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APPENDIX

1 INTRODUCTION

1.1 Project Background

Strategic Context: Airport City

1.1.1.1 Airport Authority Hong Kong (AAHK) first put forward its vision to transform Hong Kong International Airport (HKIA) into an Airport City in the "*From City Airport to Airport City*" report published in 2019. The Airport City vision envisages growing HKIA's position as the preeminent international aviation hub in Asia Pacific, while transforming HKIA into a new landmark and one of the key economic growth engines for Hong Kong. To realise the Airport City vision, AAHK has adopted a strategy to fully capitalise on the unique geographical advantage of HKIA and capture opportunities arising from the new infrastructures connected to the airport, such as the Hong Kong-Zhuhai-Macao Bridge (HZMB).

1.1.1.2 The commissioning of the HZMB in 2018 has greatly improved the connectivity between Hong Kong and cities in the Greater Bay Area (GBA), and further expand the catchment area of HKIA as the region's leading international hub. To meet the growing demand and extend the airport's reach, AAHK will continue to strengthen HKIA's capacity for passenger and cargo service, through the expansion into a Three-runway System and other capacity enhancement plans. In addition, AAHK is introducing a growing cluster of functional enhancements with a view to transforming the airport into a new landmark and attracting more visitors to the Airport City from within Hong Kong, the GBA and other parts of Asia. Such functional enhancements include SKYCITY, a major integrated development that comprises retail complexes, dining areas, hotels and entertainment facilities, as well as AsiaWorld-Expo (AWE) future developments and other related plans, with complementary infrastructural support and technological innovations.

1.1.1.3 The infrastructural support to the airport's capacity and functional enhancements includes, among others, a series of AAHK's recommendations for land uses on the Hong Kong Port (HKP) (formerly known as Hong Kong Boundary Crossing Facilities) Island of HZMB. The key project items include the building of automated car parks for transfer air passengers and visitors to Hong Kong travelling via HZMB, and an autonomous transportation system for visitors to travel between the HKP Island, SKYCITY and Tung Chung Town Centre. In addition, land parcels on the HKP Island have been reserved for the development of air cargo logistics. As announced in the Chief Executive's 2020 Policy Address, the HKSAR Government has accepted these proposals. It is also noted in the 2020 Policy Address that optimising the use of the land adjacent to the airport will not only provide more job opportunities and a better living environment for the expanding Tung Chung community, but also inject new development elements and economic impetus into the whole North Lantau.

1.1.1.4 Under the strategic context as discussed above, the Airport City Link Project (hereafter referred to as the "Project" is put forward to enhance the connectivity of Airport Island:

Enhancement of Connectivity

Airport Tung Chung Link – Autonomous Transportation System connecting Tung Chung

1.1.1.5 AAHK is taking forward the Airportcity Link (ACL) project, a purpose-built bridge on which a vehicular road and a pedestrian walkway will be provided to connect the HKP Island and SKYCITY. As an environmental initiative, ACL will only be served exclusively by AAHK's electric vehicles, such that there is no air pollutant emission during its operation. Non-AAHK vehicles are restricted from accessing the ACL. In the longer term, ACL will be served by AAHK's autonomous transportation system. As the next step, an extension of the ACL's autonomous transportation system is being planned, called Airport Tung Chung Link (ATCL). ATCL, operated by AAHK, will run along the road on the eastern coast of the Airport Island to connect to Tung Chung Town Centre. With the use of zero emission vehicles (i.e. electric vehicles), and ultimately an autonomous transportation system (supported by zero emission autonomous vehicles) for the ATCL, the Airport Island will be seamlessly connected with the HKP Island and Tung Chung Town Centre in an environmentally-friendly manner.

