWL
		2012/05/28	287	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
HZMB 004		2015/07/28	1126	NWL
		2012/09/04	421	NWL
		2012/03/31	262	NWL
HZMB 003	NL179	2013/10/15	812	NWL
		2013/06/25	697	NWL
		2012/12/10	529	NEL
		2012/03/31	261	NWL
		2011/11/06	Baseline	NEL
		2011/09/16	Baseline	NWL
HZMB 002	WL111	2014/05/31	951	NWL
		2013/12/26	878	NWL
		2013/12/19	863	NWL
		2013/11/01	839	NWL
		2013/10/15	819	NWL
		2013/09/24	798	NWL
		2013/02/14	573	NWL
		2012/12/11	536	NWL
		2012/12/11	535	NWL
		2012/10/12	466	NWL
		2012/10/24	475	NWL
		2012/05/28	281	NWL
		2012/03/29	250	NWL
		2011/11/02	Baseline	NWL
HZMB 001	WL46	2016/07/18	1276	NWL
		2016/05/23	1251	NWL
		2014/08/25	997	NWL
		2013/08/21	771	NWL
		2013/06/13	681	NWL
		2013/04/01	617	NWL
		2013/02/14	573	NWL
		2012/03/29	250	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
	CH98	2011/11/02	Baseline	NWL
	NL11	2011/11/02	Baseline	NWL
		2011/11/07	Baseline	NWL
	NL12	2011/11/02	Baseline	NWL
	NL33	2011/09/23	Baseline	NWL
		2011/11/01	Baseline	NEL
		2011/11/05	Baseline	NWL
		2011/11/07	Baseline	NWL
	NL46	2011/10/28	Baseline	NWL
	CH153	2011/10/11	Baseline	NWL
	NL48	2001/11/07	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/09/16	Baseline	NWL
	NL75	2011/09/16	Baseline	NWL
		2011/09/16	Baseline	NWL
		2011/11/01	Baseline	NEL
	NL80	2011/11/02	Baseline	NWL
	NL118	2011/09/06	Baseline	NWL
	NL120	2011/11/06	Baseline	NEL
		2011/10/10	Baseline	NWL
	NL123	2011/11/06	Baseline	NEL
		2011/10/10	Baseline	NWL
		2011/10/06	Baseline	NWL
	NL139	2011/11/01	Baseline	NEL
		2011/10/10	Baseline	NEL
		2011/09/16	Baseline	NWL
	NL165	2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
	NL170	2011/10/06	Baseline	NEL
	NL188	2011/11/07	Baseline	NWL
		2011/11/01	Baseline	NWL
		2011/10/28	Baseline	NWL
	NL191	2011/09/07	Baseline	NWL
	NL202	2011/11/07	Baseline	NWL
		2011/10/28	Baseline	NWL
	NL210	2011/11/07	Baseline	NWL
		2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/09/07	Baseline	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
	NL214	2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/10/28	Baseline	NWL
	NL220	2011/10/10	Baseline	NEL
	NL224	2011/10/28	Baseline	NWL
	NL226	2011/11/05	Baseline	NWL
		2011/10/17	Baseline	WL
	NL230	2011/11/02	Baseline	NWL
		2011/10/17	Baseline	WL
	NL233	2011/10/28	Baseline	NWL
		2011/10/06	Baseline	NWL
		2011/09/16	Baseline	NWL
	NL241	2011/11/07	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/09/16	Baseline	NWL
	NL244	2011/11/01	Baseline	NEL
		2011/11/01	Baseline	NWL
		2011/09/05	Baseline	WL
	NL256	2011/11/02	Baseline	NWL
	NL258	2011/09/16	Baseline	NWL
		2011/09/05	Baseline	WL
	NL259	2011/11/07	Baseline	NWL
	NL261	2011/11/01	Baseline	NEL
	NL264	2011/11/06	Baseline	NEL
		2011/10/06	Baseline	NEL
		2011/09/23	Baseline	NWL
	NL269	2011/11/02	Baseline	NWL
	NL272	2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/10/28	Baseline	NWL
		2011/09/16	Baseline	NWL
	NL278	2011/11/02	Baseline	NWL
	NL279	2011/11/02	Baseline	NWL
	SL42	2011/11/02	Baseline	NWL
	SL43	2011/10/28	Baseline	NWL

Identification Number	Baseline Identification Number	Date (YYYY-MM-DD)	Sighting Number	Area Sighted
	WL04	2011/11/05	Baseline	NWL
		2011/11/02	Baseline	NWL
		2011/10/17	Baseline	WL
		2011/10/10	Baseline	NWL
		2011/09/16	Baseline	NWL
	WL05	2011/11/01	Baseline	NEL
		2011/11/01	Baseline	NEL
	WL11	2011/11/07	Baseline	NWL
	WL25	2011/10/17	Baseline	WL
		2011/09/23	Baseline	WL
		2011/09/16	Baseline	NWL
	WL88	2011/11/02	Baseline	WL
		2011/09/16	Baseline	NWL
	WL116	2011/09/16	Baseline	NWL
	WL124	2011/11/02	Baseline	NWL
	WL156	2011/10/28	Baseline	NWL
		2011/09/23	Baseline	WL
	WL162	2011/09/16	Baseline	NWL
	NL275	2011/09/23	Baseline	WL
	SL48	2011/11/02	Baseline	WL
		2011/10/17	Baseline	WL
		2011/09/23	Baseline	WL
	CH108	2011/11/02	Baseline	WL
		2011/11/02	Baseline	WL
	CH157	2011/11/02	Baseline	WL
	NL206	2011/10/07	Baseline	WL
	WL28	2011/09/23	Baseline	WL
	WL42	2011/11/02	Baseline	WL
		2011/09/05	Baseline	WL
	WL47	2011/10/17	Baseline	WL
	WL61	2011/10/17	Baseline	WL
		2011/09/23	Baseline	WL
	WL66	2011/11/07	Baseline	WL
	WL68	2011/09/05	Baseline	WL
		2011/09/05	Baseline	WL
	WL72	2011/11/02	Baseline	WL
		2011/11/02	Baseline	WL
		2011/09/23	Baseline	WL
	WL87	2011/09/23	Baseline	WL

<b>Identification Number</b>	<b>Baseline Identification Number</b>	<b>Date (YYYY-MM-DD)</b>	<b>Sighting Number</b>	<b>Area Sighted</b>
	WL88	2011/11/02	<i>Baseline</i>	<i>WL</i>
		2011/09/16	<i>Baseline</i>	<i>WL</i>
	WL116	2011/09/16	<i>Baseline</i>	<i>WL</i>
	WL118	2011/11/02	<i>Baseline</i>	<i>WL</i>
		2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL123	2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL124	2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL128	2011/11/07	<i>Baseline</i>	<i>WL</i>
		2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL131	2011/11/02	<i>Baseline</i>	<i>WL</i>
		2011/11/02	<i>Baseline</i>	<i>WL</i>
		2011/09/23	<i>Baseline</i>	<i>WL</i>
	WL132	2011/09/23	<i>Baseline</i>	<i>WL</i>
	WL137	2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL138	2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL144	2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL145	2011/09/05	<i>Baseline</i>	<i>WL</i>
	WL146	2011/10/17	<i>Baseline</i>	<i>WL</i>
	WL153	2011/11/07	<i>Baseline</i>	<i>WL</i>
	WL157	2011/09/23	<i>Baseline</i>	<i>WL</i>
	WL158	2011/09/23	<i>Baseline</i>	<i>WL</i>
	WL163	2011/11/07	<i>Baseline</i>	<i>WL</i>
		2011/11/02	<i>Baseline</i>	<i>WL</i>
	WL165	2011/10/17	<i>Baseline</i>	<i>WL</i>
	WL167	2011/10/17	<i>Baseline</i>	<i>WL</i>
	WL170	2011/11/07	<i>Baseline</i>	<i>WL</i>
	WL171	2011/10/28	<i>Baseline</i>	<i>WL</i>

