1 INTRODUCTION

1.1 BACKGROUND

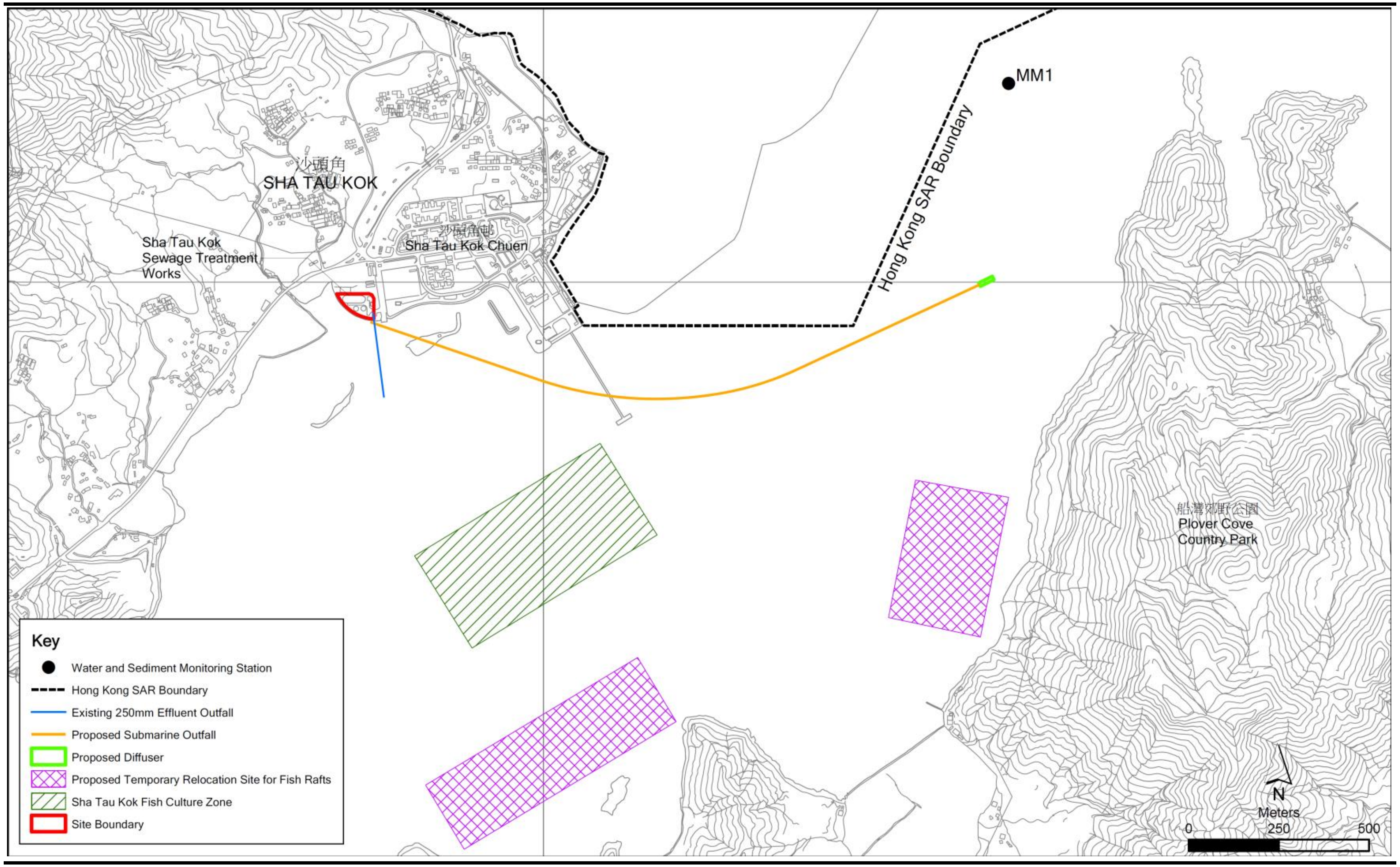
The existing Sha Tau Kok Sewage Treatment Works (STKSTW) provides secondary level treatment to sewage collected from Sha Tau Kok Township (including Yim Liu Ha, Tsoi Yuen Kok and Sha Tau Kok Tsuen). STKSTW was commissioned in 1989 with a design capacity of 1,660 m^3/day at average dry weather flow (ADWF). The STKSTW and its surrounding environment are shown in *Figure 1.1*.

To cope with the forecast increase in sewage flow upon completion of the sewerage under the project "*North District sewerage, stage 2 part 2A - Pak Hok Lam trunk sewer and Sha Tau Kok village sewerage*" in Sha Tau Kok areas and extension of village sewerage in the areas as planned by Environmental Protection Department (EPD), as well as the proposed housing developments in Sha Tau Kok town, there is an urgent need for the expansion of STKSTW. The existing capacity is expected to be fully committed in 2017/18 based on the flow projection derived from the latest planning data and village sewerage programme. The Drainage Services Department (DSD) is undertaking a project named *"Expansion of Sha Tau Kok Sewage Treatment Works, Phase 1"* (hereinafter referred to as the "Project") to develop engineering design and assess the associated environmental impacts from the required expansion.

The Project requires an Environmental Permit from the Hong Kong SAR Government. In relation to this, DSD has prepared a Project Profile for application for an Environmental Impact Assessment (EIA) Study Brief which was submitted to EPD on 5 November 2012. The *EIA Study Brief* (No. ESB-253/2012) was issued by EPD on 17 December 2012.

An EIA has been prepared according to the EIA Study Brief. Sufficient protection measures have been taken into account in the design of the temporary sewage treatment plant (TSTP) as well as the expanded STKSTW to minimize the risk of emergency discharge from the TSTP and the expanded STKSTW to reasonable level.

Figure 1.1 Location of the Sha Tau Kok Sewage Treatment Works



1.2 *PURPOSE OF THE METHOD STATEMENT*

The STKSTW is located within the highly sheltered embayment of the Starling Inlet. Any major discharge of untreated sewage, no matter how low the possibility is, could result in major change in water quality and long resident time of pollutants. Since the nearby Sha Tau Kok Fish Culture Zone (STKFCZ) is one of Hong Kong's largest gazetted mariculture zone, any untreated discharge from the STKSTW may affect this major fisheries operation and result in widespread impact. As a good practice, DSD agreed to conduct a water quality modelling assessment using Delft3D model developed in the *Expansion of the Sha Tau Kok Sewage Treatment Works EIA* to assess the potential extent of water quality impact in case of emergency discharge of untreated sewage from the TSTP and the expanded STKSTW. This document is prepared for agreement with EPD on the approach of quantitative modelling assessment of the emergency discharge scenarios.

This method statement should be read in conjunction with the Water Quality Modelling Method Statement prepared under the *Expansion of the STKSTW EIA*, which is enclosed as *Annex 5A*, because the details on model settings, meteorology data, background pollution loading, etc., would be the same and would not be further discussed in this document.

The methodology has been based on the following two focus areas:

- Review of protection measures taken into account in the TSTP and the expanded STKSTW; and
- Development of emergency discharge modelling scenarios.

It should be highlighted that this *Method Statement* would only present the development of modelling scenarios for emergency discharge from the TSTP and the expanded STKSTW and does not mean to provide any water quality assessment. Detailed assessment of water quality impacts from emergency discharge would be provided in a separate water quality assessment report.

1.3 *INTERPRETATION OF THE REQUIREMENTS: KEY ISSUES AND CONSTRAINTS*

The objectives of the modelling exercise are to assess:

1. Water quality impacts on the STKFCZ and other mariculture activities, as well as other sensitive receivers from emergency discharge of untreated sewage from the TSTP and the expanded STKSTW;

2. Potential extent of water quality impact from emergency discharge to identify location(s) which are likely to be suitable for temporary relocation of fish rafts; and

3. Anticipated time required for water quality at STKFCZ and the overall Starling Inlet to return to the baseline condition after the emergency discharge.

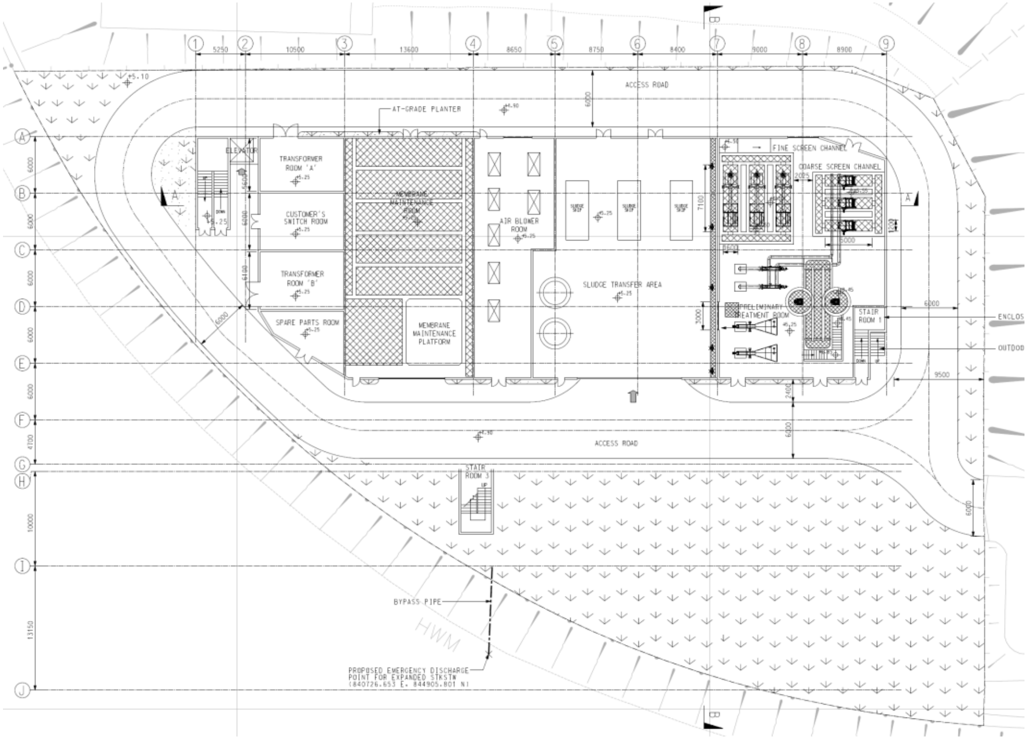
It should be noted that the modelled scenarios selected under this *Method Statement* cover only a reasonably worst case scenario based on the protection measures as well as past record provided by DSD under typical dry and wet seasons. An actual emergency discharge event, if any, could be different in terms of time, tide conditions, effluent quality, duration, etc. Therefore, the prediction by this modelling exercise is meant to be indicative of a reasonably worst case scenario.

1.4 MODEL SELECTION AND OTHER DETAILED MODEL SETTINGS

This modelling exercise will be conducted using Delft3D using the Sha Tau Kok Fine Grid Model (STK Model) and according to the model setting, calibrated parameters and background pollution loading inventory developed under the *Expansion of the STKSTW EIA*. The *Water Quality Modelling Method Statement* developed under the EIA is enclosed as *Annex 5A* and would not be provided in this document.

It should be highlighted that the proposed location of the safety outlet is located at the seawall of the existing STKSTW (shown in *Figure 1.2* below), which is close to the toe of the seawall (around 0 mPD). *Annex 5B* of the *Expansion of the STKSTW EIA* indicates that effluent from the existing STKSTW outfall (discharge from the existing submarine outfall) would eventually stay at about the upper 10% of the water column regardless of season. It is therefore expected that untreated effluent discharge at the proposed safety outlet would also get to the surface after near field mixing. Therefore, no additional CORMIX modelling would be required.

Figure 1.2 Location of the Proposed Safety Outlet



2 WATER SENSITIVE RECEIVERS

The major purpose of this modelling exercise is to assess potential water quality impact on the STKFCZ and other fish culture zones as well as to identify locations that are less impacted and are likely to be suitable for temporary relocation of fish rafts. The potential water quality impact on other WSRs identified under the EIA would also be assessed. These WSRs are illustrated in *Figure 2.1* and listed in *Table 2.1*. The corresponding locations shown in *Figure 2.1* would be selected as modelling output locations to represent the level of impact experienced by the WSRs.