Marine Facilities – SKYCITY Pier and Berthing Facilities

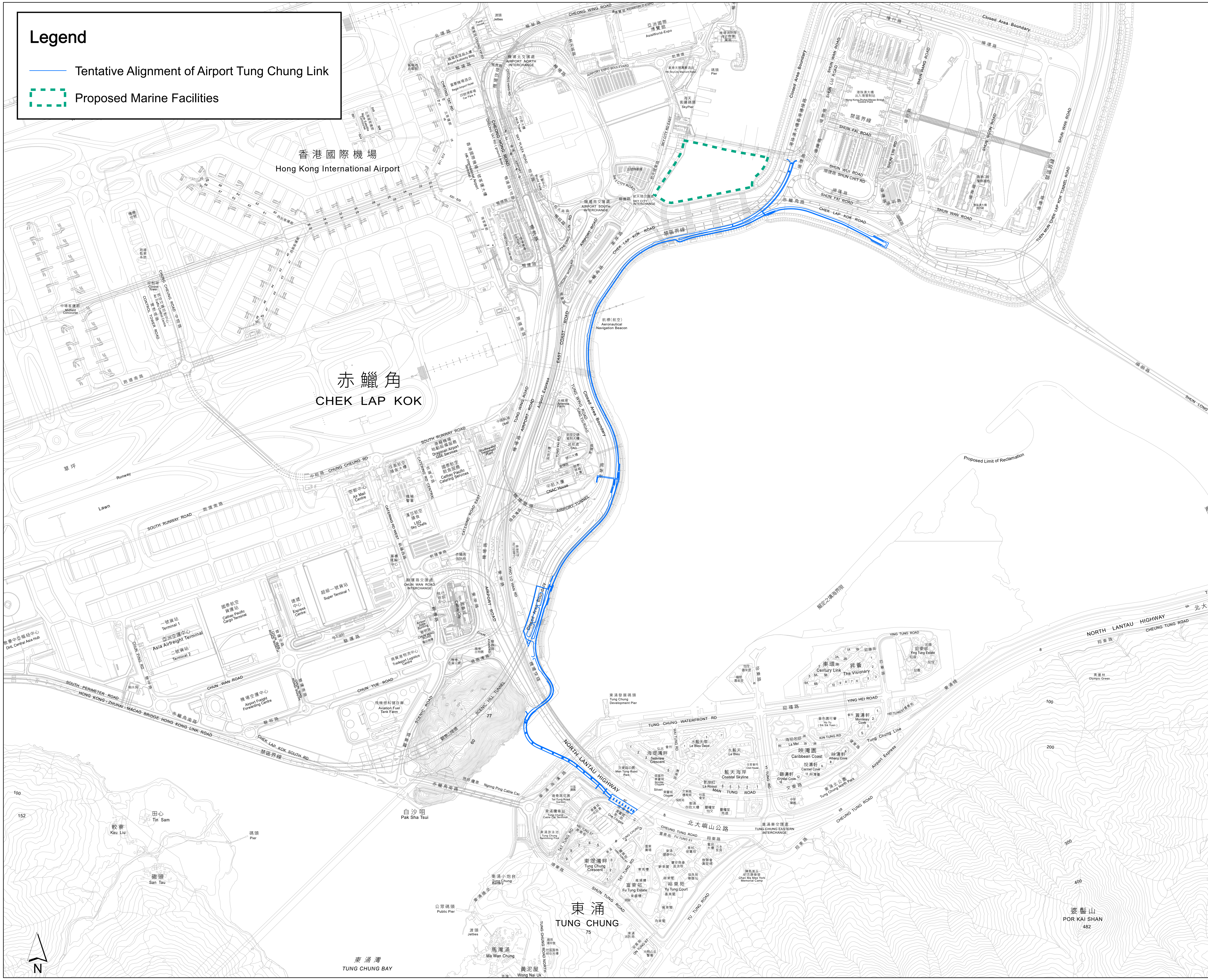
1.1.1.6 To the east of the Airport Island along the coast of SKYCITY, marine facilities will be provided in the area including a pier and berthing facilities to put the sea area into good use. These marine facilities would provide services for users to travel to the Airport or HKP Island. In other international airports such as the Singapore Changi Airport, there are similar sea access facilities near the airport for leisure and tourism, and transport where necessary.

1.1.1.7 A Project Profile (No. PP-623/2021) was submitted to the Environmental Protection Department (EPD) for application of an Environmental Impact Assessment (EIA) Study Brief under section 5(1)(a) of the Environmental Impact Assessment Ordinance (EIAO) and an EIA Study Brief (No. ESB-342/2021) for the Project was issued on 26 July 2021 under section 5(7)(a) of the EIAO.

1.1.1.8 On 21 September 2021, the Airport Authority Hong Kong appointed Meinhardt (Hong Kong) Ltd, to provide consultancy services for the Airport Tung Chung Link Project under Contract C21C04.