HZMB 001 2012-03-18\_10-52-16



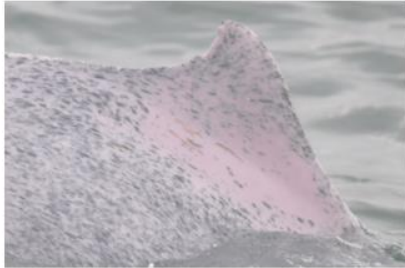
HZMB 001 2012-03-18\_11-07-00



HZMB 002 2012-03-18\_10-53-38



HZMB 002 2013-02-14\_15-41-58\_02



HZMB 003 2012-03-18\_10-54-02\_02



HZMB 003 2012-12-10\_11-20-34\_02



HZMB 004 2012-03-18\_10-54-28\_01



HZMB 004 2012-09-04\_09-24-54



HZMB 005 2012-03-18\_10-51-26\_01



HZMB 005 2012-12-10\_15-49-53\_04



HZMB 006 2012-03-18\_11-17-54



HZMB 006 2012-03-18\_11-21-16\_02



HZMB 007 2012-03-18\_11-06-40\_01



HZMB 007 2012-12-10\_11-21-27



HZMB 008 2012-05-28\_09-14-06



HZMB 009 2012-05-28\_09-15-02



HZMB 011 2012-03-10\_13-19-04\_01



HZMB 011 2012-03-10\_13-22-52





HZMB 012 2012-05-28\_09-15-44\_01



HZMB 013 2012-05-28\_09-11-04\_01



HZMB 013 2012-05-28\_09-19-30\_01



HZMB 014 2012-06-13\_12-57-56\_02 1C



HZMB 015 2012-07-10\_10-22-28\_02



HZMB 016 2012-07-10\_10-23-28\_02 9A



HZMB 016 2012-12-11\_12-26-46\_01



HZMB 017 2012-07-10\_10-31-34\_03



HZMB 018 2012-07-10\_10-34-36\_03



HZMB 018 2012-12-10\_11-14-55



HZMB 019 2012-07-10\_10-42-50\_01



HZMB 020 2012-07-10\_10-43-22\_02



HZMB 021 WL 2012-07-10\_10-23-30



HZMB 022 2013-02-15\_14-59-12\_01



HZMB 022 2013-04-01\_10-38-57\_03



HZMB 023 2012-07-10\_10-42-20\_02



HZMB 023 2013-04-01\_10-43-27



HZMB 024 2012-06-14\_13-09-40\_03



HZMB 024 2012-06-14\_13-12-02\_01



HZMB 025 2012-06-13\_12-51-58



HZMB 025 2013-02-21\_16-49-44



HZMB 026 2012-06-13\_12-59-46\_01 2C



HZMB 027 2012-06-14\_13-33-40



HZMB 028 2012-08-08\_13-53-56



HZMB 028 2012-08-08\_13-59-08\_05



HZMB 029 2012-08-25\_11-57-08\_01



HZMB 030 2012-08-25\_11-57-04\_03



HZMB 031 2012-08-25\_11-58-40\_01



HZMB 032 2012-10-24\_13-58-34\_02



HZMB 032 2012-12-11\_11-37-06\_01



HZMB 033 2012-08-15\_11-08-02\_03



HZMB 033 2012-10-12\_14-55-22\_06



HZMB 034 2012-11-01\_13-30-58\_02



HZMB 035 2012-11-01\_11-59-54



HZMB 036 2012-09-03\_08-53-14\_01



HZMB 036 2012-11-01\_11-37-20\_01



HZMB 037 2012-11-01\_11-47-18\_03



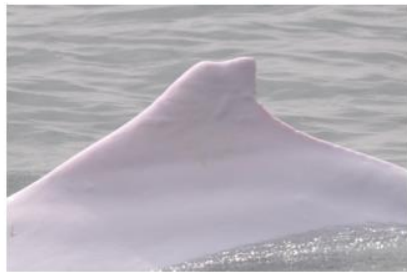
HZMB 038 2012-11-01\_11-40-32\_01



HZMB 040 2012-11-01\_13-22-54\_03



HZMB 040 2013-02-21\_13-27-55\_01



HZMB 041 2013-02-15\_14-41-58\_01



HZMB 041 2013-02-15\_14-45-08\_02



HZMB 042 2012-11-01\_17-01-20\_02



HZMB 043 2012-09-03\_08-54-50\_02



HZMB 044 2013-02-15\_14-41-06\_01



HZMB 044 2013-02-15\_14-46-22



HZMB 045 2013-02-15\_14-58-16\_01



HZMB 046 2012-09-03\_10-21-44\_03



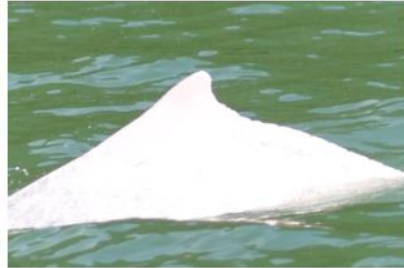
HZMB 047 2012-09-03\_10-11-52\_01



HZMB 048 2012-09-03\_15-33-04\_03



HZMB 049 2012-09-03\_15-39-04\_02



HZMB 050 2013-02-15\_14-59-04\_03



HZMB 050 2013-02-15\_15-00-34\_01



HZMB 051 2013-01-28\_10-57-38



HZMB 051 2013-02-15\_15-56-54\_04



HZMB 052 2012-09-04\_10-33-08



HZMB 053 2012-09-04\_11-08-56\_01



HZMB 054 2012-09-05\_11-06-42\_04



HZMB 055 2012-09-04\_11-21-04\_01



HZMB 056 2012-09-18\_09-56-52



HZMB 056 2012-09-18\_10-01-04



HZMB 057 2012-09-18\_08-44-30



HZMB 059 2013-02-21\_16-49-34\_02



HZMB 060 2012-09-18\_14-57-50\_01



HZMB 061 2012-09-18\_17-17-58\_01



HZMB 063 2012-10-12\_14-54-50\_03



HZMB 064 2012-10-12\_14-54-48\_01



HZMB 064 2012-10-24\_14-02-40\_05



HZMB 067 2012-10-24\_14-40-28\_01



HZMB 068 2012-10-24\_14-32-56\_02



HZMB 069 2012-10-24\_14-37-06



HZMB 070 2012-10-24\_14-38-06





HZMB 072 2012-10-24\_14-37-52\_03\_9A



HZMB 073 2012-12-10\_11-13-02



HZMB 073 2012-12-10\_11-20-33



HZMB 074 2013-02-21\_17-11-59\_03



HZMB 075 2012-12-06\_11-40-11\_01



HZMB 076 2012-12-11\_13-11-24\_01



HZMB 077 2012-12-11\_13-02-24



HZMB 078 2013-01-08\_13-44-00\_02



HZMB 078 2013-02-15\_15-03-16\_03



HZMB 079 WL\_2013-01-28\_09-38-49



HZMB 080 WL\_2013-01-28\_09-46-26\_01



HZMB 081 2013-01-28\_10-04-13\_01



HZMB 082 2013-01-28\_12-59-32\_01



HZMB 082 WL 2013-02-15\_14-57-44\_02



HZMB 083 2013-01-28\_13-22-47



HZMB 083 2013-02-15\_15-00-38\_03



HZMB 084 2013-02-14\_15-54-46



HZMB 085 2013-02-15\_14-45-40\_02



HZMB 085 2013-02-15\_14-46-42\_01



HZMB 086 2013-02-15\_14-46-14\_02



HZMB 087 2013-02-15\_14-58-54\_04



HZMB 087 2013-02-15\_15-00-34\_05



HZMB 088 2013-02-15\_14-57-08\_02



HZMB 089 2013-02-15\_15-00-46\_01



HZMB 090 2013-02-15\_14-58-22\_02



HZMB 091 2013-02-15\_15-02-52\_01



HZMB 092 2013-02-15\_15-41-04\_01