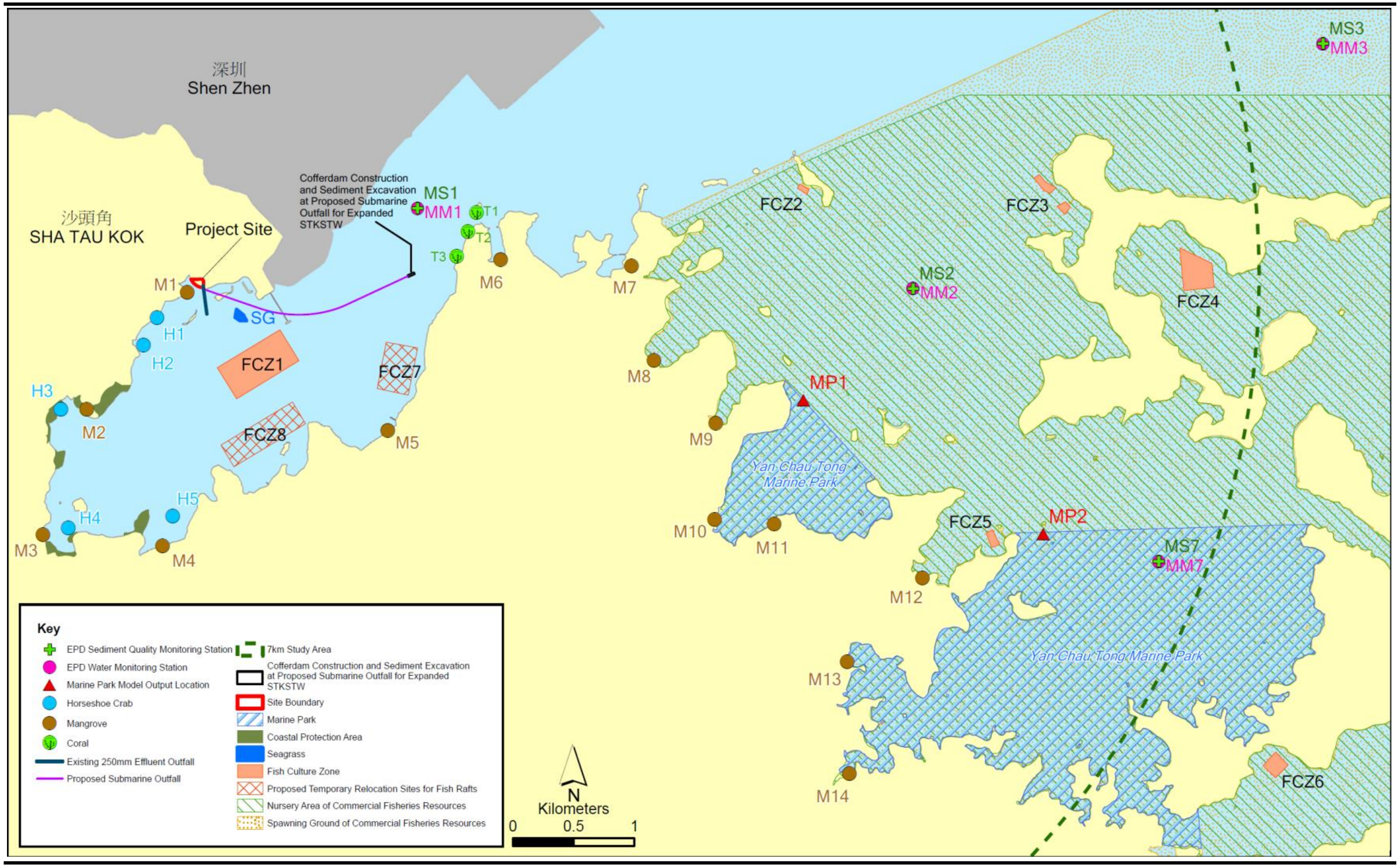
Table 2.1 ***Water Sensitive Receivers in the Vicinity of the Project Site***

Description	**Location**	**Model Output Location**
Fisheries Sensitive Receivers		
Fish Culture Zones	Sha Tau Kok	FCZ1 ^
	Ap Chau	FCZ2
	Kat O	FCZ3
	O Pui Tong	FCZ4
	Sai Lau Kong	FCZ5
	Wong Wan	FCZ6
	Temporary Relocation Zone of Fish Rafts for the Sha Tau Kok Fish Culture Zone 1 and 2	FCZ7, FCZ8
Spawning and Nursery Grounds of Commercial Fisheries Resources	North Mirs Bay	FCZ2-FCZ6, M8-M14, MP1, MP2 *
Ecological Sensitive Receivers		
Seagrass bed	-	SG
Horseshoe crab	Off STKSTW	H1
		H2
	Off Pak Hok Lam	
		H3
	Off Nga Yiu Tau	
	A Chau	H4
	Off Luk Keng	H5
Mangrove stand	Off Nga Yiu Tau	M1
	Off Wu Shek Kok	M2
	Off Tai Wan	M3
	Off Luk Keng	M4
	Off Kuk Po	M5
	Kei Shan Tsui	M6
	Tai Sham Chung	M7
	So Lo Pun	M8
	Pak Kok Wan	M9
	Yan Chau Tong Marine Park	M10, M11, M13, M14
	Ngau Shi Wu Wan	M12
Marine Park	Yan Chau Tong	MP1, MP2
Coral sites identified under this EIA	Off Ah Kung Au	T1, T2, T3
EPD Water Quality Monitoring Station		
Water Quality Monitoring Station	Mirs Bay Water Control Zone (WCZ)	MM1, MM2, MM3, MM7

^Noted: To allow detailed presentation of the impact on the STKFCZ, 4 observation points were setup at the 4 corner of the gazetted boundary of the STKFCZ. These observation points are named as FCZ1A, FCZ1B, FCZ1C, and FCZ1D accordingly and are shown as separate time series in *Appendix B*.

*Note: The spawning and nursery grounds of commercial fisheries resources covers a wide range in the Study Area and included about half of the model output locations identified under this Study. The model output location FCZ2 which is closest to the proposed and existing outfall would be adopted to represent the worst case impact to this WSR.

Figure 2.1 Water Sensitive Receivers near the Project



3 *ASSESSMENT CRITERIA*

Sensitive receivers of concern under this exercise are mariculture activities and other marine ecological resources. Mariculture activities are sensitive to dissolved oxygen (DO) depletion, elevation in toxic unionized ammonia (UIA) and suspended solids (SS). There are corresponding WQO criteria for these water quality parameters (≥ 5 mg/L for DO, < 30% elevation above ambient for SS and < 0.021 mg/L for UIA) and these WQO criteria would be considered in the assessment of water quality impact from the emergency bypass event. For other marine ecological resources, the same set of water quality assessment criteria in the EIA would be adopted.

The potential impact from emergency bypass would also be compared against the corresponding baseline scenario to identify the corresponding change in water quality and to determine the time required for the water quality of the fish culture zones to return to normal level.

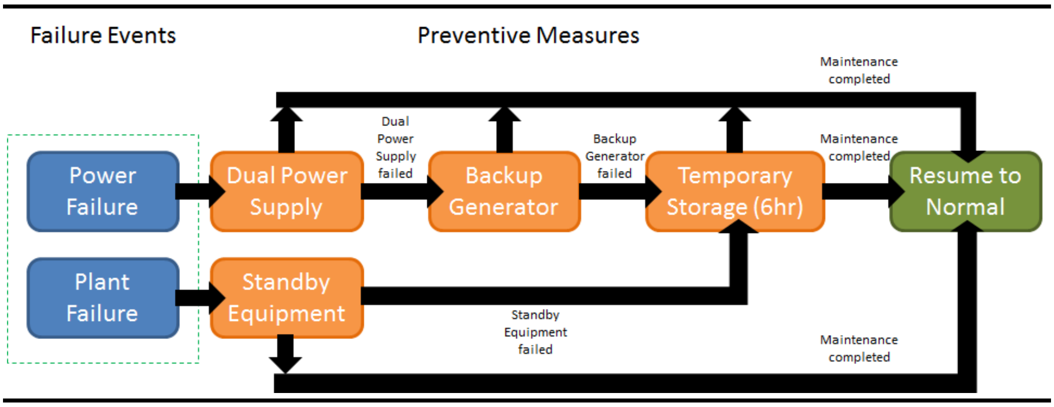
4 REVIEW OF PROTECTION MEASURES IN THE TSTP AND THE EXPANDED STKSTW

Based on the latest update, the following protection measures have been taken into account in the engineering design of the TSTP and the expanded STKSTW:

- Routine/ regular checking to the equipment
- Provision of dual power supply and backup generator to eliminate the risk of power failure;
- Provision of standby equipment (online and on-shelf) for all treatment units;
- Operation of STKSTW is under 24-hour monitoring by Shift Team of Sha Tau Kok (for new STKSTW) and/or Shek Wu Hui STW in order to allow inspection and any necessary repair works by DSD at the earliest possible time;
- A remote control and monitoring system (SCADA) will also be installed to allow off-site DSD staff (Shift Team) to monitor the operation of STKSTW; and
- Provision of on-site storage of raw sewage up to 6 hours for the TSTP and STKSTW (1).

Detailed discussion on the protection measures to avoid any emergency discharge is provided in *Section 5* of the EIA. The hierarchy of major design measures for preventing emergency discharge from the TSTP and the expanded STKSTW is illustrated in *Figure 4.1*.

Figure 4.1 Hierarchy of Design Measures to Prevent Emergency Discharge for the Expanded STKSTW



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(1) The storage volume for the TSTP and the expanded STKSTW are 625 m^3 and 2,500 m^3 respectively.

5 DEVELOPMENT OF EMERGENCY DISCHARGE MODELLING SCENARIOS

5.1 EMERGENCY RESPONSE PLAN

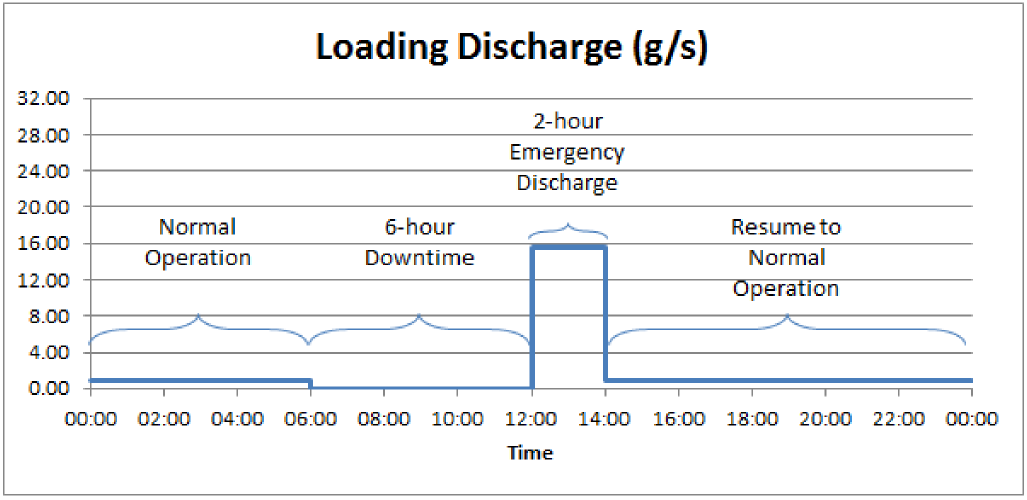
A brief estimation on response time required for emergency response is provided in *Table 5.1*.

Table 5.1 Outline of Emergency Response Plan for the TSTP and the Expanded STKSTW

Start Time of the Event (hr)	**Procedure**	**Anticipated Duration**
0.00	When a problem occur, it will be identified by the DSD staff on duty or Shift Team from alert of SCADA - proceed to **Procedure A**	30 min
Procedure A		
0.50	Report to the works manager	Immediate
0.50	Works manager to assign appropriate staff to carry out inspection and assess the problem	Travel: 45 min Assessment: 30 min
1.75	If the problem is considered major and need outside support – proceed to **Procedure B**	-
1.75	If the problem is considered minor, back-up equipment could be started up by the on-duty staff (for new STKSTW) or could be repaired by the emergency team, carry out repair	Use back-up equipment / minor repair: 120 min
1.75	Monitor the repair progress and water level in the storage tank (until resume to normal)	-
3.75	Resume to normal operation	End
Procedure B		
1.75	Report to senior management	Immediate
5.75	Alert EPD (Regional Office) and designated public (e.g. STK District Rural Committee, representatives of mariculturists) the possibility of emergency discharge. The mariculturists may consider moving the fish culture zone.	Immediate
1.75	Seek external support (e.g. maintenance contractor, DSD staff in other plants)	Travel: 60 min Assessment: 60 min
3.75	Carry out repair by external support	Repair: 120 min
5.75	If more time to repair is anticipated – proceed to **Procedure C**	-
5.75	Resume to normal operation	End
Procedure C		
5.75	Assess the problem and estimate the time required for repair	N/A

Based on DSD's past experience in other sewage treatment works (where some of the above protection measures are absent), sewage treatment works could generally resume normal operation within 6 hours after a service interruption. On the other hand, past operation record of the existing STKSTW shows no incident of emergency discharge. For the purpose of this exercise, an 8-hour down time is assumed for the emergency scenarios for the TSTP and the expanded STKSTW. This means the assumed discharge of untreated sewage would last for 2 hours, preceded by 6 hours of "no discharge" period (i.e. before the emergency storage is full). The discharge pattern for the modelled emergency discharge scenarios is illustrated below in *Figure 5.1*.

Figure 5.1 *Typical Discharge Pattern Modelled*



Note: The above illustrate the calculated loading of SS during normal operation (00:00 to 06:00 and 14:00 onwards), 6-hour downtime (from 06:00 to 12:00) and 2-hour emergency discharge (12:00 to 14:00). The loading profile for other water quality parameters would be different only by the scale.

5.2 SELECTION OF TIDAL CONDITION

Since the discharge period modelled would last for only 2 hours, it is necessary to select an appropriate tidal condition for discharge in order to fulfill the objective of the modelling exercise. The objectives of the modelling exercise are stipulated under *Section 1.3* above. Since WSRs are located all around the coastline of the Starling Inlet, the selection of tidal condition by tracer dispersion modelling could only select for the worst case for one group of WSRs at a particular direction. For this Study, the STKFCZ would be selected as the WSR for evaluating the worst case in view of its fisheries, economic and social value and large area coverage.

The proposed safety outlet of the expanded STKSTW is location on the seawall of the STKSTW, which is about 650 m away from the STKFCZ. For the TSTP, the existing submarine outfall would be adopted as the safety outlet. For the purpose of bullets 1 and 2 under *Section 1.3*, it is considered a fast moving current would bring pollutants from the emergency bypass to the STKFCZ and the rest of the Starling Inlet more quickly. This means a more extensive area of influence would be predicted for discharge at high water in spring tide (with strong offshore current). For the purpose of bullet 3 under *Section 1.3*, however, a weakly flushed environment (i.e. neap tide) would likely results in long retention time of the pollutants. In view of the above, two modelling scenarios would be conducted for each of the emergency scenarios for the TSTP and the expanded STKSTW for both seasons.