1.2 Description of Site Location of the Project

1.2.1.1 The Project is to construct and operate (i) the Airport Tung Chung Link (ATCL) to connect Hong Kong Port (HKP) Island and Tung Chung Town Centre; and (ii) marine facilities in the waters between Airport Island and HKP Island. The location of the Project is shown in **Figure 1** and the scope of works consists of:



Rev	Date	Descriptions	Check

香港國際機場 HONG KONG INTERNATIONAL AIRPORT

HONG KONG INTERNATIONAL AIRPORT

Consultant

MEINHARDT

in association with

OTC Planning & Design

ERM

Consultant's Signatures for Approval	Date
Design Supervisor	
Checkers	
Authorized Representative	

Title
Project Layout

Drawing No.
Figure 1

Date:6/7/2022

Status	Scale	Rev
	1:15,000 @A3	

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ATCL

(a) Construction of about 3.8km long road with approximately 2,750m at-grade section, 810m land viaduct and 220m marine viaduct and a provision spur line of an approximate 1.2 km long connecting the planned Aviation Academy for future extension;

(b) Construction of 2-3 at grade and 1 elevated ATCL stations;

(c) Construction of a depot; and

(d) Realignment of existing Kwo Lo Wan Road and airport trail and other affected facilities, reprovision and diversion of affected utilities and construction of ancillary facilities such as walkways, footbridges, and plant room(s);

Marine Facilities

(e) Construction of a pier and berthing facilities with about 73 berths; and

(f) Construction of ancillary facilities including floating platforms, gangs, floating wave attenuator, guide piles, etc.

1.3 Designated Projects

1.3.1.1 The Project consists of the following designated projects under the following items of Part I, Schedule 2 of the EIAO:

- Item A.6(c) – A transport depot located less than 200 m from the nearest boundary of an existing or planned educational institution;
- Item A.8 – A road or railway bridge more than 100 m in length between abutments;
- Item C.12(b) – A dredging operation exceeding 500,000 m^3 or a dredging operation which is less than 100 m from a seawater intake point;
- Item C.3(a) – Reclamation works resulting in 5% decrease in cross sectional area calculated on the basis of 0.0mPD in a sea channel; and
- Item O.2 – A marina designed to provide moorings or dry storage for not less than 30 vessels used primarily for pleasure or recreation.

1.4 Objectives and Scope of this Working Paper

1.4.1.1 As per required under Clause 6 under Model Details – Simulation of the Appendix D-l of the EIA Study Brief (ESB-342/2021),

The Applicant shall submit a Water Quality Modelling Plan for agreement with EPD before proceeding to modelling assessment. The Plan shall demonstrate that the models meet the requirements under the sections of Modelling software general, Model details Calibration & Validation and Model details - Simulation in this Appendix (D-1 of the EIA Study Brief). The Plan shall also set out the methodology for the modelling assessment under the section of Modelling Assessment in this Appendix (D-1 of the EIA Study Brief).

1.4.1.2 This Working Paper was prepared to satisfy the above requirement of the EIA Study Brief to facilitate EPD's agreement for modelling assessment methodology with respect to the specific sources of water quality impact from this Project.

1.5 Structure of this Working Paper

1.5.1.1 Following this introductory section, the remainder of this Working Paper is presented as follows:

- Section 2 discusses the potential sources of water quality impact named in the EIA Study Brief and the proposed nature (qualitative or quantitative) methodology for assessment, as well as explains whether computational modelling is required for sources of water quality impact that requires quantitative assessment;
- Section 3 provides technical details on the modelling exercise;
- Section 4 identifies water sensitive receivers;
- Section 5 proposes criteria for assessment;
- Section 6 details the considerations for concurrent projects; and
- Section 7 summarizes modelling scenarios for this EIA study.

2 KEY ISSUES FOR MODELLING

2.1.1.1 As stated in Appendix D of the Study Brief, the water quality impact assessment of this Project shall cover the issues listed below in **Table 1**.