HZMB 098 2013-05-24\_13-17-20\_02



HZMB 098 2014-08-04\_13-41-32



HZMB 099 2013-06-13\_10-00-39\_01



HZMB 100 2013-07-08\_09-34-44\_03



HZMB 100 2013-07-08\_09-43-16\_03



HZMB 101 2013-07-08\_09-35-35\_01



HZMB 101 WL 2013-07-08\_09-42-35\_03



HZMB 102 2013-07-08\_09-43-13



HZMB 103 2013-07-08\_13-52-32\_02



HZMB 098 2013-04-29\_10-57-14\_03



HZMB 098 WL\_2013-07-12\_10-08-01\_01



HZMB 099 2013-06-13\_10-00-39\_01



HZMB 100 2013-07-08\_09-34-44\_03



HZMB 100 2013-07-08\_09-43-16\_03



HZMB 101 2013-07-08\_09-35-35\_01



HZMB 101 WL 2013-07-08\_09-42-35\_03



HZMB 102 2013-07-08\_09-43-13



HZMB 103 2013-07-08\_13-52-32\_02



HZMB 104 2013-07-08\_14-00-59\_01



HZMB 104 2013-07-08\_14-08-35\_02



HZMB 105WL 2013-07-08\_14-17-45



HZMB 106 WL\_2013-08-21\_09-37-43



HZMB 107 2013-08-21\_11-54-23\_02



HZMB 107 2013-08-21\_12-01-31\_01



HZMB 108 2013-08-30\_16-04-04\_02



HZMB 110 2013-10-15\_09-39-45



HZMB 111 2013-10-15\_10-21-46\_01



HZMB 112 2013-10-15 10-20-30



HZMB 113 2013-10-24 11-04-54 01



HZMB 114 2013-10-24 11-06-19



HZMB 115 2013-12-26 13-54-54 01



HZMB 116 2013-12-26 13-59-59



HZMB 116 2014-07-14 12-40-48



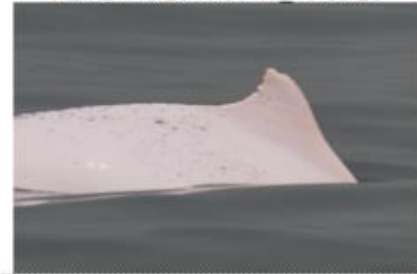
HZMB 117 2014-01-06 11-39-43 03



HZMB 118 2014-01-06 13-40-50 01



HZMB 119 2014-04-19 10-55-28



HZMB 120 2014-05-31 09-50-10\_02



HZMB 120 2014-05-31 09-50-27



HZMB 121 LL 2014-07-14 11-08-30 (4)



HZMB 122 2014-08-04 09-33-46\_01



HZMB 122 2014-08-04 09-34-18\_01



HZMB 123 2014-08-25#2



HZMB 124 LL 2014-09-22\_09-33-30



HZMB 125 2014-10-13\_13-58-29\_04 M



HZMB 126 2015-01-03-10-02-25\_02 MED





HZMB 126 2015-01-03-10-05-18\_01 MED



HZMB 127 2015-01-03-11-39-50\_01 MED



HZMB 127 2015-01-03-11-42-25\_02 MED



HZMB 128 2015-01-03-11-39-52\_01 MED



HZMB 128 2015-01-03-11-42-22\_03 MED



HZMB 129 2015-09-07-13-47-07 MED



HZMB 129 2015-09-07-13-50-30\_02 MED



HZMB 130 2016-02-04\_14-10-26\_01 MED



HZMB 130 2016-02-04\_14-10-27\_01 MED



HZMB 131 2016-03-22\_14-38-08 Med



HZMB 132 2016-05-23\_10-49-54\_01 MED



HZMB 132 2016-05-23\_10-53-54 MED



HZMB 133 LL 2016-05-23\_12-14-02\_01 MED



HZMB 134 LL 2016-05-23\_12-35-03 MED



HZMB 134 LL 2016-05-23\_12-37-35 MED





# China Harbour Engineering Company Limited

## Monthly Summary Waste Flow Table for May / 2017 (year)

Project : Hong Kong – Zhuhai – Macao Bridge, Hong Kong Boundary Crossing Facilities – Reclamation Works

Contract No.: HY/2010/02

Month	Actual Quantities of Inert C&D Materials Generated Monthly							Actual Quantities of C&D Wastes Generated Monthly				
	Total Quantity Generated	Hard Rock and Large Broken Concrete (see Note 1)	Reused in the Contract	Reused in other Projects	Surplus Surcharge exported to Macau	Disposed as Public Fill	Imported Fill	Metals	Paper/ cardboard packaging	Plastics (see Note 2)	Chemical Waste (see Note 4)	Others, e.g. general refuse (see Note 3)
	(in '000m <sup>3</sup> )	(in '000m <sup>3</sup> )	(in '000m <sup>3</sup> )	(in '000m <sup>3</sup> )	(in '000m <sup>3</sup> )	(in '000m <sup>3</sup> )	(in '000m <sup>3</sup> )	(in '000 kg)	(in '000kg)	(in '000kg)	(in '000kg)	(in '000 m <sup>3</sup> )
Jan-17	0.0000	0.0000	0.0000	15.6100	73.2375	0.0000	18.8927	0.0000	0.3640	0.0000	0.0000	0.0455
Feb-17	0.0000	0.0000	0.0000	39.0950	182.3675	0.0000	17.5747	0.0000	0.3920	0.0000	0.0000	0.0260
Mar-17	0.0000	0.0000	0.0000	60.6496	171.6925	0.0000	20.6013	0.0000	0.0000	0.0000	0.0000	0.0585
Apr-17	0.0000	0.0000	0.0000	2.4750	55.3140	0.0000	39.9607	0.0000	0.4480	0.0000	0.0000	0.0325
May-17	0.0000	0.0000	0.0000	0.0000	4.5540	0.0000	22.4307	0.0000	0.0000	0.0000	0.0000	0.0455
Jun-17												
Sub-total	0.0000	0.0000	0.0000	117.8296	487.1655	0.0000	119.4601	0.0000	1.2040	0.0000	0.0000	0.2080
Jul-17												
Aug-17												
Sep-17												
Oct-17												
Nov-17												
Dec-17												
Total	0.0000	0.0000	0.0000	117.8296	487.1655	0.0000	119.4601	0.0000	1.2040	0.0000	0.0000	0.2080

- Notes:
- (1) Broken concrete for recycling into aggregates.
  - (2) Plastics refer to plastic bottles / containers / sheets / foam / barrier from packaging materials.
  - (3) Use the conversion factor : 1 full load of dumping truck being equivalent to 6.5m<sup>3</sup> by volume.
  - (4) Chemical waste refer to spent “battery” and “oil with water”.