Conservative tracer modelling has been conducted to verify the selection of worst case scenarios considered above. In the inert tracer modelling exercise, a 2-hour discharge event of conservative tracer at a rate of 1 g/s is considered in the model at the surface layer of the water column where the safety outlet of the TSTP and the expanded STKSTW is located. The conservative tracer is then dispersed and diluted by tidal flushing and the potential elevation of conservative tracer at the nearby sensitive receivers were evaluated to determine the worst-case tidal condition for Delft3D full WAQ simulation.

Contour plots showing the maximum depth-averaged conservative tracer concentration in the Starling Inlet under different tidal conditions in both seasons are provided in *Appendix A*. Time series plots showing the depth-averaged conservative tracer concentration at nearby sensitive receivers are provided in *Appendix B*. Each appendix contains a subsection for the modelling results for the discharge from the TSTP and the expanded STKSTW.

As shown in *Appendix A*, the spatial extent of the tracer does not vary significantly given the same season and tide magnitude (spring or neap), except for spring tide in wet season. In comparison, the predicted plume extends further into the western side of the Starling Inlet as a thin stripe in dry season. It is because lower freshwater discharge rate along the coastline in dry season allow the plume stay close to the coastline (which turn into thin stripe upon tidal action) and stay within the Starling Inlet for longer period of time. In comparison, higher freshwater discharge along the coastline (there is one major stream on the west side of to the STKSTW) pushes the plume offshore and out of the Starling Inlet more quickly, resulting in rounder and more outward plume. Tide magnitude also affects the extent and size of the plume, though less significant when compared with the effect of the season. Plume in spring tide tends to stay more outward of the Starling Inlet, as a result of enhanced flushing bringing more tracer to the outside of the embayment. In wet season, the plume in spring tide spreads further away from the safety outlet, giving large but flatter footprint (characterized by contour lines which are further away).

Appendix B shows depth-averaged conservative tracer concentration at nearby sensitive receivers. The start times of the time series plots are the same as the corresponding start times for emergency discharge under different tidal phasing (i.e. high water, ebbing, low water or flooding). As shown in *Appendix B*, tidal phasing affects significantly the time when the plume hit the nearby receivers, and tide magnitude affects the maximum level of tracer at the nearby receivers while season affects the overall rate of clearance of tracer from the embayment. The time required for first peak of tracer concentration to arrive at the nearby receivers is generally the longest for emergency discharge under low water condition (because the subsequent flooding tidal current pushes release tracer inward of the Starling Inlet). Spring tide brings higher peak of tracer concentration to the nearby receivers in a shorter time lag after the emergency discharge, and the associated peaks last shorter period of time. Higher discharge rate in wet season results in higher clearance rate of tracer from the Starling Inlet. This means (1) the receivers outside the Starling Inlet get hit by the plume earlier, and (2) the Starling Inlet returns to baseline in shorter period of time, when compared with dry season. Similar to the observation from *Appendix A*, the shorter distance from the safety outlet of the TSTP to the STKFCZ results in shorter time for the plume to reach the STKFCZ, a higher peak and overall tracer concentration. On the other hand, the time required for tracer clearance does not seem to decrease significantly even though the discharge at the existing STKSTW outfall by the TSTP is further offshore and better flushed. A summary of plume behavior under different tidal phasing, magnitude and season is provided below in *Table 5.2*.

Table 5.2 ***Summary of Observations from Conservative Tracer Modelling***

	Observations	**Conclusion**
Season		
Dry	1. Plume close to coastline 2. Slow clearance from the Starling Inlet	Longer resident time
Wet	1. Plume further away from coastline 2. Higher clearance from the Starling Inlet	Higher impact to FCZ1
Tidal Magnitude		
Spring	1. Larger but flatter plume 2. Reach receivers in shorter time 3. Higher clearance from the Starling Inlet	Higher impact to FCZ1
Neap	1. Smaller and more concentrated plume 2. Reach receivers in longer time 3. Lower clearance from the Starling Inlet	Longer resident time
Tidal Phasing		
High water	1. Plume moves significantly away from coastline in wet season 2. Plume intrudes to FCZ1 significantly in spring tide of wet season	Highest impact to FCZ1
Mid-ebb	Plume intrudes deeper into the Starling Inlet	-
Low Water	1. Reach receivers in longer time 2. Plume moves significantly away from coastline in wet season 3. Plume intrudes to FCZ1 significantly in spring tide of wet season	Higher impact to FCZ1
Mid-flood	Plume intrudes deeper into the Starling Inlet	-

In view of the above observations from the conservative tracer modelling exercise, it is proposed:

1. It is observed that the maximum level of conservative tracer predicted at the nearest receivers (FCZ1) the highest for discharge in high water condition. Therefore the full water quality simulation would be conducted in high water condition in spring tide of both seasons.

2. Worst case scenario in terms of resident time is expected to occur in emergency discharge in neap tide of dry season. Therefore full water quality simulation using Delft3D would be conducted to determine the

time required for the restoration of water quality in the Starling Inlet back to normal. Yet for the purpose of informing the resident time of pollutant in wet season, full water quality simulation would also be conducted for emergency discharge in neap tide of wet season. Since tidal phasing bears no significant impact on the resident time of the tracer (representing the pollutants released), the emergency discharge would be assumed to occur in high water so the pollutants reaches the nearby receivers slightly earlier.

A summary of Delft3D WAQ modelling scenarios is presented below in *Table 5.3*.

Table 5.3 *Modelling Scenarios for this Exercise*

	TSTP	Expanded STKSTW
Delft3D WAQ Inert Tracer (Modelling completed, results presented in *Appendices B & C*)		
Selection of worst case tidal condition	8 scenarios per season for both the TSTP and the Expanded STKSTW (2 [spring or neap tide] × 4 [high water, mid-ebb, low water and mid-flood] × 2 [TSTP, the Expanded STKSTW])	
Delft3D WAQ Full Water Quality Simulation (Modelling to be conducted)		
Worst case in terms of impact to receivers	High water condition under spring tide in both seasons	High water condition under spring tide in both seasons
Worst case in terms of pollution resident time	High water condition under neap tide in both seasons	High water condition under neap tide in both seasons

5.3 *POLLUTION LOADING FROM EMERGENCY DISCHARGE*

Weekly influent quality records of the existing STKSTW from Jan 2010 to Jun 2013, with a total of 178 sampling incidents covering six parameters namely pH, carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), ammonia nitrogen (NH_3-N), nitrite nitrogen (NO_2-N), nitrate nitrogen ((NO_3) and orthophosphate phosphorus (Ortho-P), were retrieved from DSD for analysis under this modelling exercise. A summary of statistics of these parameters are provided below in *Table 5.4*.

Table 5.4 *Summary of Recorded Influent Quality from Jan 2011 to Nov 2015 at the STKSTW*

Unit:	CBOD (mg/L)	TSS (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	Ortho-P (mg/L)
Maximum	200	760	51	<0.20	<1.2	3.0
Minimum	69	59	12	<0.10	<1.0	1.0
Average	134	128	25	<0.12	<1.0	2.1

Note:

(1) Calculation based on monthly average available from DSD.

(2) NO_2-N, NO_3-N and Ortho-P baseline available from Nov 2013 to Nov 2015.

(3) Values below the detection limits considered as their detection limits when calculating averages.

As shown, the pollutant concentration in sewage influent to the STKSTW varies quite significantly. The maximum, minimum and monthly average of the have been considered to describe the range and central value of the data.

The average value of CBOD lies between the maximum and minimum values of CBOD and each are about ±50% away from the average value. The same is observed for the maximum, minimum and average of Ortho-P. The average values of TSS and NH_3-N are both skewed toward the lower range, which indicates the presence of small number of outliers of high values for both parameters. For NO_3-N and NO_2-N, both values are very low compared with NH_3-N because raw sewage is generally anoxic (septic) and favors the reduction of oxidized nitrogen species to reduced nitrogen species. All records of NO_3-N and NO_2-N are below the corresponding detection limits. For CBOD, TSS, NH_3-N and Ortho-P, the arithmetic means would be used for adopted in the 2-hour emergency discharge. For NO_3-N and NO_2-N, half of the average values (i.e. 0.5 and 0.06 mg/L respectively) would be adopted. This means the calculation assumes the level of NO_3-N and NO_2-N can be of any value from zero to the detection limit. Such assumption is considered conservative (in view of the high detection limit), yet not overly conservative because the contribution of nitrogen to receiving water by these oxidized nitrogen species is minimal (~2%) when compared with ammonia and organic nitrogen (which combines to give TKN discussed below).

For the three other major pollutants, namely total phosphorus (TP), total Kjeldahl nitrogen (TKN) and *E. coli*, which are not included in the available influent data, further discussion is provided below.

5.3.1 *Total Phosphorus*

Mogens Henze and Yves Comeau (2008) (1) suggests that the ratio of total phosphorus to ortho-P is around 1:0.60 to 1:0.67. The adopted level of ortho-P would correspond to total P level of 3.00 to 3.33 mg/L. The upper values of 3.33 mg/L would be adopted in the 2-hour emergency discharge scenario.

5.3.2 *Total Kjeldahl Nitrogen*

Sampling and testing of raw sewage has been conducted at the Tai Po Sewage Treatment Works in 2001 under the approved EIA of Tai Po Sewage Treatment Works Stage V (AEIAR-081/2004). The approved EIA suggested the level of TKN in raw sewage is around 57 mg/L in dry season and 46 mg/L in wet season. The approved EIA of Upgrading of Pillar Point Sewage Treatment Works (AEIAR-118/2008) suggested similar level of TKN of 48 mg/L in both seasons (sum of organic nitrogen and ammonia nitrogen). It is considered the value adopted in the Tai Po Sewage Treatment Works EIA more conservative and would be adopted for modelling assessment under this Study.

(1) Henze, M. & Comeau, Y. (2008). Wastewater Characterization. Retrieved January 8, 2016 from UNESCO, Web site: http://ocw.unesco-ihe.org/pluginfile.php/462/mod_resource/content/1/Urban_Drainage_and_Sewerage/5_Wet_Weather_and_Dry_Weather_Flow_Characterisation/DWF_characterization/Notes/Wastewater%20characterization.pdf

5.3.3 *E. coli*

Secondary treatment with oxidation ditch and disinfection is being used in the existing STKSTW. The removal efficiency of *E. coli* is for secondary treatment method with disinfection is generally very high (up to 99.97%) according to Table A5-2-7 of *Appendix 5-2* of the *HATS Stage 2A EIA*. Past records from 2013 July to 2015 March indicate effluent *E. coli* level is generally around 1 or 2 no./100ml. Therefore if the removal efficiency of *E. coli* at the existing STKSTW deviates from the estimation slightly, there would be significant error in the estimation of influent *E. coli* level. In view of the above, it is considered not appropriate to back-calculate the level of *E. coli* in influent based on the level of effluent and the typical *E. coli* removal efficiency stated in the *HATS Stage 2A EIA*. Instead, *E. coli* levels in influent / untreated effluent /undisinfected effluent from approved sewage treatment works EIAs are reviewed. A summary of assumed *E. coli* levels is provided below in *Table 5.5*.

Table 5.5 ***Influent E.coli Level in Approved Sewage Treatment Works EIAs***

Approved Major Sewage Treatment Works EIA	*E. coli* Level (no./100ml)	Remarks
HATS Stage 2A EIA & *HATS ADF EIA*	1×10^7	Undisinfected effluent after chemically-enhanced primary treatment
Tai Po Sewage Treatment Works Stage 5 EIA	2×10^7	Design load concentration of TPSTW
Upgrading of Pillar Point Sewage Treatment Works EIA	1.75×10^7	Influent concentration of PPSTW

As shown, the levels of *E. coli* adopted in approved sewage treatment works EIAs are generally of similar order of magnitude. The highest *E.coli* concentration of 2×10^7 no./100ml would be adopted in this modelling exercise.

It should be noted that the pollution loading for the rest of the background pollution sources remain the same as the normal operation, despite the fact that the mariculturists would likely move their fish rafts from the STKFCZ to other locations away from the safety outlet where the emergency bypass enter marine water. This allows simple comparison of the sole effect from the emergency bypass scenario and also assessing the worst case if mariculturists fail to relocate their fish rafts.