Table 1 Key Water Quality Issues Listed under Appendix D of the Study Brief

#	Potential Issue	Proposed Approach for this Assessment
Construction Phase		
C1	Marine construction of the Project (i.e. dredging, piling) (Sediment dispersion, associated dissolved oxygen depletion and release of contaminants from marine works)	There will not be any open sea dredging for construction phase. Bored piling for the bridge piles crossing the Airport Channel would be conducted inside steel casing within silt curtain. Potential water quality impact would be limited and would be assessed qualitatively. Marine piling at the berth area is also considered to have minor sediment or other WQ impact and would be assessed qualitatively.
C2	Construction of the Project (Generation of wastewater, sewage from workforce, etc.)	Qualitative (Preventive measures, effluent control and good site practice)
Operation Phase		
O1	Operation of the Project (Change in flow regime due to presence of floating structure and bridge piles)	Quantitative, Delft3D FLOW
O2	Operation of the Project (Generation of wastewater, sewage from staff, visitors, passengers etc.)	Marine Facilities: The facilities will serve strictly for berthing purposes only. Sewage generation is not anticipated. Discharge from marine facilities and vessels are controlled under the *Water Pollution Control Ordinance* and *Merchant Shipping (Prevention and Control of Pollution) Ordinance*. Adverse water quality impact associated with the operation of marine facilities is not anticipated. Proposed Depot: Qualitative (Provision of sewer connection, effluent control and proper disposal)
O3	Maintenance dredging	Maintenance requirements are being reviewed and will be confirmed in later stage before commencing the modelling

#	Potential Issue	Proposed Approach for this Assessment
		works. In this Working Paper, it is assumed maintenance dredging would be required.
O4	Potential oil spillage associated with the operation of the vessels	High risk activities are not expected to be conducted at the berthing area. In general, vessel speed at or around the berthing area would be low such that collision risk and consequence will be low as well. Vessels involves at the berthing area would likely be small and thus any spill would be limited. The sheltered environment of the berth also limits the potential spread and allow containment and clean-up be conducted easily. In view of the above, qualitative assessment is deemed sufficient.

2.1.1.2 As shown in **Table 1**, the potential water quality impact on operation phase change in flow regime as well as maintenance dredging requires quantitative assessment with the aid of computational modelling tools. On the other hand, some potential sources of water quality impacts are expected to be minimal given suitable infrastructure (i.e. sewer connection) and other control measures. These potential sources of water quality impacts would be assessed qualitatively, with due consideration of built-in design control, good site practices and other control measures. As this Working Paper presents information on the approach for numerical modelling and assessment works for the EIA study, the potential sources of water quality impacts requiring only qualitative assessment are not further discussed in this Working Paper but the details will be discussed in the EIA study.

3 ASSESSMENT APPROACH AND MODELLING CONSIDERATIONS

3.1 Assessment Area

3.1.1.1 The proposed Project elements span from Tung Chung to the east side of the Airport Island and the west side of the Hong Kong Port (HKP). According to Clause 3.4.6.2 of the EIA Study Brief, the Assessment Area for shall include areas within 500 m from the boundary of the Project and shall cover the North Western Water Control Zone (NWWCZ) as designated under the *Water Pollution Control Ordinance* (Cap. 358). The proposed Project elements which may interact with bodies of water are all located at very sheltered waters. Given the relatively small footprint of works as well as the sheltered nature of water bodies affected, a model that covers at least the NWWCZ is deemed sufficient.

3.2 Model Selection

3.2.1.1 The Delft3D suite of models will be utilized to provide a modelling platform for hydrodynamic and water quality modelling. For this Study, modelling would be conducted based on an updated version of the Delft3D model (referred as "Refined West Harbour Model" or "ref-WHM") previously developed under the *EIA of Expansion of Hong Kong International Airport into a Three-Runway System* (AEIAR-185/2014, referred as "3RS EIA" hereafter), which was already calibrated and validated. Model validation exercise conducted under AEIAR-185/2014 was document under the Appendix 8.3 of the approved EIA (https://www.epd.gov.hk/eia/register/report/eiareport/eia_2232014/html/Appendix%208.3.pdf). The ref-WHM is based on the West Harbour Model and utilizes the domain-decomposition (DD) functionality of Delft3D and provide additional level of grid refinement at the body of water north to the Lantau Island. The boundary of the refined sub-domain is at least 10 km from the footprint of this Project, and is therefore considered sufficient to cover any significant level of change in hydrodynamic and water quality induced by the Project.