## Appendix J

### Cumulative Statistics on Exceedances, Complaints, Notifications of Summons and Successful Prosecutions

#### Cumulative statistics on Exceedances

		Total no. recorded in this month	Total no. recorded since project commencement
1-Hour TSP	Action	-	-
	Limit	-	-
24-Hour TSP	Action	-	-
	Limit	-	-
Noise	Action	-	-
	Limit	-	-
Water Quality	Action	-	2
	Limit	-	3
Dolphin Monitoring	Action	-	-
	Limit	-	-

Remarks: Exceedances which are not project-related are not presented in this table.

#### Cumulative statistics on Complaints, Notifications of Summons and Successful Prosecutions

	Date Received	Subject	Status	Total no. received in this month	Total no. received since project commencement
Environmental complaints	27 March 2017	An environmental complaint was received by EPD on 27 March 2017, and the complainant complained that a very loud sound was intermittently heard by the Complainant since 10pm on 26 March and such loud sound was heard by the complainant until midnight. It was suspected that the sound came from the Hong Kong-Zhuhai-Macao Bridge (HZMB) construction works near the artificial	Closed	1	45

		island. In addition, a large area of pollution was observed on sea in the morning of the day the complainant made the complaint. It was suspected that was caused by the HZMB construction works. After investigation, there is no adequate information to conclude the complaint is related to this Contract.			
	17 April 2017	One environmental complaint was received on 17 April 2017, the organization which made the complaint, Green Sense, complained that “muddy water was observed at area surrounding the Hong Kong-Zhuhai-Macao Bridge (HZMB) artificial island, it is suspected that there were overflow muddy water from the artificial island. Tam Hoi-pong of Green Sense stated that there should not be too much muddy water if reclamation was conducted according to the EIA report. He suspected that there are problems of reclamation works, silt curtain have not effectively screen out the mud and sand, the construction works is not ideal and unable to ensure water quality. After investigation, there is no adequate information to conclude the complaint is related to this Contract.	Closed	1	46
<b>Notification of summons</b>	-	-	-	-	2
<b>Successful Prosecutions</b>	-	-	-	-	2

## Appendix K – Event Action Plan

### Event / Action Plan for Air Quality

Event	Action			
	ET Leader	IEC	ER	Contractor
<b>Action Level</b>				
Exceedance for one sample	<ol style="list-style-type: none"> <li>1. Identify source, investigate the causes of exceedance and propose remedial measures;</li> <li>2. Inform IEC and ER;</li> <li>3. Repeat measurement to confirm finding;</li> <li>4. Increase monitoring frequency to daily.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET;</li> <li>2. Check Contractor's working method.</li> </ol>	<ol style="list-style-type: none"> <li>1. Notify Contractor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Rectify any unacceptable practice;</li> <li>2. Amend working methods if appropriate.</li> </ol>
Exceedance for two or more consecutive samples	<ol style="list-style-type: none"> <li>1. Identify source;</li> <li>2. Inform IEC and ER;</li> <li>3. Advise the ER on the effectiveness of the proposed remedial measures;</li> <li>4. Repeat measurements to confirm findings;</li> <li>5. Increase monitoring frequency to daily;</li> <li>6. Discuss with IEC and Contractor on remedial actions required;</li> <li>7. If exceedance continues, arrange meeting with IEC and ER;</li> <li>8. If exceedance stops, cease additional monitoring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET;</li> <li>2. Check Contractor's working method;</li> <li>3. Discuss with ET and Contractor on possible remedial measures;</li> <li>4. Advise the ER on the effectiveness of the proposed remedial measures;</li> <li>5. Supervise Implementation of remedial measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Notify Contractor;</li> <li>3. Ensure remedial measures properly implemented.</li> </ol>	<ol style="list-style-type: none"> <li>1. Submit proposals for remedial to ER within 3 working days of notification;</li> <li>2. Implement the agreed proposals;</li> <li>3. Amend proposal if appropriate.</li> </ol>

Event	Action			
	ET Leader	IEC	ER	Contractor
<b>Limit Level</b>				
Exceedance for one sample	<ol style="list-style-type: none"> <li>1. Identify source, investigate the causes of exceedance and propose remedial measures;</li> <li>2. Inform ER, Contractor and EPD;</li> <li>3. Repeat measurement to confirm finding;</li> <li>4. Increase monitoring frequency to daily;</li> <li>5. Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and ER informed of the results.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET;</li> <li>2. Check Contractor's working method;</li> <li>3. Discuss with ET and Contractor on possible remedial measures;</li> <li>4. Advise the ER on the effectiveness of the proposed remedial measures;</li> <li>5. Supervise implementation of remedial measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Notify Contractor;</li> <li>3. Ensure remedial measures properly implemented.</li> </ol>	<ol style="list-style-type: none"> <li>1. Take immediate action to avoid further exceedance;</li> <li>2. Submit proposals for remedial actions to IEC within 3 working days of notification;</li> <li>3. Implement the agreed proposals;</li> <li>4. Amend proposal if appropriate.</li> </ol>
Exceedance for two or more consecutive samples	<ol style="list-style-type: none"> <li>1. Notify IEC, ER, Contractor and EPD;</li> <li>2. Identify source;</li> <li>3. Repeat measurement to confirm findings;</li> <li>4. Increase monitoring frequency to daily;</li> <li>5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented;</li> <li>6. Arrange meeting with IEC and ER to discuss the remedial actions to be taken;</li> <li>7. Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and ER informed of the results;</li> <li>8. If exceedance stops, cease additional monitoring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Discuss amongst ER, ET, and Contractor on the potential remedial actions;</li> <li>2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly;</li> <li>3. Supervise the implementation of remedial measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Notify Contractor;</li> <li>3. In consultation with the IEC, agree with the Contractor on the remedial measures to be implemented;</li> <li>4. Ensure remedial measures properly implemented;</li> <li>5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Take immediate action to avoid further exceedance;</li> <li>2. Submit proposals for remedial actions to IEC within 3 working days of notification;</li> <li>3. Implement the agreed proposals;</li> <li>4. Resubmit proposals if problem still not under control;</li> <li>5. Stop the relevant portion of works as determined by the ER until the exceedance is abated.</li> </ol>