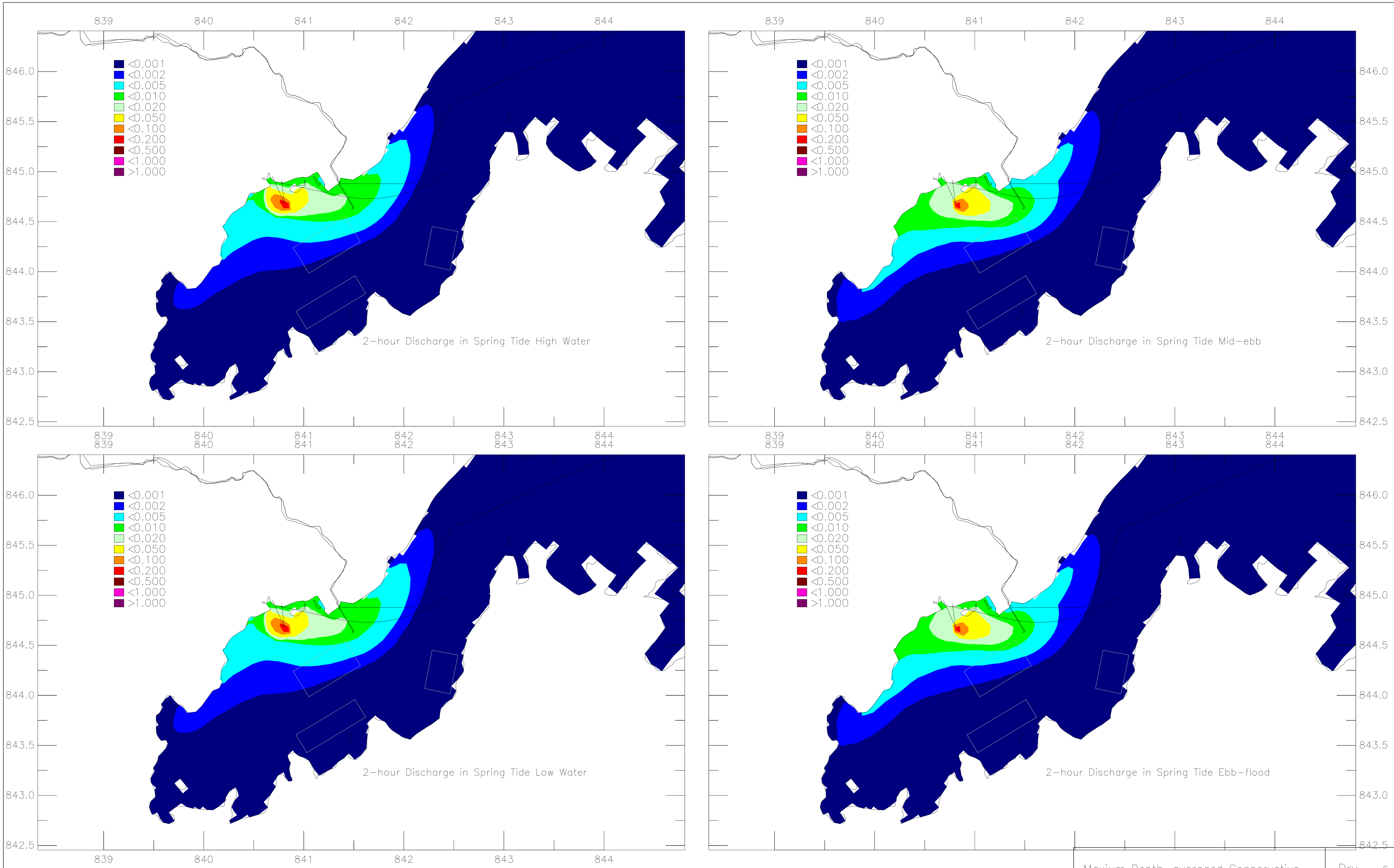
CONTENTS

Appendix A

Maximum Depth-averaged Conservative Tracer Concentration for 2-hour Discharge under Different Tides Conditions in Both Season

Appendix A1

Maximum Depth-averaged Conservative Tracer Concentration for 2-hour Discharge under Different Tides Conditions in Both Seasons from the Expanded STKSTW



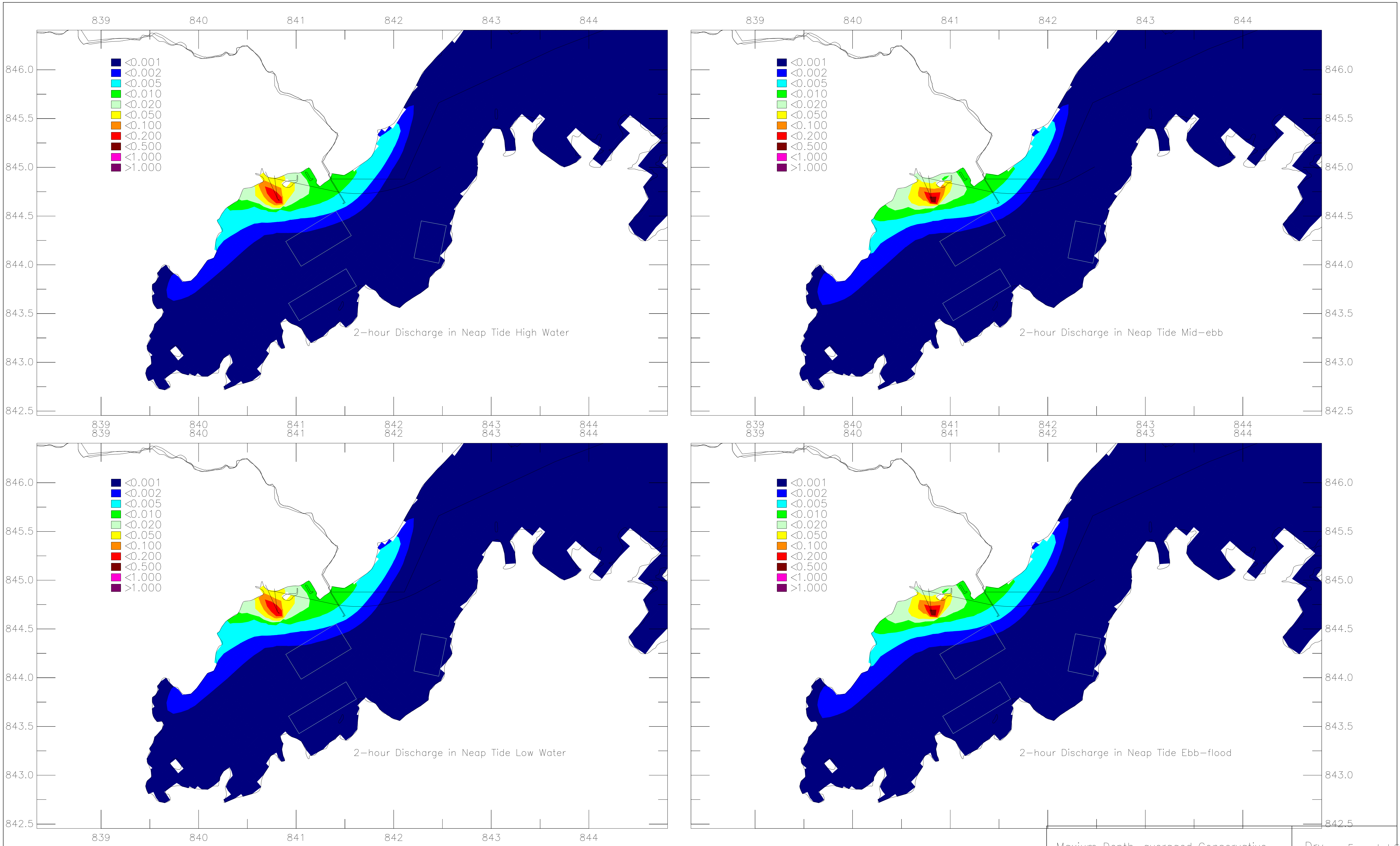
Maxium Depth–averaged Conservative
Tracer Concentration for 2–hour
Discharge under Different Tide Conditions

Dry Expanded STKS

Spring Tide

ERM HK Limited

Emergency·cTr.ssn



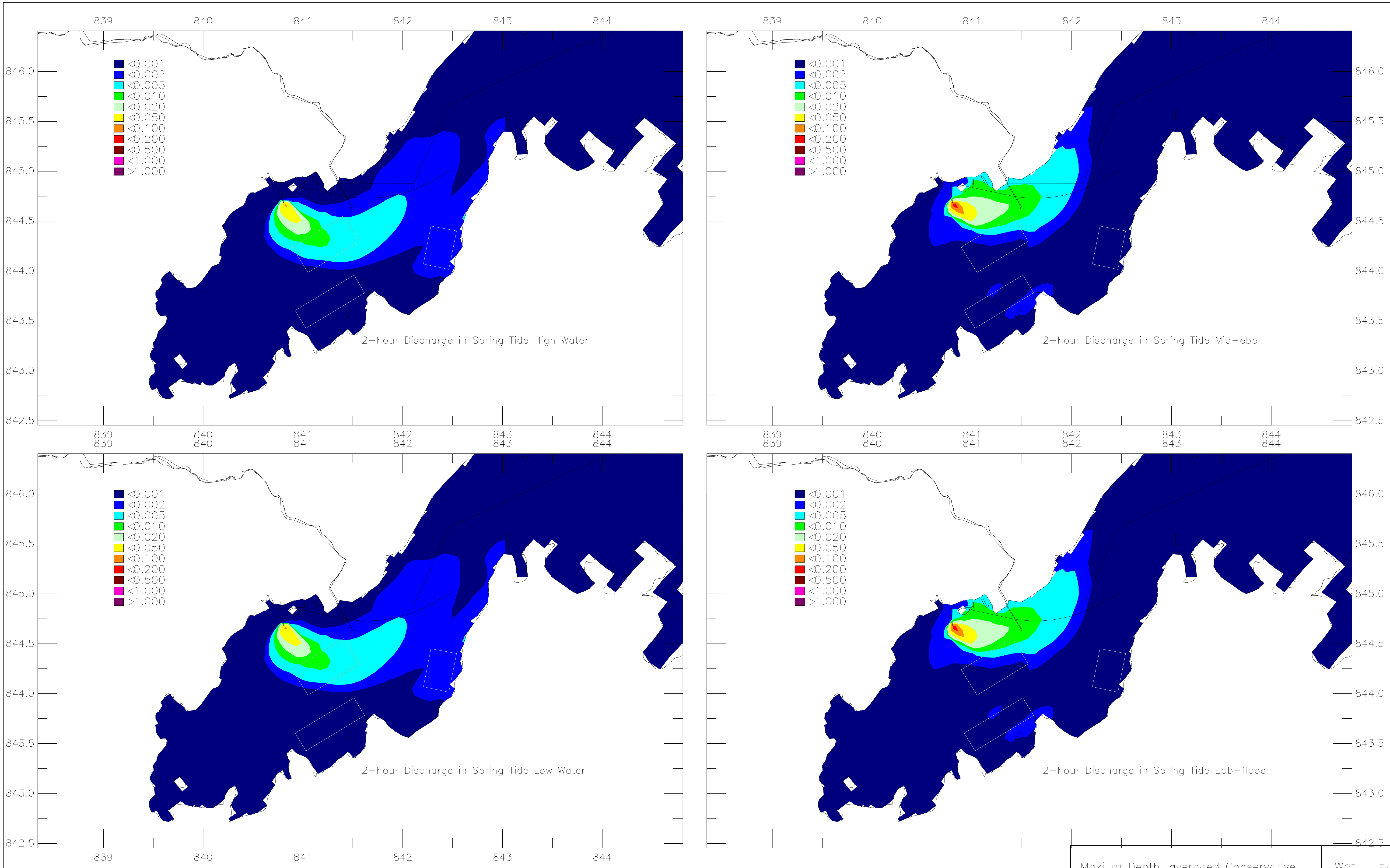
Maxium Depth−averaged Conservative
Tracer Concentration for 2−hour
Discharge under Different Tide Conditions

Dry Expanded STKS

Neap Tide

ERM HK Limited

Emergency·cTr.ssn



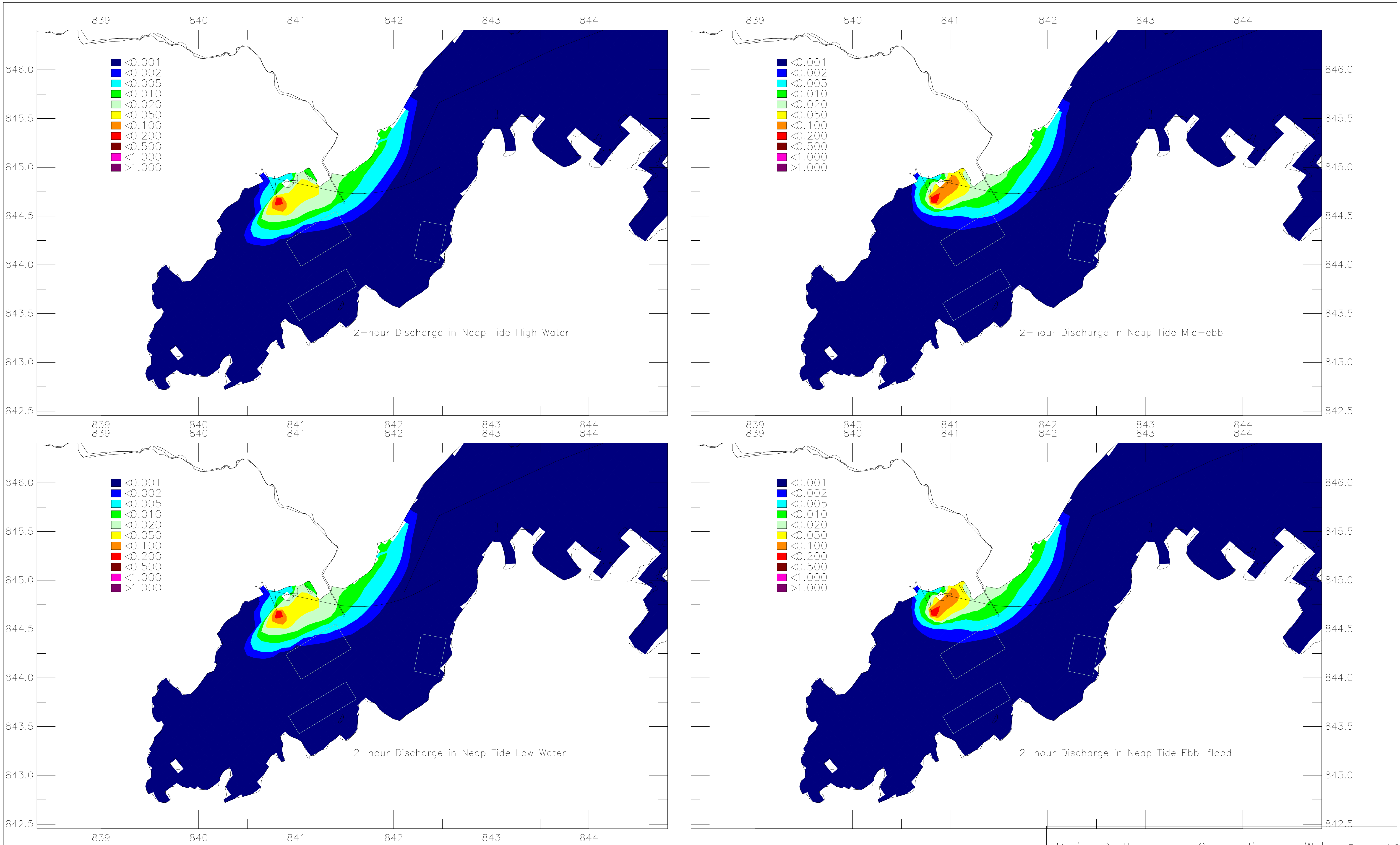
Maxium Depth−averaged Conservative Tracer Concentration for 2−hour Discharge under Different Tide Conditions