3.2.1.2 For this EIA study, minor adjustment and refinement of the ref-WHM has been made to enhance grid resolution at project area where marine works and / or marine structures could result in potential construction / operation phase impact on water quality / flow regime. Specifically, local grid refinements (3 additional grid lines) have been made at the Airport Channel between Tung Chung and the Airport Island, as well as the body of water between the HKP and the Airport Island to ensure model resolution of 75 m or below. At location further away, model resolution reduces outwards. The resolution at the sub-domain boundary at Ma Wan Channel is below 130 m and that at the sub-domain boundary at the west of Lantau is below 140 m. Following the settings adopted in the version of ref-WHM in the 3RS EIA, the ref-WHM adopted for this Study will be vertically divided into 10 sigma layers. Overview of both models are provided in **Exhibit 1**. A comparison of the Original ref-WHM and the Updated ref-WHM are provided in **Exhibit 2**.

Exhibit 1 Overview of ref-WHM (Original – Left; Updated – Right) around Project Site (Refinement Highlight in Dashed Lines)

Model Coverage of ref-WHM adopted under 3RS Project	Model Coverage of Updated ref-WHM adopted under this Study

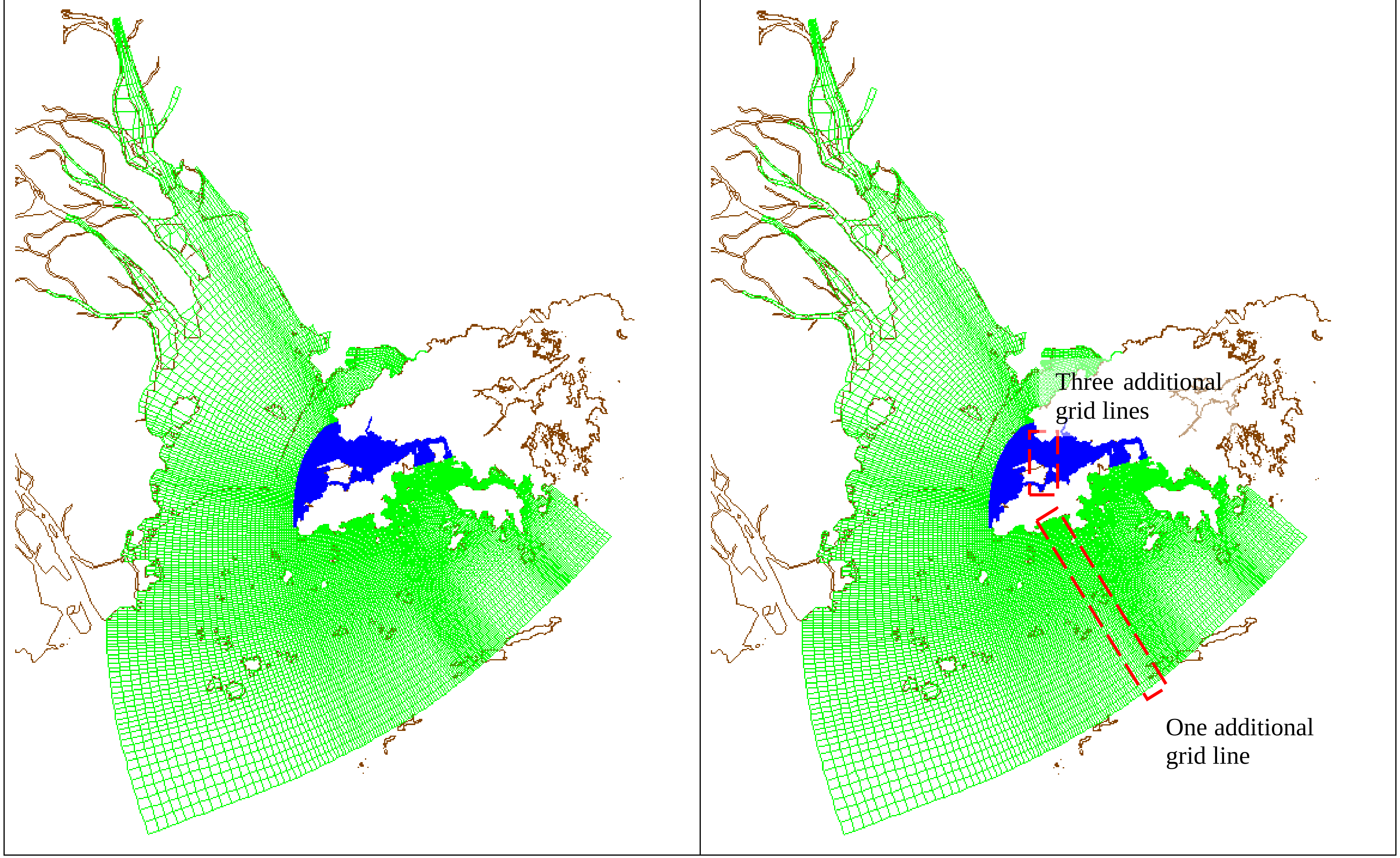
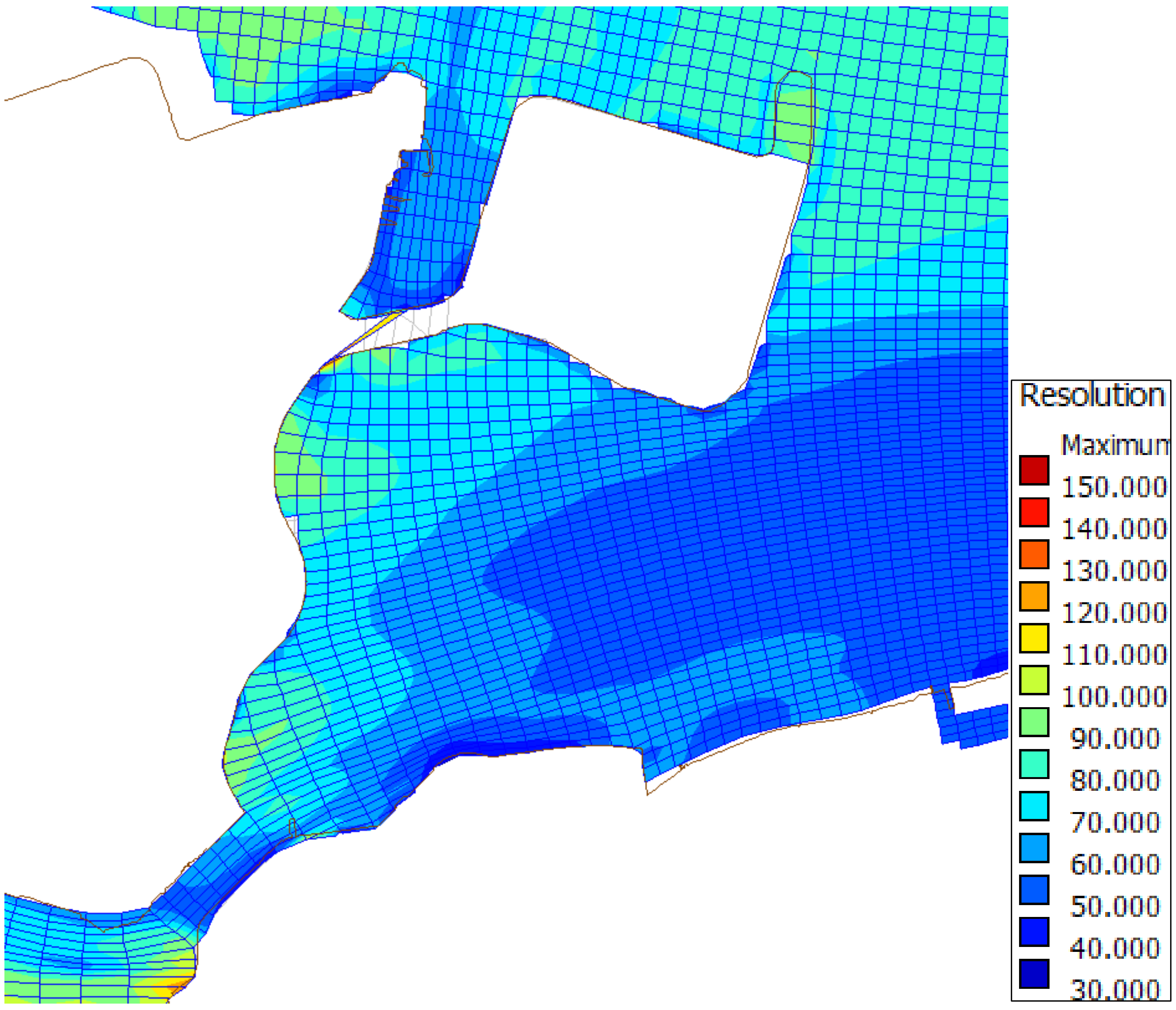