Event / Action Plan for Construction Noise

Event	Action			
	ET Leader	IEC	ER	Contractor
Action Level	<ol style="list-style-type: none"> <li>1. Notify IEC and Contractor;</li> <li>2. Identify source, investigate the causes of exceedance and propose remedial measures;</li> <li>3. Report the results of investigation to the IEC, ER and Contractor;</li> <li>4. Discuss with the Contractor and formulate remedial measures;</li> <li>5. Increase monitoring frequency to check mitigation effectiveness.</li> </ol>	<ol style="list-style-type: none"> <li>1. Review the analysed results submitted by the ET;</li> <li>2. Review the proposed remedial measures by the Contractor and advise the ER accordingly;</li> <li>3. Supervise the implementation of remedial measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Notify Contractor;</li> <li>3. Require Contractor to propose remedial measures for the analysed noise problem;</li> <li>4. Ensure remedial measures are properly implemented.</li> </ol>	<ol style="list-style-type: none"> <li>1. Submit noise mitigation proposals to IEC;</li> <li>2. Implement noise mitigation proposals.</li> </ol>
Limit Level	<ol style="list-style-type: none"> <li>1. Inform IEC, ER, EPD and Contractor;</li> <li>2. Identify source;</li> <li>3. Repeat measurements to confirm findings;</li> <li>4. Increase monitoring frequency;</li> <li>5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented;</li> <li>6. Inform IEC, ER and EPD the causes and actions taken for the exceedances;</li> <li>7. Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and ER informed of the results;</li> <li>8. If exceedance stops, cease additional monitoring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Discuss amongst ER, ET, and Contractor on the potential remedial actions;</li> <li>2. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly;</li> <li>3. Supervise the implementation of remedial measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Notify Contractor;</li> <li>3. Require Contractor to propose remedial measures for the analysed noise problem;</li> <li>4. Ensure remedial measures properly implemented;</li> <li>5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Take immediate action to avoid further exceedance;</li> <li>2. Submit proposals for remedial actions to IEC within 3 working days of notification;</li> <li>3. Implement the agreed proposals;</li> <li>4. Resubmit proposals if problem still not under control;</li> <li>5. Stop the relevant portion of works as determined by the ER until the exceedance is abated.</li> </ol>



Event / Action Plan for Water Quality

Event	Action			
	ET Leader	IEC	ER	Contractor
Action level being exceeded by one sampling day	<ol style="list-style-type: none"> <li>1. Repeat <i>in situ</i> measurement to confirm findings;</li> <li>2. Identify source(s) of impact;</li> <li>3. Inform IEC, contractor and ER;</li> <li>4. Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>5. Discuss mitigation measures with IEC, ER and Contractor;</li> <li>6. Ensure mitigation measures are implemented;</li> <li>7. Repeat measurement on next day of exceedance to confirm findings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET and Contractor's working methods;</li> <li>2. Discuss with ET and Contractor on possible remedial actions;</li> <li>3. Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly;</li> <li>4. Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of non-compliance in writing;</li> <li>2. Discuss with IEC on the proposed mitigation measures;</li> <li>3. Make agreement on mitigation measures to be implemented;</li> <li>4. Ensure mitigation measures are properly implemented.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inform the ER and confirm notification of the non-compliance in writing;</li> <li>2. Rectify unacceptable practice;</li> <li>3. Check all plant and equipment and consider changes of working methods;</li> <li>4. Discuss with ET and IEC on possible remedial actions and propose mitigation measures to IEC and ER;</li> <li>5. Implement the agreed mitigation measures.</li> <li>6. Amend working methods if appropriate.</li> </ol>

Event	Action			
	ET Leader	IEC	ER	Contractor
Action level being exceeded by two or more consecutive sampling days	<ol style="list-style-type: none"> <li>1. Repeat <i>in situ</i> measurement to confirm findings;</li> <li>2. Identify source(s) of impact;</li> <li>3. Inform IEC, Contractor and ER;</li> <li>4. Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>5. Discuss mitigation measures with IEC, ER and Contractor;</li> <li>6. Ensure mitigation measures are implemented;</li> <li>7. Increase the monitoring frequency to daily until no exceedance of Action level;</li> <li>8. Repeat measurement on next day of exceedance to confirm findings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET and Contractor's working method;</li> <li>2. Discuss with ET and Contractor on possible remedial actions;</li> <li>3. Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly;</li> <li>4. Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of non-compliance in writing;</li> <li>2. Discuss with IEC on the proposed mitigation measures;</li> <li>3. Make agreement on mitigation measures to be implemented;</li> <li>4. Ensure mitigation measures are properly implemented;</li> <li>5. Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inform the Engineer and confirm notification of the non-compliance in writing;</li> <li>2. Rectify unacceptable practice;</li> <li>3. Check all plant and equipment and consider changes of working methods;</li> <li>4. Discuss with ET and IEC on possible remedial actions and propose mitigation measures to IEC and ER within 3 working days of notification;</li> <li>5. Implement the agreed mitigation measures;</li> <li>6. Amend working methods if appropriate.</li> </ol>

Event	Action			
	ET Leader	IEC	ER	Contractor
Limit level being exceeded by one sampling day	<ol style="list-style-type: none"> <li>1. Repeat <i>in-situ</i> measurement to confirm findings;</li> <li>2. Identify source(s) of impact;</li> <li>3. Inform IEC, Contractor, ER and EPD;</li> <li>4. Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>5. Discuss mitigation measures with IEC, ER and Contractor;</li> <li>6. Ensure mitigation measures are implemented;</li> <li>7. Increase the monitoring frequency to daily until no exceedance of Limit level.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET and Contractor's working method;</li> <li>2. Discuss with ET and Contractor on possible remedial actions;</li> <li>3. Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly;</li> <li>4. Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Discuss with IEC, ET and Contractor on the proposed mitigation measures;</li> <li>3. Request Contractor to critically review the working methods;</li> <li>4. Ensure mitigation measures are properly implemented;</li> <li>5. Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inform the ER and confirm notification of the non-compliance in writing;</li> <li>2. Rectify unacceptable practice;</li> <li>3. Check all plant and equipment and consider changes of working methods;</li> <li>4. Submit proposal of mitigation measures to ER within 3 working days of notification and discuss with ET, IEC and ER;</li> <li>5. Implement the agreed mitigation measures;</li> <li>6. Amend working methods if appropriate.</li> </ol>

Event	Action			
	ET Leader	IEC	ER	Contractor
Limit level being exceeded by two or more consecutive sampling days	<ol style="list-style-type: none"> <li>1. Repeat <i>in-situ</i> measurement to confirm findings;</li> <li>2. Identify source(s) of impact;</li> <li>3. Inform IEC, contractor, ER and EPD;</li> <li>4. Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>5. Discuss mitigation measures with IEC, ER and Contractor;</li> <li>6. Ensure mitigation measures are implemented;</li> <li>7. Increase the monitoring frequency to daily until no exceedance of Limit level for two consecutive days.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET and Contractor's working method;</li> <li>2. Discuss with ET and Contractor on possible remedial actions;</li> <li>3. Review the Contractor's mitigation measures whenever necessary to assure their effectiveness and advise the ER accordingly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing;</li> <li>2. Discuss with IEC, ET and Contractor on the proposed mitigation measures;</li> <li>3. Request Contractor to critically review the working methods;</li> <li>4. Make agreement on the mitigation measures to be implemented;</li> <li>5. Ensure mitigation measures are properly implemented;</li> <li>6. Assess the effectiveness of the implemented mitigation measures;</li> <li>7. Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the construction activities until no exceedance of Limit level.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inform the ER and confirm notification of the non-compliance in writing;</li> <li>2. Take immediate action to avoid further exceedance;</li> <li>3. Rectify unacceptable practice;</li> <li>4. Check all plant and equipment and consider changes of working methods;</li> <li>5. Submit proposal of mitigation measures to ER within 3 working days of notification and discuss with ET, IEC and ER;</li> <li>6. Implement the agreed mitigation measures;</li> <li>7. Resubmit proposals of mitigation measures if problem still not under control;</li> <li>8. As directed by the Engineer, to slow down or to stop all or part of the construction activities until no exceedance of Limit level.</li> </ol>