Wet Expanded STKS

Spring Tide

ERM HK Limited

Emergency·cTr.ssn



Maxium Depth−averaged Conservative Tracer Concentration for 2−hour Discharge under Different Tide Conditions

Wet Expanded STKS

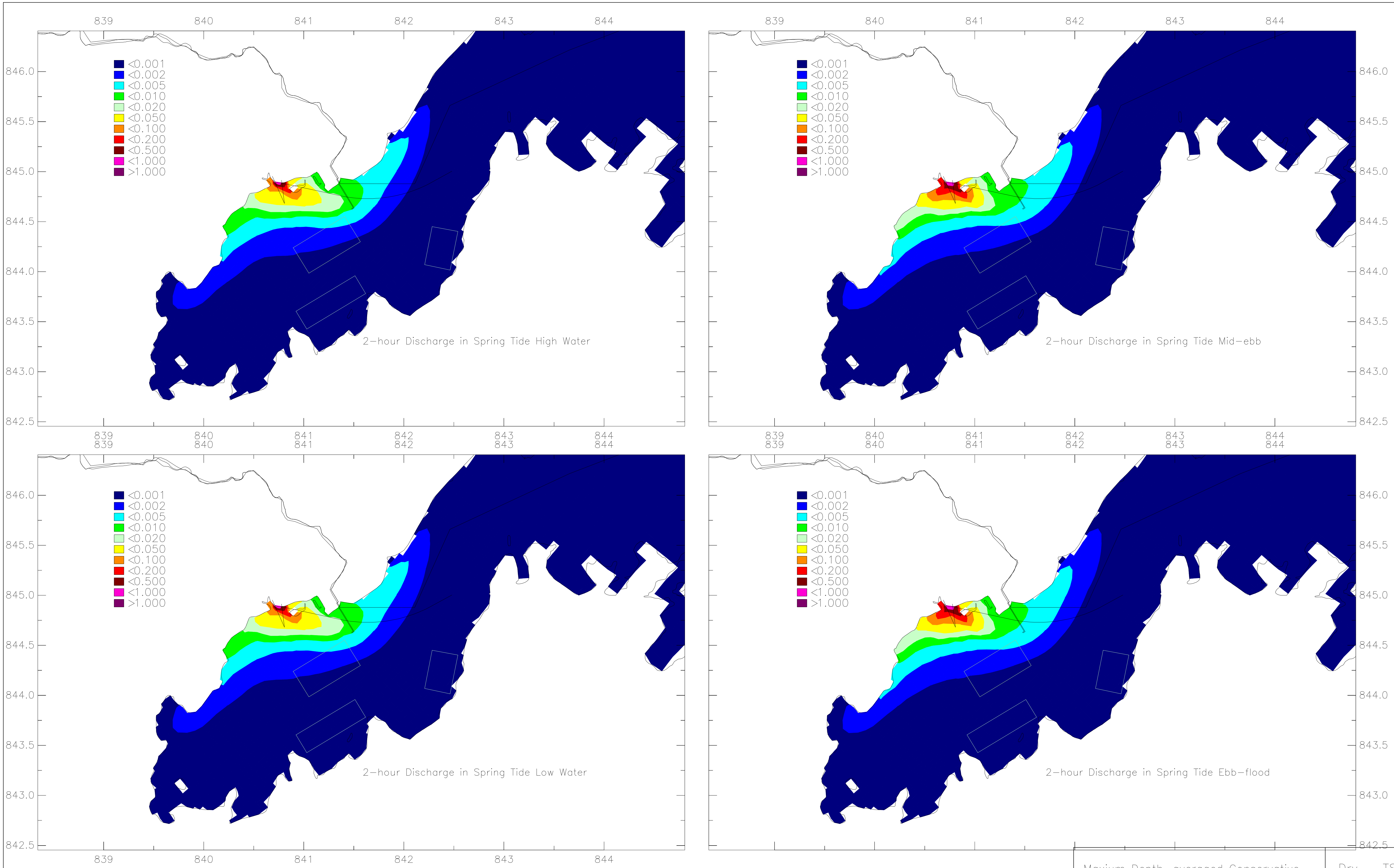
Neap Tide

ERM HK Limited

Emergency·cTr.ssn

Appendix A2

Maximum Depth-averaged Conservative Tracer Concentration for 2-hour Discharge under Different Tides Conditions in Both Seasons from the TSTP



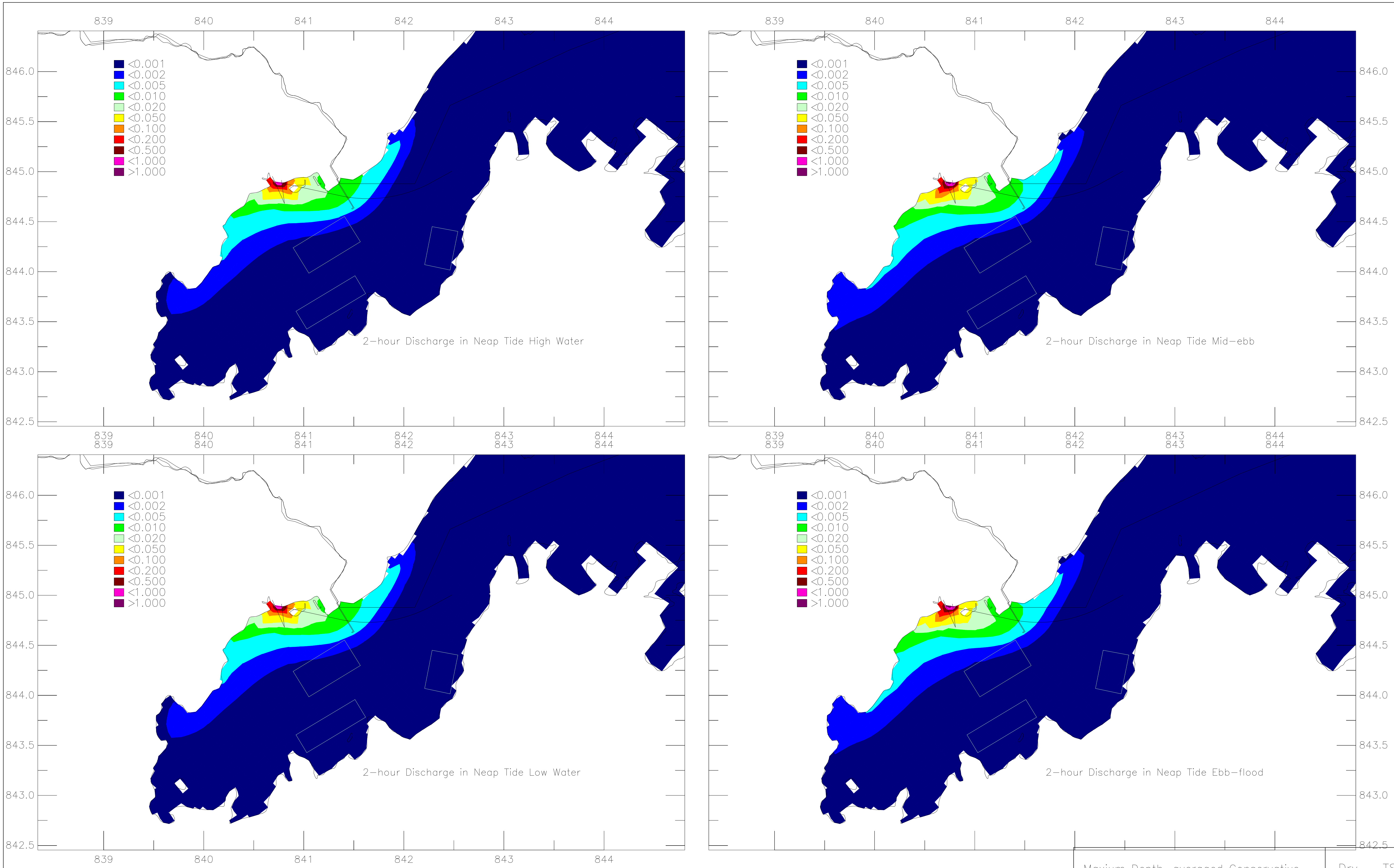
Maxium Depth-averaged Conservative
Tracer Concentration for 2-hour
Discharge under Different Tide Conditions

Dry TSTP

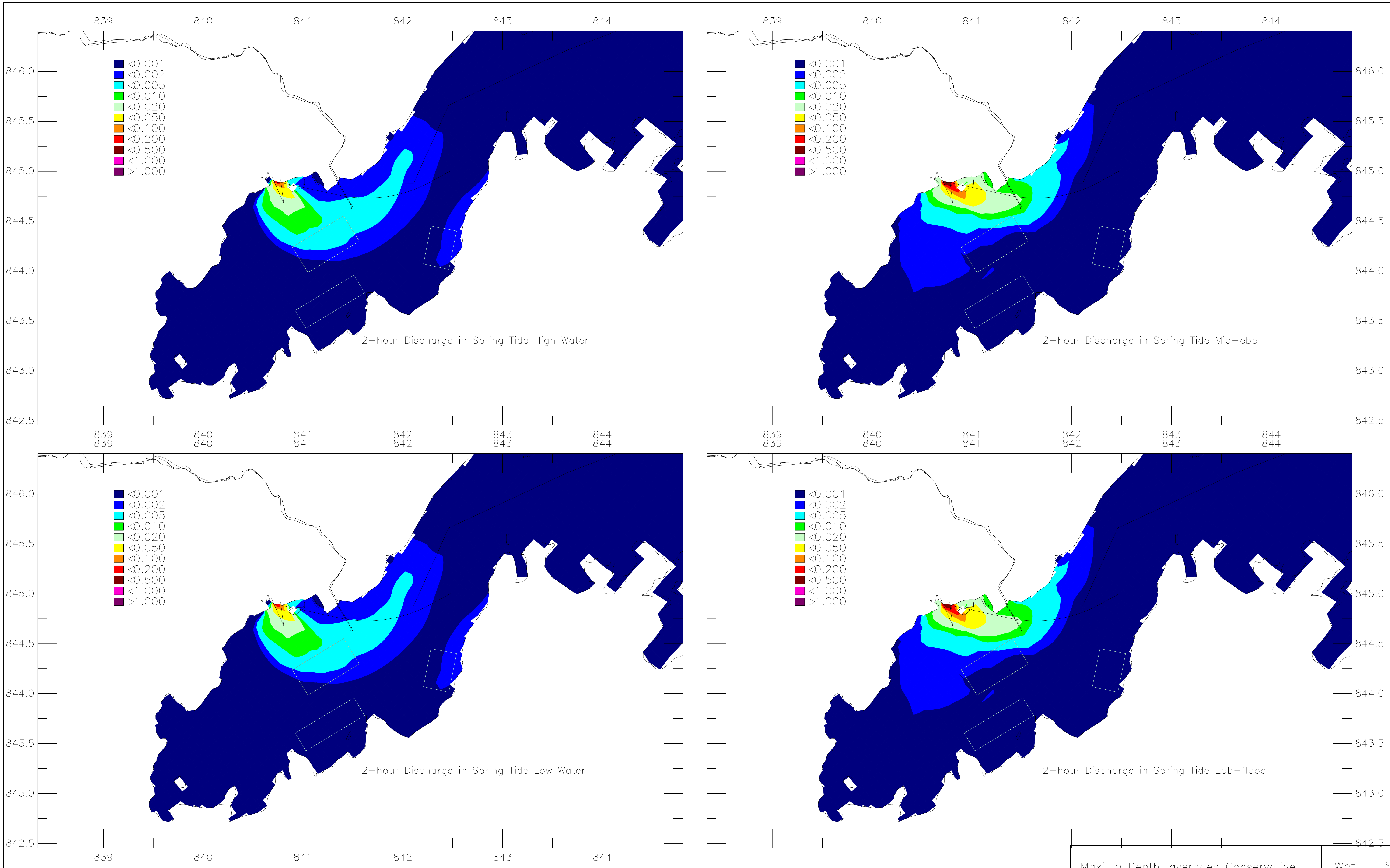
Spring Tide

ERM HK Limited

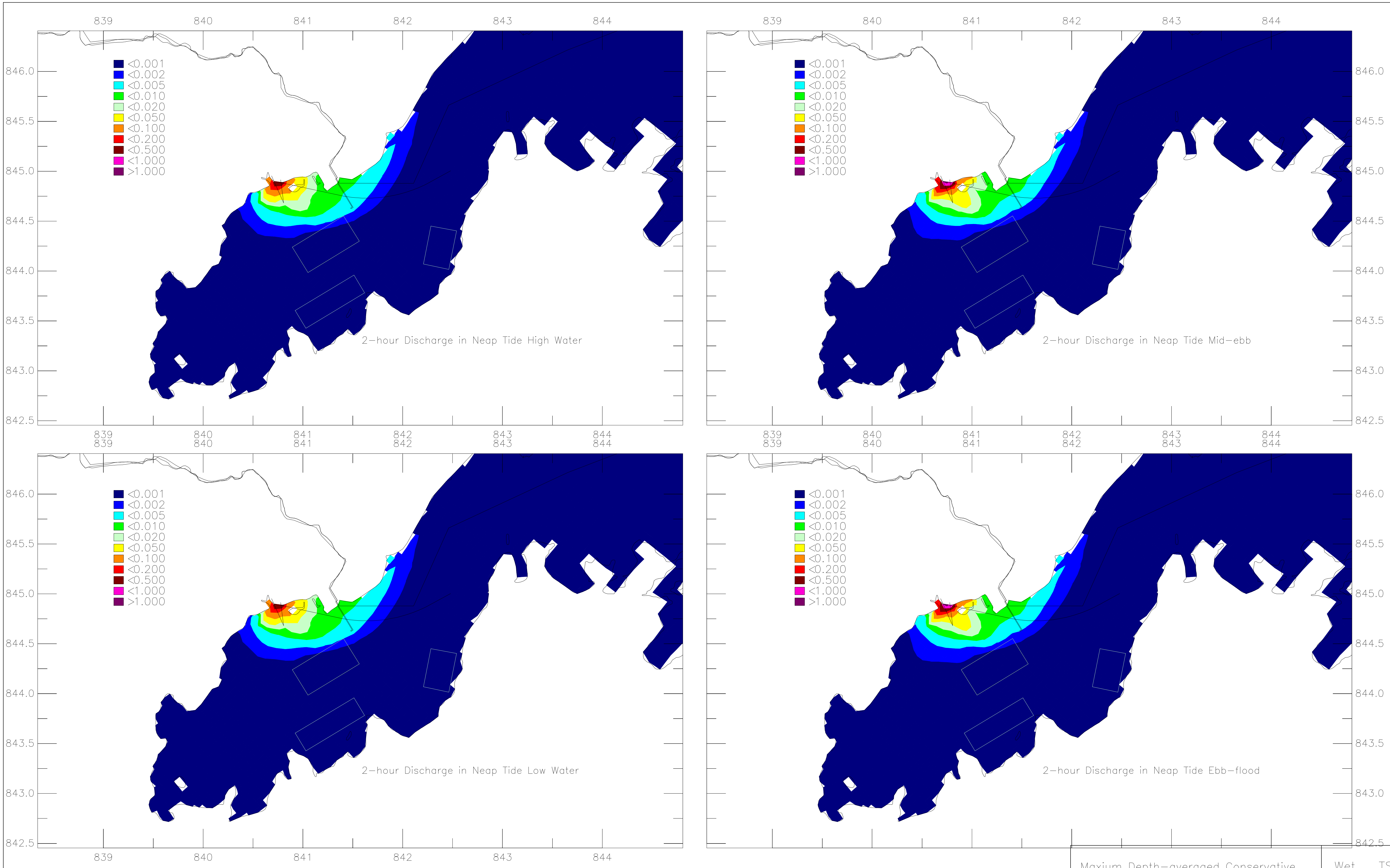
Emergency-cTr.ssn



Maxium Depth–averaged Conservative Tracer Concentration for 2–hour Discharge under Different Tide Conditions	Dry TSTP
	Neap Tide
ERM HK Limited	Emergency·cTr.ssn



Maxium Depth−averaged Conservative Tracer Concentration for 2−hour Discharge under Different Tide Conditions	Wet TSTP
	Spring Tide
ERM HK Limited	Emergency·cTr.ssn



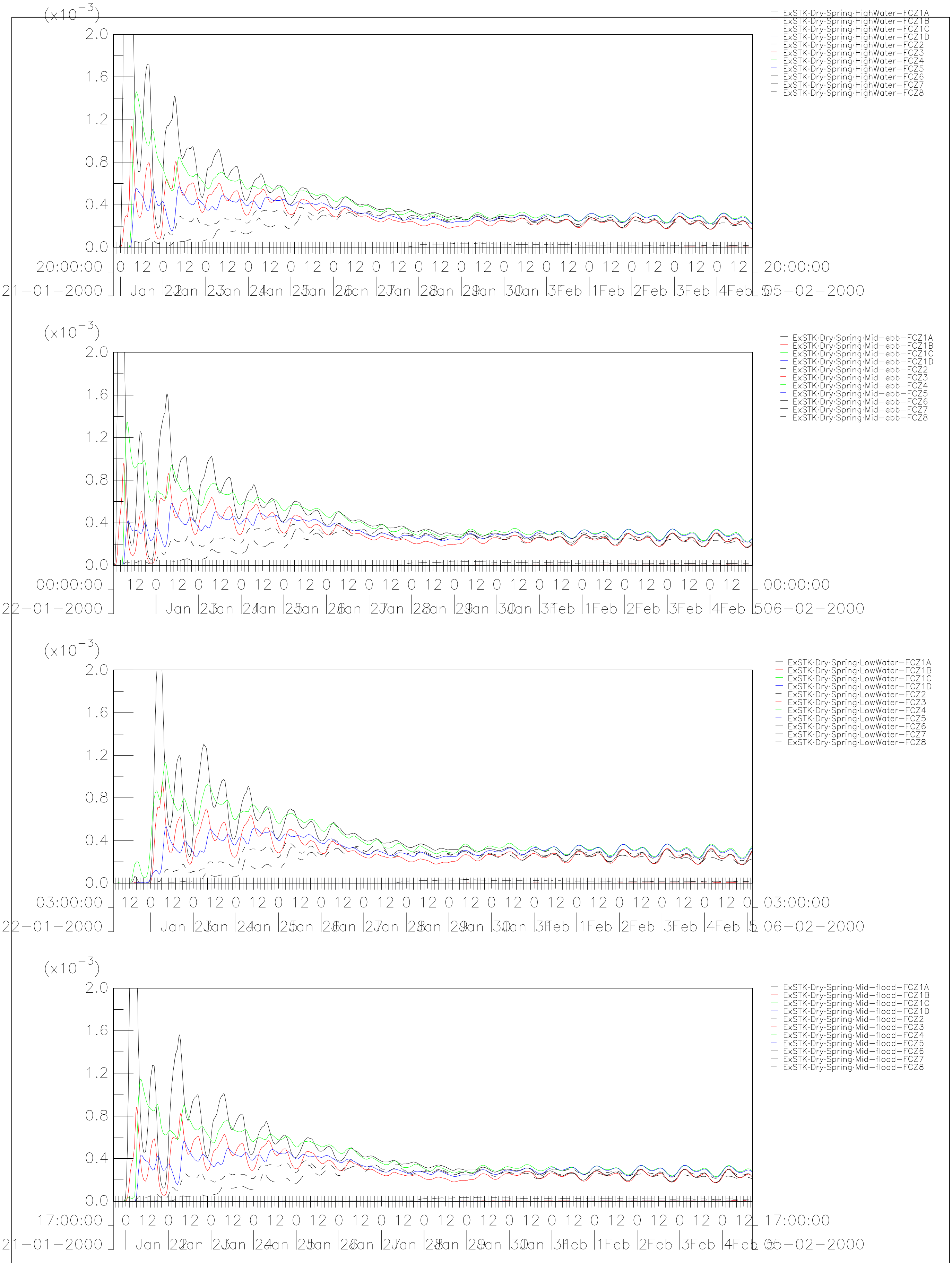
Maxium Depth-averaged Conservative Tracer Concentration for 2-hour Discharge under Different Tide Conditions	Wet TSTP Neap Tide
ERM HK Limited	Emergency·cTr.ssn

Appendix B

Depth-averaged Conservative Tracer Concentration at Nearby Fish Culture Zones for 2-hour Discharge under Different Tides Conditions in Both Season

Appendix B1

Depth-averaged Conservative Tracer Concentration at Nearby Fish Culture Zones for 2-hour Discharge under Different Tides Conditions in Both Seasons from the TSTP

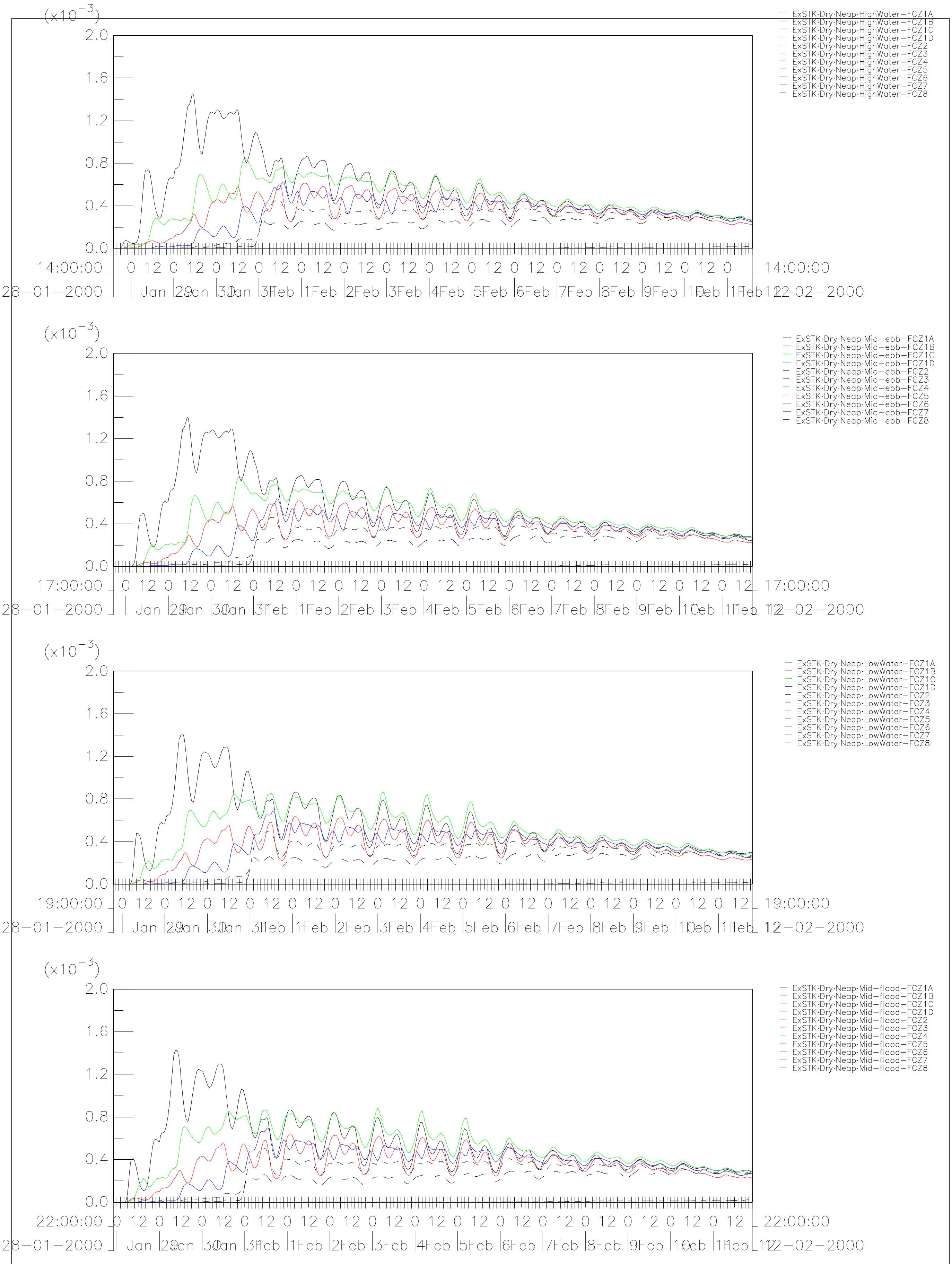


Expansion of Sha Tau Kok Sewage Treatment Works

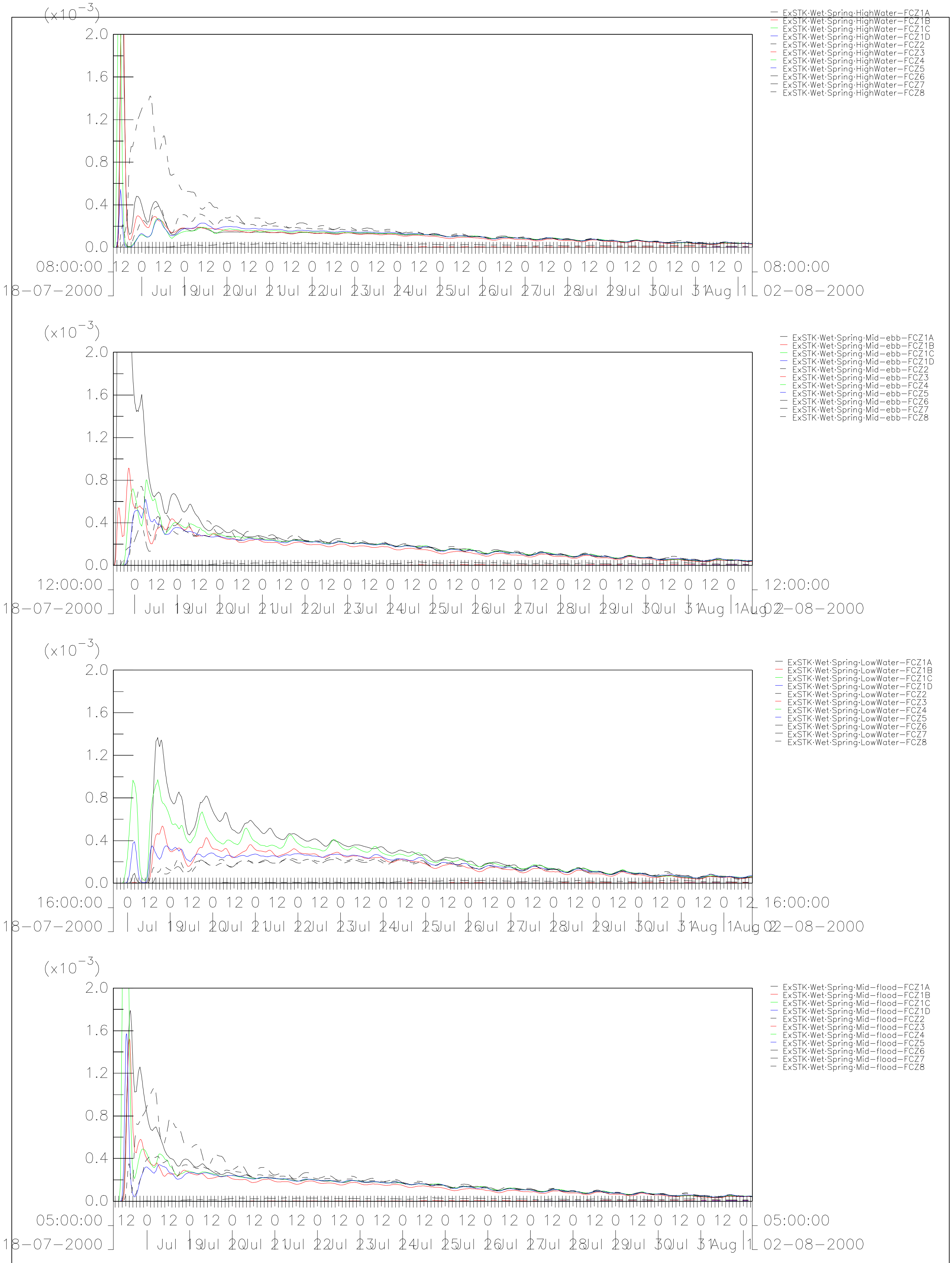
Depth−averaged Conservative Tracer Concentration at Fisheries Receivers