Event / Action Plan for Dolphin Monitoring

Event	ET Leader	IEC	ER / SOR	Contractor
Action Level	<ol style="list-style-type: none"> <li>1. Repeat statistical data analysis to confirm findings;</li> <li>2. Review all available and relevant data, including raw data and statistical analysis results of other parameters covered in the EM&amp;A, to ascertain if differences are as a result of natural variation or previously observed seasonal differences;</li> <li>3. Identify source(s) of impact;</li> <li>4. Inform the IEC, ER/SOR and Contractor;</li> <li>5. Check monitoring data.</li> <li>6. Review to ensure all the dolphin protective measures are fully and properly implemented and advise on additional measures if necessary.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET and Contractor;</li> <li>2. Discuss monitoring results and finding with the ET and the Contractor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Discuss monitoring with the IEC and any other measures proposed by the ET;</li> <li>2. If ER/SOR is satisfied with the proposal of any other measures, ER/SOR to signify the agreement in writing on the measures to be implemented.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inform the ER/SOR and confirm notification of the non-compliance in writing;</li> <li>2. Discuss with the ET and the IEC and propose measures to the IEC and the ER/SOR;</li> <li>3. Implement the agreed measures.</li> </ol>
Limit Level	<ol style="list-style-type: none"> <li>1. Repeat statistical data analysis to confirm findings;</li> <li>2. Review all available and relevant data, including raw data and statistical analysis results of other parameters covered in the EM&amp;A, to ascertain if differences are as a result of natural variation or previously observed seasonal differences;</li> <li>3. Identify source(s) of impact;</li> <li>4. Inform the IEC, ER/SOR and Contractor of findings;</li> <li>5. Check monitoring data;</li> <li>6. Repeat review to ensure all the</li> </ol>	<ol style="list-style-type: none"> <li>1. Check monitoring data submitted by ET and Contractor;</li> <li>2. Discuss monitoring results and findings with the ET and the Contractor;</li> <li>3. Attend the meeting to discuss with ET, ER/SOR and Contractor the necessity of additional dolphin monitoring and any other potential mitigation measures.</li> <li>4. Review proposals for additional monitoring and any other mitigation measures submitted by ET and Contractor and</li> </ol>	<ol style="list-style-type: none"> <li>1. Attend the meeting to discuss with ET, IEC and Contractor the necessity of additional dolphin monitoring and any other potential mitigation measures.</li> <li>2. If ER/SOR is satisfied with the proposals for additional dolphin monitoring and/or any other mitigation measures submitted by ET and Contractor and verified by IEC, ER/SOR to signify the agreement in writing on such proposals and any other mitigation measures.</li> <li>3. Supervise the implementation</li> </ol>	<ol style="list-style-type: none"> <li>1. Inform the ER/SOR and confirm notification of the non-compliance in writing;</li> <li>2. Attend the meeting to discuss with ET, IEC and ER/SOR the necessity of additional dolphin monitoring and any other potential mitigation measures.</li> <li>3. Jointly submit with ET to IEC a proposal of additional dolphin monitoring and/or any other mitigation measures when necessary.</li> <li>4. Implement the agreed additional dolphin monitoring and/or any other mitigation</li> </ol>

	<p>dolphin protective measures are fully and properly implemented and advise on additional measures if necessary.</p> <p>7. If ET proves that the source of impact is caused by any of the construction activity by the works contract, ET to arrange a meeting to discuss with IEC, ER/SOR and Contractor the necessity of additional dolphin monitoring and/or any other potential mitigation measures (e.g., consider to modify the perimeter silt curtain or consider to control/temporarily stop relevant construction activity etc.) and submit to IEC a proposal of additional dolphin monitoring and/or mitigation measures where necessary.</p>	<p>advise ER/SOR of the results and findings accordingly.</p> <p>5. Supervise / Audit the implementation of additional monitoring and/or any other mitigation measures and advise ER/SOR the results and findings accordingly.</p>	<p>of additional monitoring and/or any other mitigation measures.</p>	<p>measures.</p>
--	--	--	---	------------------

**Report No. D017**  
**Monitoring Period March 2017 - May 2017**

The Action and Limit Levels of Chinese White Dolphin (CWD) monitoring which was extracted from the enhanced Event and Action Plan<sup>#</sup> are reproduced below:

	North Lantau Social Cluster	
	NEL	NWL
<b>Action Level</b>	(STG<4.2) & (ANI<15.5)	(STG<6.9) & (ANI<31.3)
<b>Limit Level</b>	[(STG<2.4) & (ANI<8.9)] AND [(STG<3.9) & (ANI<17.9)]	

**Quarterly Encounter Rate**

	STG*	ANI**	Level Exceeded
<b>NEL</b>	0.0	0.0	Limit
<b>NWL</b>	0.5	2.9	

<sup>#</sup> Reference is made to the enhanced Event Action Plan for Chinese White Dolphin Monitoring accepted by EPD on 7 May 2013.

\*Quarterly Encounter Rate of Number of Dolphin Sightings (STG) presents averaged encounter rates of the three monitored months in terms of groups per 100km per survey event.

\*\*Quarterly Encounter Rate of Total Number of Dolphins (ANI) presents averaged encounter rates of the three monitored months in terms of individuals per 100km per survey event.

**Investigation Results:**

- a) Causes of exceedance
- After review of all available and relevant data, including the raw data and analyses of other parameters included in the EM&A, no significant variation is detected in key environmental parameters.
  - No direct relationship with Project construction activities can be found between either the increase or decrease of dolphin numbers in NEL but this project activities may contribute to disturbance.
  - Current mitigation measures are being upheld. Dolphin Watching Plan has been implemented from the start of works of the Project.
  - There has been no failure or reduction of dolphin-specific mitigation measures.
  - Meetings were held on 9 December 2014, 27 April 2015, 10 July 2015, 6 October 2016, 15 January 2016, 20 April 2016, 22 July 2016, 14 October 2016, 10 February 2017, 29 May 2017 and 17 July 2017 between ENPO, project ET for this and other HZMB projects and engineer representatives, to discuss dolphin encounter rates during the period September-November 2014, December 2014-February 2015, March 2015-May 2015, June 2015-August 2015, September 2015 - November 2015, December 2015 - February 2016, March 2016 - May 2016, June 2016 - August 2016, September 2016 - November 2016, December 2016 - February 2017 and March 2017 - May 2017. It was concluded that the HZMB construction work is one of the contributing factors affecting the dolphins. It was also concluded the contribution of impacts due to individual HZMB contracts and processes cannot be separated from the other activities within the dolphins habitat.
- b) Action required under the action plan  
 Please refer to corresponding Event and Action Plan.
- c) Action taken under the action plan

1. Statistical data analysis has been repeated to confirm findings;
2. All available and relevant data, including raw data and statistical analysis results of other parameters covered in the EM&A have been reviewed;
3. Identification of source of impact was carried out;
4. The IEC, ER and Contractor have been informed of findings;
5. Monitoring data has been checked;
6. Review has been repeated to ensure all the dolphin protective measures are fully and properly implemented and where necessary, additional measures were recommended;
7. After investigation, there was no evidence that indicated that the reduced number of dolphins in NWL and NEL was related solely to Project works. It was also concluded the contribution of impacts due to the HZMB works as a whole (or individual contracts) cannot be quantified nor separate from the other stress factors. Please also refer to the attachment for full investigation result.