From top to bottom: 2−hour discharge during highwater, mid−ebb, low water, mid−flood

Expansion of Sha Tau Kok Sewage Treatment Works	Dry	Spring Tide
	Appendix B−1	
ERM	GPP	Emergency·cTr.ssn



Expansion of Sha Tau Kok Sewage Treatment Works Depth–averaged Conservative Tracer Concentration at Fisheries Receivers From top to bottom: 2–hour discharge during highwater, mid–ebb, low water, mid–flood	Dry	Neap Tide
	Appendix B–2	
ERM	GPP	Emergency·cTr.ssn



Expansion of Sha Tau Kok Sewage Treatment Works

Depth–averaged Conservative Tracer Concentration at Fisheries Receivers

From top to bottom: 2–hour discharge during highwater, mid–ebb, low water, mid–flood

Wet

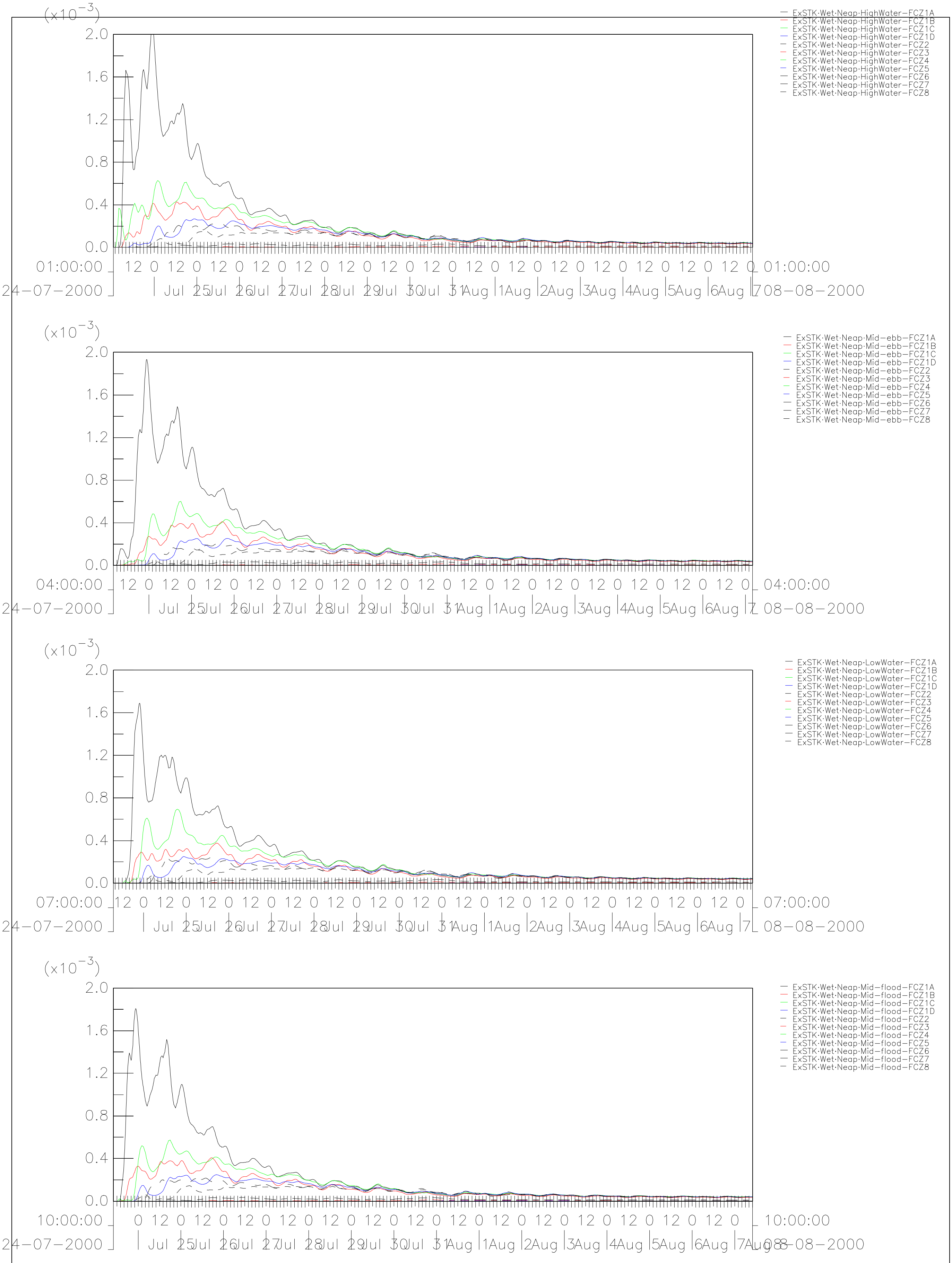
Spring Tide

Appendix B–3

ERM

GPP

Emergency·cTr.ssn



Expansion of Sha Tau Kok Sewage Treatment Works

Depth–averaged Conservative Tracer Concentration at Fisheries Receivers

From top to bottom: 2–hour discharge during highwater, mid–ebb, low water, mid–flood

Wet

Neap Tide

Appendix B–4

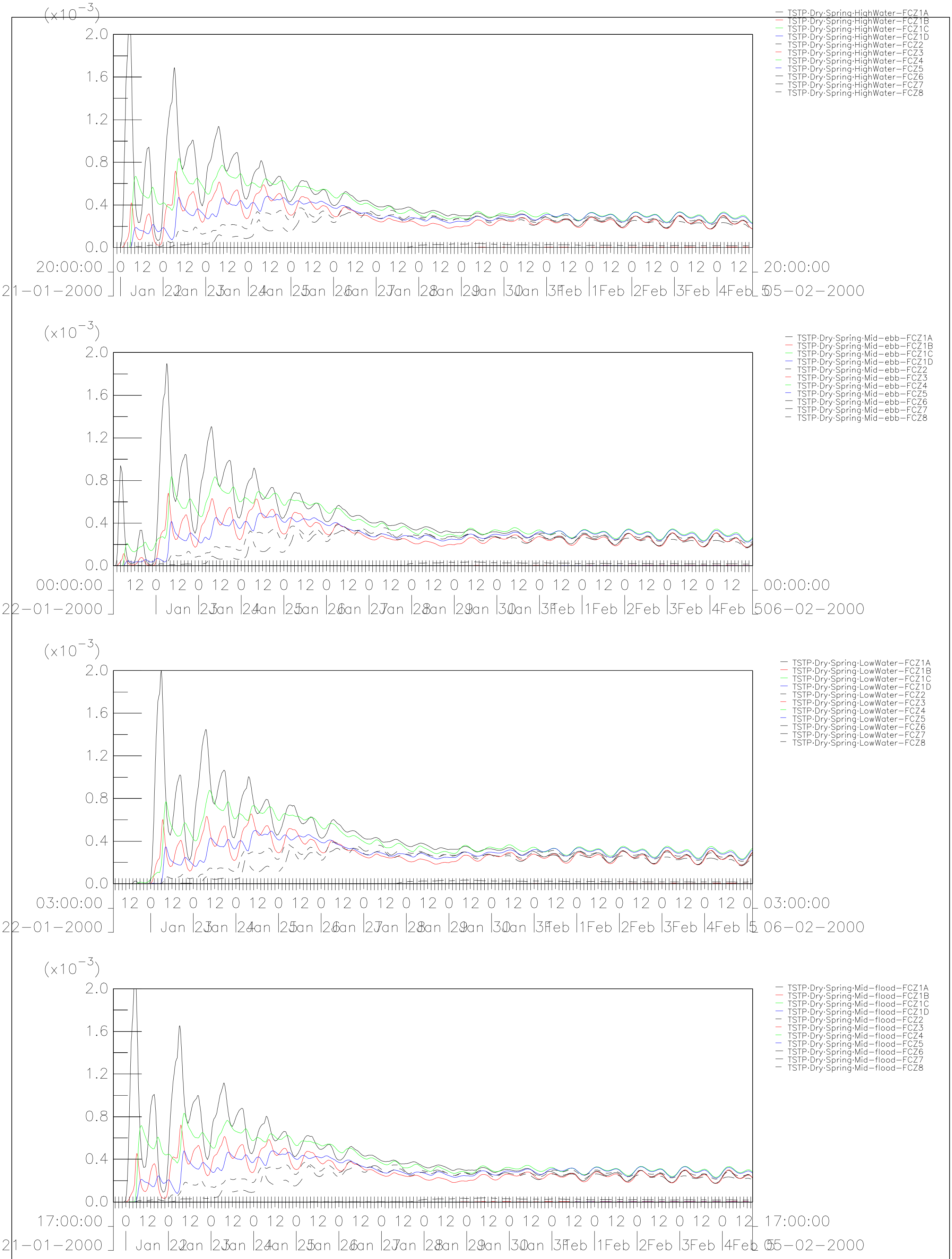
ERM

GPP

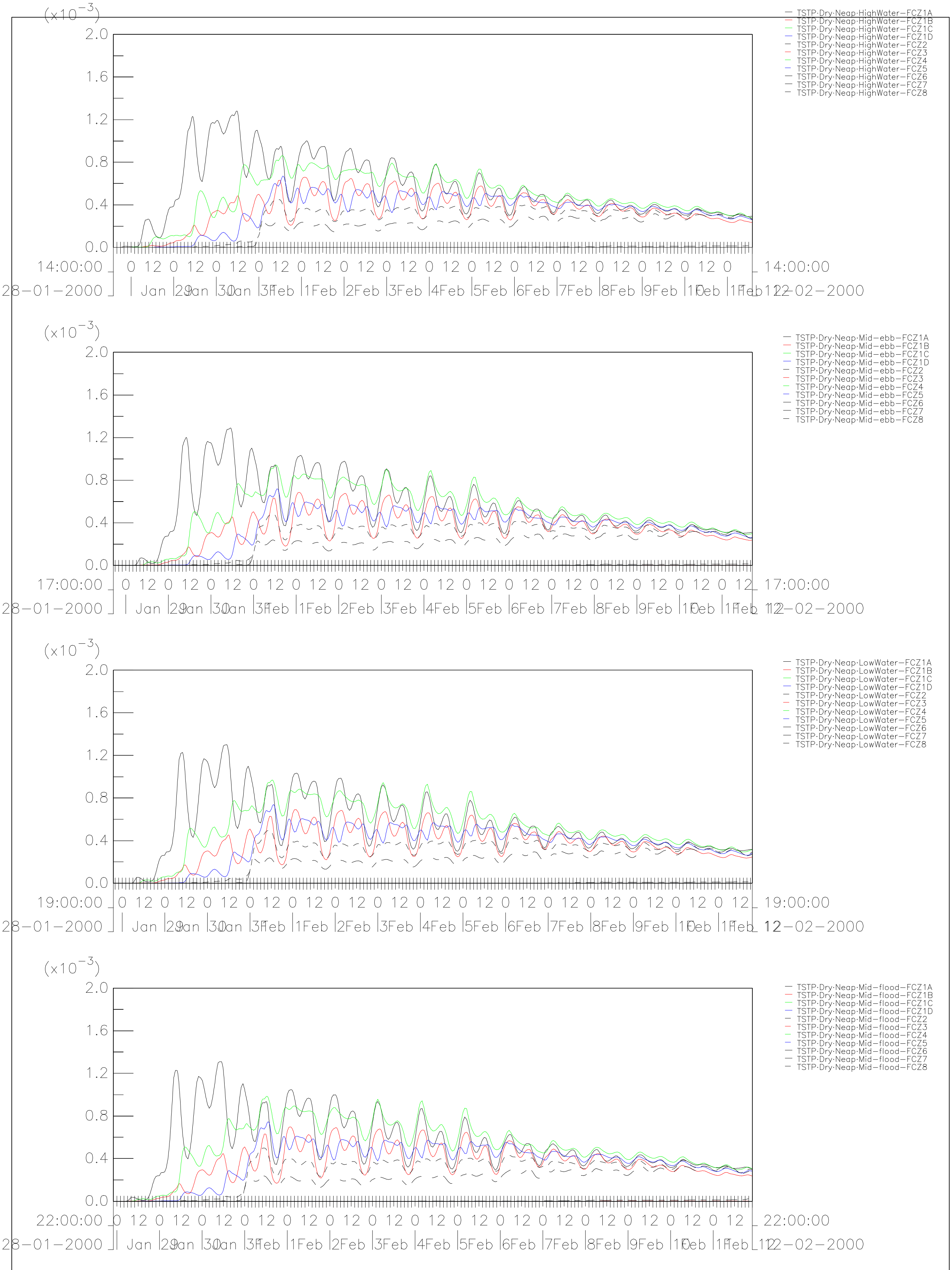
Emergency·cTr.ssn

Appendix B2

Depth-averaged Conservative Tracer Concentration at Nearby Fish Culture Zones for 2-hour Discharge under Different Tides Conditions in Both Seasons from the Expanded STKSTW



Expansion of Sha Tau Kok Sewage Treatment Works Depth–averaged Conservative Tracer Concentration at Fisheries Receivers From top to bottom: 2–hour discharge during highwater, mid–ebb, low water, mid–flood	Dry	Spring Tide
	Appendix B–1	
ERM	GPP	Emergency·cTr.ssn



Expansion of Sha Tau Kok Sewage Treatment Works

Depth–averaged Conservative Tracer Concentration at Fisheries Receivers

From top to bottom: 2–hour discharge during highwater, mid–ebb, low water, mid–flood

Dry

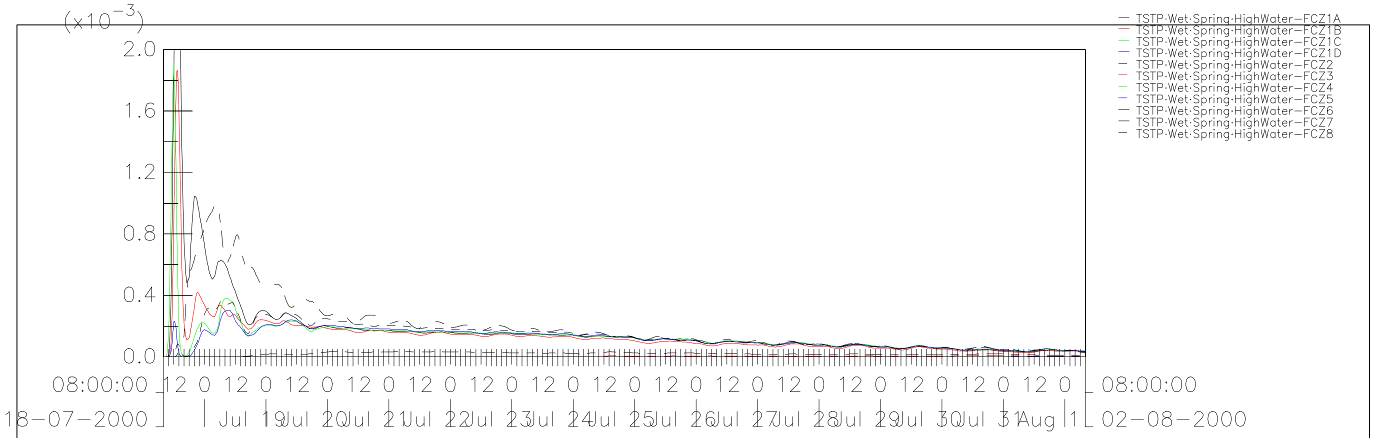
Neap Tide

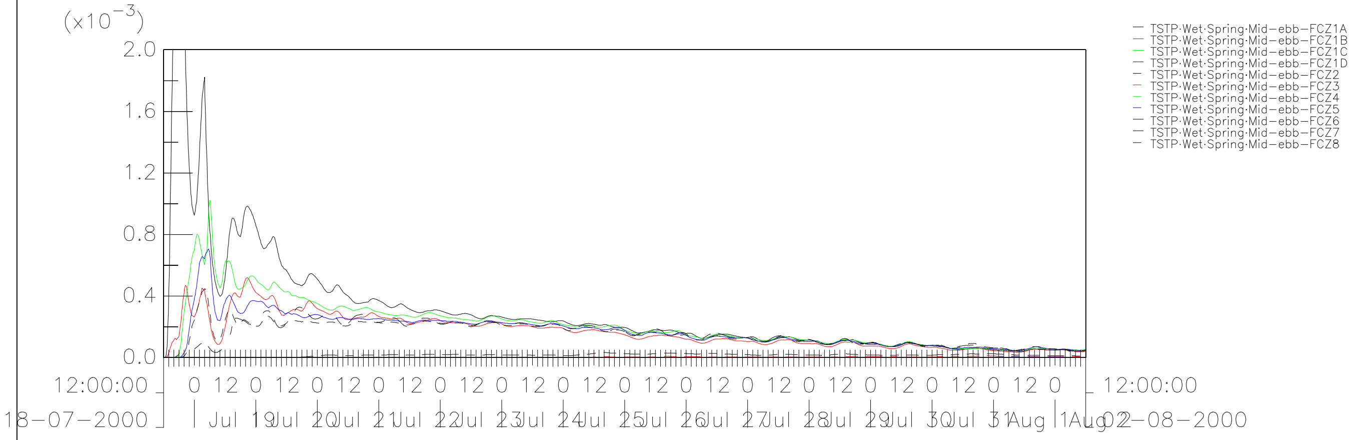
Appendix B–2

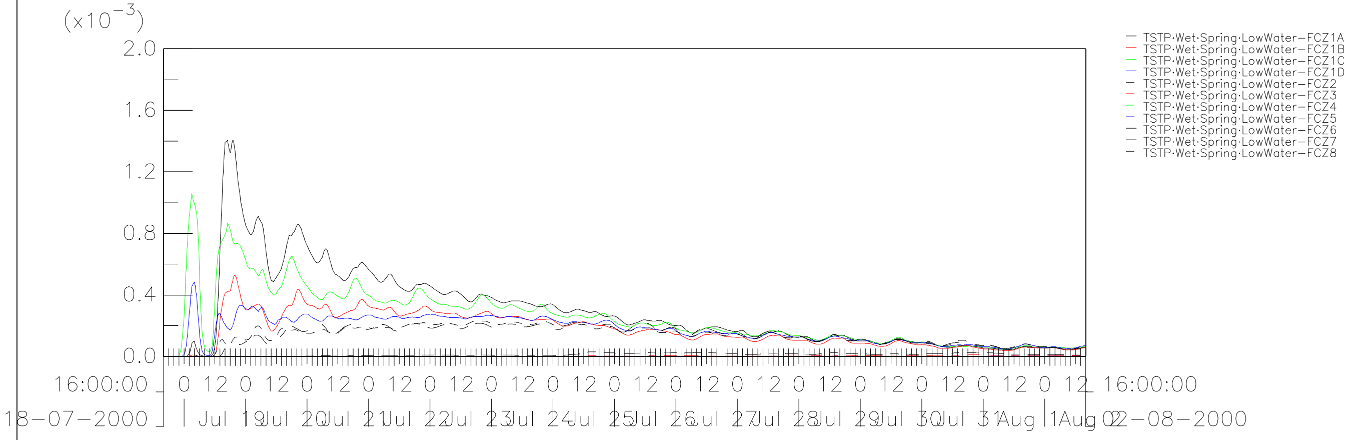
ERM

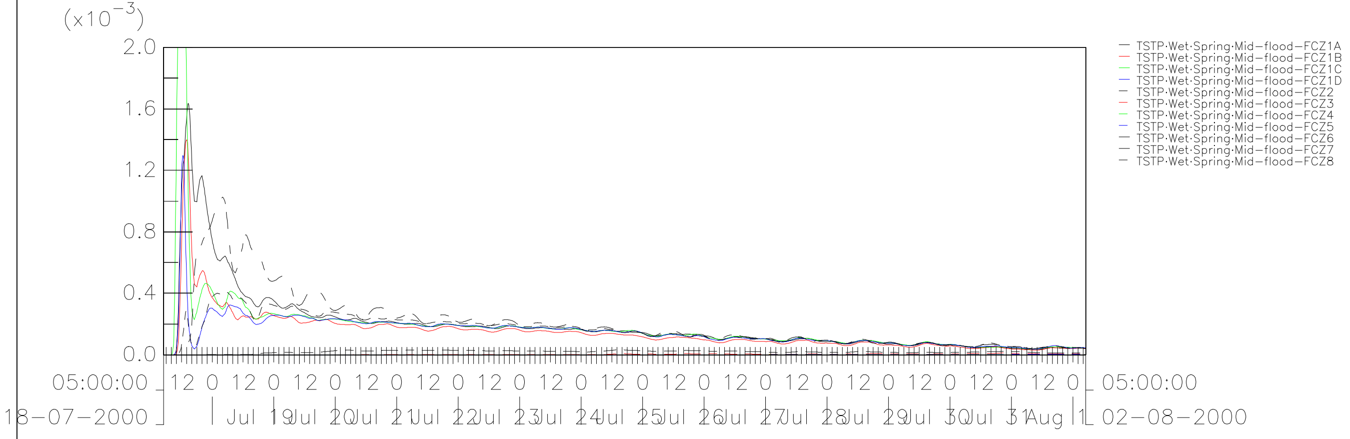
GPP

Emergency·cTr.ssn

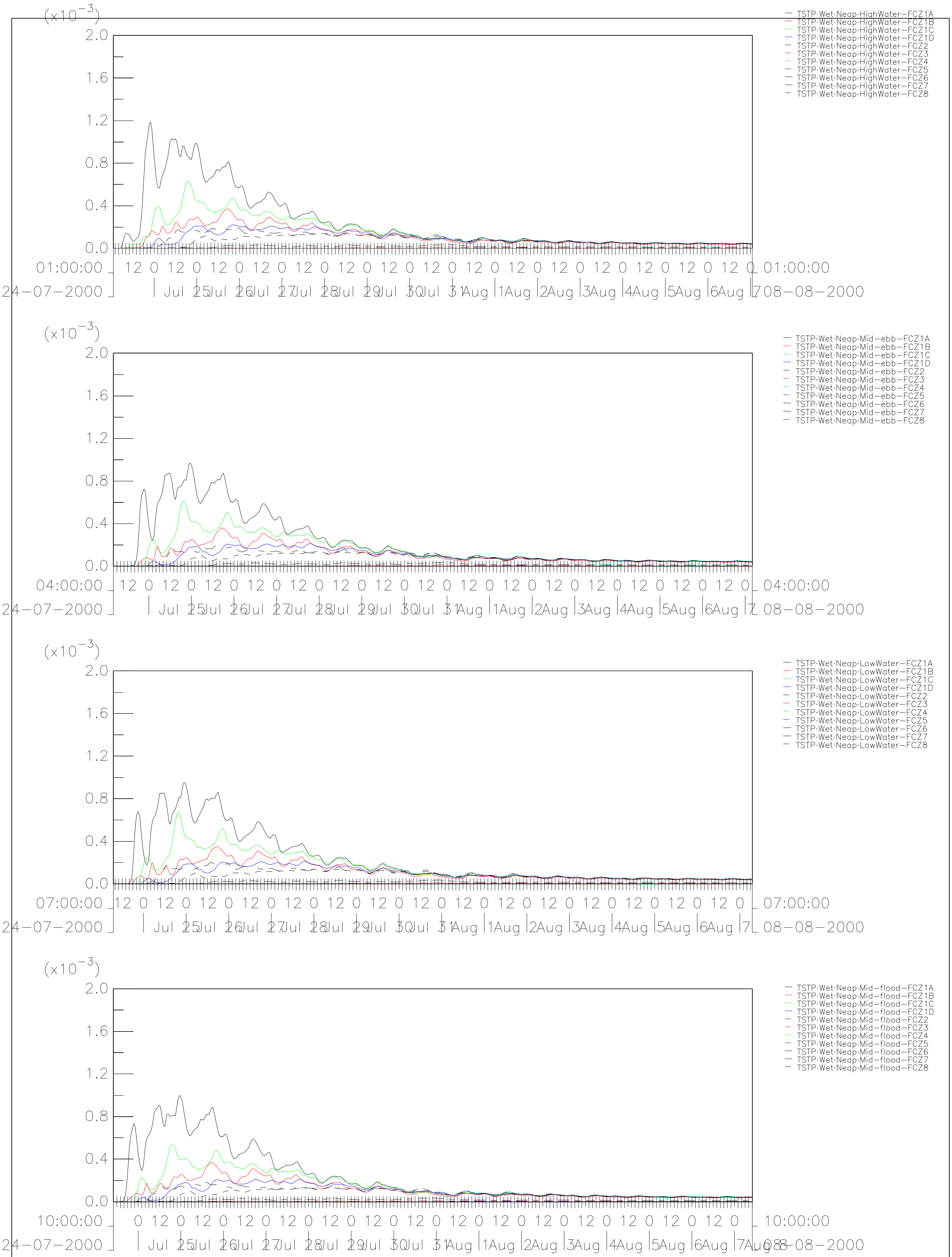








Expansion of Sha Tau Kok Sewage Treatment Works
Depth−averaged Conservative Tracer Concentration at Fisheries Receivers
From top to bottom: 2−hour discharge during highwater, mid−ebb, low water, mid−flood
Wet
Spring Tide
Appendix B−3
ERM
GPP
Emergency·cTr.ssn



Expansion of Sha Tau Kok Sewage Treatment Works Depth–averaged Conservative Tracer Concentration at Fisheries Receivers From top to bottom: 2–hour discharge during highwater, mid–ebb, low water, mid–flood	Wet	Neap Tide
	Appendix B–4	
ERM	GPP	Emergency·cTr.ssn