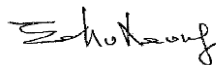
d) ET's conclusions and recommendations for mitigation

- Current mitigation measures for CWD are being implemented fully, and the Contractor has been reminded to consistently implement existing mitigation measures.
- It was considered that the current monitoring works under the EM&A programmes have already provided a high level of monitoring effort, and the joint meeting with ENPO, project ET for this and other HZMB projects and engineer representatives on 20 April 2016 concluded that additional monitoring in the three monitoring areas was not considered necessary as it may not generate additional information regarding dolphin distribution pattern in these three areas. Instead, it was considered that existing data can be reviewed and alternative analytical methods can be explored to see if it could provide new insight to the dolphin distribution pattern. On a meeting held on 6 October 2015, ENPO stated an extension of survey work into waters outside the three currently surveyed areas for this project was underway to investigate expanded habitat use of dolphins outside the project area. As this has not yielded sufficient new data, this survey has now come to an end.
- The joint meetings with ENPO, project ET for this and other HZMB projects and engineer representatives held regularly **throughout June 2016-May 2017** have discussed that efforts be made to implement additional protection measures. These have been implemented where possible and, in particular, marine traffic for the HKBCF project is much reduced. In addition, the Brothers Marine Park (BMP) has been designated and controls for marine traffic and other activities are being enforced by the appropriate management authorities

e) Contractor's actions to implement the mitigation

- The Contractor was reminded to ensure relevant mitigation measures were fully implemented.
- The marine works of HZMB projects are largely completed and in water works should be finished by the end of 2018
- All but some small sections of silt curain have now been removed and the HKBCF footprint is reduced.
- Regular reporting of vessel movement to ENPO should continue to monitor the continued reduction of Project related vessels.

ET Leader Signature & Date:



10-May-18



**Report No. D017**  
**Monitoring Period March 2017 – May 2017**

### ***Investigation Report Attachment***

- 1. Review all available and relevant data (construction activities), including raw data and analyses of other parameters (air, noise, water and underwater acoustic) covered in the EM&A, to ascertain if differences are a result of natural variation or previously observed seasonal differences.***

On Monday 17<sup>th</sup> July 2017, a meeting was held between ENPO, ET for this contract and other HZMB contracts and engineer representatives following the limit level/action level exceedances for Chinese white dolphin encounter rate during the period March – May 2017. AFCD data was reviewed and noted as the best provider of the current dolphin distribution patterns and mortality events. The AFCD low abundance figure for both NEL and NWL for the period 2016-17 was also noted. Surveys conducted by mainland China authorities as part of HZMB dolphin monitoring will soon be available for review but a preliminary review indicates that dolphin occurrence has also decreased in adjacent, mainland Chinese waters. The broad view of dolphin occurrence in the inner Pearl River Estuary is one of an overall decline in habitat use by the dolphin population.

In the last monitoring year (June 2016-May 2017), there has been a consistent decrease of dolphins in the NEL and NWL areas. Any increases that may have been indicated towards the end of the reporting period have fallen again. As stated in previous investigation reports, the HZMB works is one of the contributing factors affecting the dolphins and it was reiterated at this latest meeting that there are also concurrent works ongoing in both NEL and NWL, some of which are not part of the HZMB Project. It was noted that the new project which was initiated in November 2016 has expanded extensively in scale and now occupies considerable areas of NWL. This project has prevented the successful completion of some of the transect lines. This new project is in addition to the existing pressures the dolphins faced in the Lantau habitat before the HZMB development started, e.g., boat traffic, habitat degradation, pollution, competition with fisheries. All ETs noted at the meeting that mitigation across individual HZMB sites has been fully implemented. The regular checking and auditing of all mitigation works at the HKBCF reclamation works record that all dolphin mitigation measures in the form of vessel routes and speeds, etc., have been implemented and DEZ/DWP are in place. The meeting summarised that multiple factors, as listed above and including the HZMB project, have all contributed to dolphin distribution changes in Hong Kong. The impact of the new project is as yet unquantified but is noted as influencing a large part of NWL, which dolphins have seem to have entirely vacated

- For impact water quality monitoring, an action level exceedance of turbidity was recorded at both SR4(N) and IS8 during the flood tide on 24 March 2017; 1 action level exceedance and 1 limit level exceedance of suspended solids were recorded at SR4(N) and IS8 respectively, also during flood tide on 24 March 2017; 1 action level exceedance of suspended solids were recorded at both SR4(N) and IS8 during ebb tide on 24 March 2017. No other exceedances were recorded at any monitoring station during the reporting month of March 2017. **After investigation, the exceedances were considered unrelated to this Contract's activities.**
- For impact water quality monitoring, 1 action level exceedance of suspended solids was recorded at IS(Mf)11 during flood tide on 28 April 2017. No other exceedances were recorded at any monitoring stations in the reporting month of April 2017. **After investigation, the exceedance was considered unrelated to this Contract's activities.**
- No exceedances were recorded at any monitoring stations in the reporting month of May 2017.

## 2. **Identify source(s) of impacts.**

There is a documented significant decline of the dolphins within Hong Kong waters in the last decade and more. In 2008, an expert panel concluded that the anthropogenic activities which occur in the Hong Kong and adjacent habitat have the potential to affect the dolphin population through pollution, infection, lowered prey availability, intense and low noise levels, collisions, behavioural changes, disturbance, entanglement in fishing gear and habitat modification by activities such as construction, dredging, sewage disposal, industrial effluent discharge, shipping, reclamation, fishing. Since this review, pro-active management by AFCD has resulted in a reduction of the negative impacts caused by non-sustainable fishing, i.e., as the trawling ban progresses, more prey should be available to dolphins, and a general reduction in fishing activities will reduce the potential for entanglement in fishing gear. It is noted that other fishing activities are ongoing in Hong Kong waters which also pose a risk of entanglement, however, data from strandings programme often cannot discern which type of fishery is (and/or net) is responsible for an individual entanglement. In other areas where coastal fisheries have been monitored by independent observers, it was noted that trawling, purse seine and gill netting have the highest bycatch incidence for bottlenose dolphins, with trawling noted as having the greatest impact (Allen *et al* 2014). Globally, trawling fisheries are of the greatest conservation concern due to their high impact on small cetaceans (Ross and Isaac 2004), and although there may still be other fisheries in operation in Hong Kong which pose an entanglement risk to dolphins, none are as intensive or as widespread as the trawl fishery was. Other identified impacts, however, are ongoing and it is noted that construction activities and the high speed ferry traffic in NEL and NWL have both increased since 2008 (AFCD Annual Monitoring Reports 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017). A recent publication incorporating data from AFCD assessed impacts known from Hong Kong between 1996 and 2013 and concluded that high speed ferries have significantly contributed to the decline in dolphins from NEL. This paper also suggests that there has been an overall decline of dolphins in the northern waters of Lantau Island (Marcotte *et al* 2015). This paper also states that caution should be exercised when interpreting these

preliminary findings and further analysis is encouraged. It is noted that the high speed ferries from NEL have been re-routed since December 2015 and now travel to the east and north of Sha Chau Lung Kwu Chau Marine Park (SCLKCMP) resulting in increased high speed ferry (HSF) traffic adjacent to an area that the dolphins have traditionally used frequently. A reduction in the number of sightings in the northern SCLKCMP area has been noted since December 2015 and this observation supports the preliminary findings of Marcotte *et al* (2015) that dolphin declines may be correlated with an increase in the frequency of HSF. This was discussed during the meeting held on 20 April 2016, and all ETs agreed that there is likely a relationship between increased HSF and decreased dolphin density. Other publications (Li *et al* 2015) examine the acoustic disturbance of high speed boats<sup>1</sup> on Chinese white dolphins and observed that frequencies of over >100kHz dominated. This is within the dolphins communication range. The recorded boat noise raised the ambient underwater noise levels from ~5 to 47 decibels, with louder levels recorded at higher speeds and at closer distances. In Hong Kong, similar vessels include small fishing boats, commonly referred to as “P4s” and high speed ferries. This study notes the potential impact these elevated levels have on Chinese white dolphins in southern China and it can be assumed that similar acoustic disturbance may occur in Hong Kong waters. It is known from studies elsewhere that dredging and marine piling activities cause significant disturbance to marine mammals (David 2006; Jefferson *et al.* 2009; Bailey *et al* 2010), including vibratory piling which was conducted as part of the HZMB construction (Wang *et al* 2014; Yang *et al* 2015). Activities which are stressful to dolphins are usually associated with increased underwater noise levels and this includes vessel traffic (from all construction works in the proximity of North Lantau). It is also noted that Hong Kong and adjacent ports are the world’s busiest commercial shipping area with heavy shipping traffic.

As part of progress in the works of HY/2010/02, there has been a reduction in both vessel traffic and sand barges during the last quarter. Vessel movement data is provided regular to ENPO, on request. This reduces the impact of underwater noise levels for this project.

Other non project related works and activities around the HZMB project area may contribute to changes in dolphin distribution and include, but may not be limited to;

- Shift in distribution or change in composition of prey resources (Buchary *et al.* 2003).
- Recent publications suggest that the health status of the dolphins in Hong Kong and adjacent waters may be poor due to the long term accumulation of pollutants therefore, making them more susceptible to new stressors (Gui *et al.* 2014)
- Recent publications suggest that the health status of cetaceans in Hong Kong and adjacent waters may be compromised due to the toxic levels of perfluorinated sulfonic acids (PFSA) recorded in the livers of *Sousa chinensis* (Lam *et al* 2016)

- 3. Repeat review to ensure all the dolphin protective measures are fully and properly**  
Site inspection of the implementation of vessel speed limit, acoustic decoupling measures, spillage and runoff prevention measures on barges, training records related to regular marine travel routes for Contract’s vessels, record of implementation of dolphin watching plan and silt curtain integrity checking record were conducted during weekly site inspection.

<sup>1</sup> Boats travelling at over 15kmph

The appropriate mitigation monitoring was in place depending on site activities, i.e., DEZ/DWP for silt curtain deployment and all other Project activities, respectively.

**4. *Investigate whether the exceedance was caused by any of the construction activity associated with the works contract.***

No single construction works associated with the HKBCF Project can be found to coincide with the observed reduction in dolphin encounter rates in NEL and NWL. As discussed at the series of meetings which have been held, it is agreed that HZMB works are one of the contributing factors affecting dolphins in Hong Kong waters. It was also concluded that the contribution of impacts due to individual Projects cannot be quantified nor separated from the other stress factors. All mitigation measures as detailed in the EM&A are being upheld and additional measures to restrict traffic number and routing have been proposed and, in some cases, already implemented for the HKBCF Project.

These factors were reported in D005, D006, D007, D008, D009, D010, D011, D012, D013, D014, D015 and D016, and the conclusions therein are still valid, that is, there are ongoing construction works, both Project related and not, which are known to impact dolphins. At this time, the long-term impacts of these works cannot be assessed although expanding the scope of monitoring areas will provide better data on impacts outside the NEL and NWL zones.

## References

- Agriculture, Fisheries and Conservation Department (AFCD) 2009. *Annual Marine Mammal Monitoring Programme April 2008-March 2009*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2010). *Annual Marine Mammal Monitoring Programme April 2009-March 2010*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2011). *Annual Marine Mammal Monitoring Programme April 2010-March 2011*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2012). *Annual Marine Mammal Monitoring Programme April 2011-March 2012*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2013). *Annual Marine Mammal Monitoring Programme April 2012-March 2013*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2014). *Annual Marine Mammal Monitoring Programme April 2013-March 2014*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2015). *Annual Marine Mammal Monitoring Programme April 2014-March 2015*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2016). *Annual Marine Mammal Monitoring Programme April 2015-March 2016*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Agriculture, Fisheries and Conservation Department (AFCD) (2017). *Annual Marine Mammal Monitoring Programme April 2016-March 2017*. The Agriculture, Fisheries and Conservation Department, Government of the Hong Kong SAR
- Allen, S., Tyne, J., Kobryn, H., Bejder, L., Pollock, K. and Loneragan, N. (2014). Patterns of Dolphin Bycatch in a North-Western Australian Trawl Fishery. *PLoS One*. 9(4)
- Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G., & Thompson, P. M. (2010). Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. *Marine Pollution Bulletin*, 60 (6), 888-897.
- Buchary, E.A., Cheung, W.L., Sumaila, U.R. and Pitcher, T.J., (2003). Back to the future: A paradigm shift for restoring Hong Kong's marine ecosystem. In *American Fisheries Society Symposium* (pp. 727-746).
- David, J.A. (2006). Likely sensitivity of bottlenose dolphins to pile-driving noise. *Water and Environment Journal* 20:48–54
- Gui, D., Yu, R., He, X., Tu, Q., Chen, L., and Wu, Y. (2014) Bioaccumulation and biomagnification of persistent organic pollutants in Indo-Pacific humpback dolphins (*Sousa chinensis*) from the Pearl River Estuary, China. *Chemosphere Volume 114, November 2014, Pages 106–113*
- Jefferson, T. A., Hung, S. K., & Würsig, B. (2009). Protecting small cetaceans from coastal development: Impact assessment and mitigation experience in Hong Kong. *Marine Policy*, 33(2), 305-311.

Lam, J.C., Lyu, J., Kwok, K.Y. and Lam, P.K., (2016). Perfluoroalkyl Substances (PFASs) in Marine Mammals from the South China Sea and Their Temporal Changes 2002–2014: Concern for Alternatives of PFOS?. *Environmental Science & Technology*.

Marcotte, D., Hung, S. K., & Caquard, S. (2015). Mapping cumulative impacts on Hong Kong's pink dolphin population. *Ocean & Coastal Management*, 109, 51-63.

Ross, A. and Isaac, S. (2004). The Net Effect. Greenpeace Environment Trust report. London: Greenpeace

Wang, Z., Wu, Y., Duan, G., Cao, H., Liu, J., Wang, K., & Wang, D. (2014). Assessing the Underwater Acoustics of the World's Largest Vibration Hammer (OCTA-KONG) and Its Potential Effects on the Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*). *PloS one*, 9(10), e1110590.

Yang Li, S., Wu, H., Xu, Y., Peng, C., Fang, L., Lin, M. & Zhang, P., (2015). Mid-to high-frequency noise from high-speed boats and its potential impacts on humpback dolphins. *The Journal of the Acoustical Society of America*, 138(2), 942-952.

Yang, L., Xu, X., Huang, Z., & Tu, X., (2015). Recording and Analyzing Underwater Noise During Pile Driving for Bridge Construction. *Acoustics Australia*, 1