Exhibit 2 **Grid Resolution of ref-WHM (Original – Green Line; Updated – Blue Line; Grid Resolution Presented for Updated Version) around Project Site**

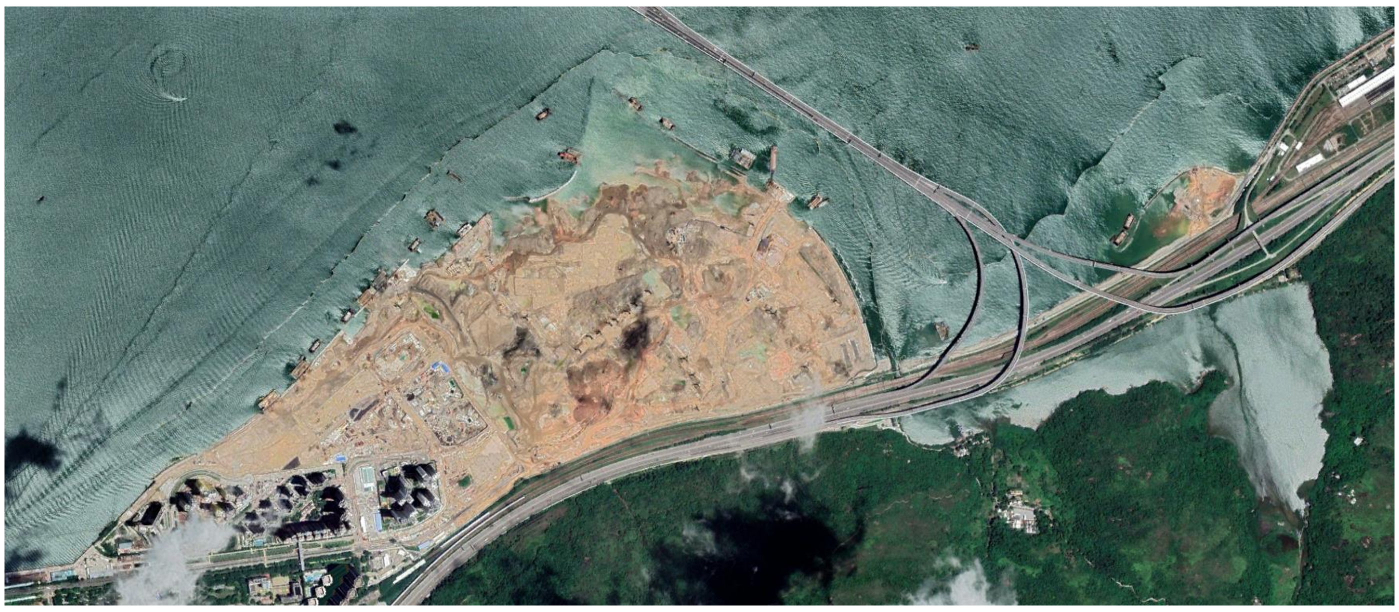


3.3 Coastline Configurations & Bathymetry

3.3.1.1 The latest coastline configuration of 2021 will be adopted in model simulations of the potential impact from Project construction and operation in this EIA study. Changes in coastline and bathymetry configuration due to future reclamation and other development activities will be reflected in the model setup of the relevant time horizons. Of notable relevance, the reclamation for the three runway system (3RS) of HKIA as well as the Tung Chung East Reclamation (plus Road P1) are particularly close to the Project site and would exert notable effect on flow regime. Based on Google Earth Imagery dated July 2021 (latest available when this Working Paper was prepared in October 2021), the reclamation for 3RS was substantially completed with minimal incomplete seawall and marine filling at the south-western tip close to the original seawall of the HKIA (**Exhibit 3**). For the Tung Chung East Reclamation, satellite imagery also indicated the majority of the landmass under this project has been filled to above water surface (**Exhibit 4**). For this reason, both of these projects are assumed to be assumed to be completed in the modelling study.

Exhibit 3 **Google Earth Imagery dated July 2021 at the Airport Island**

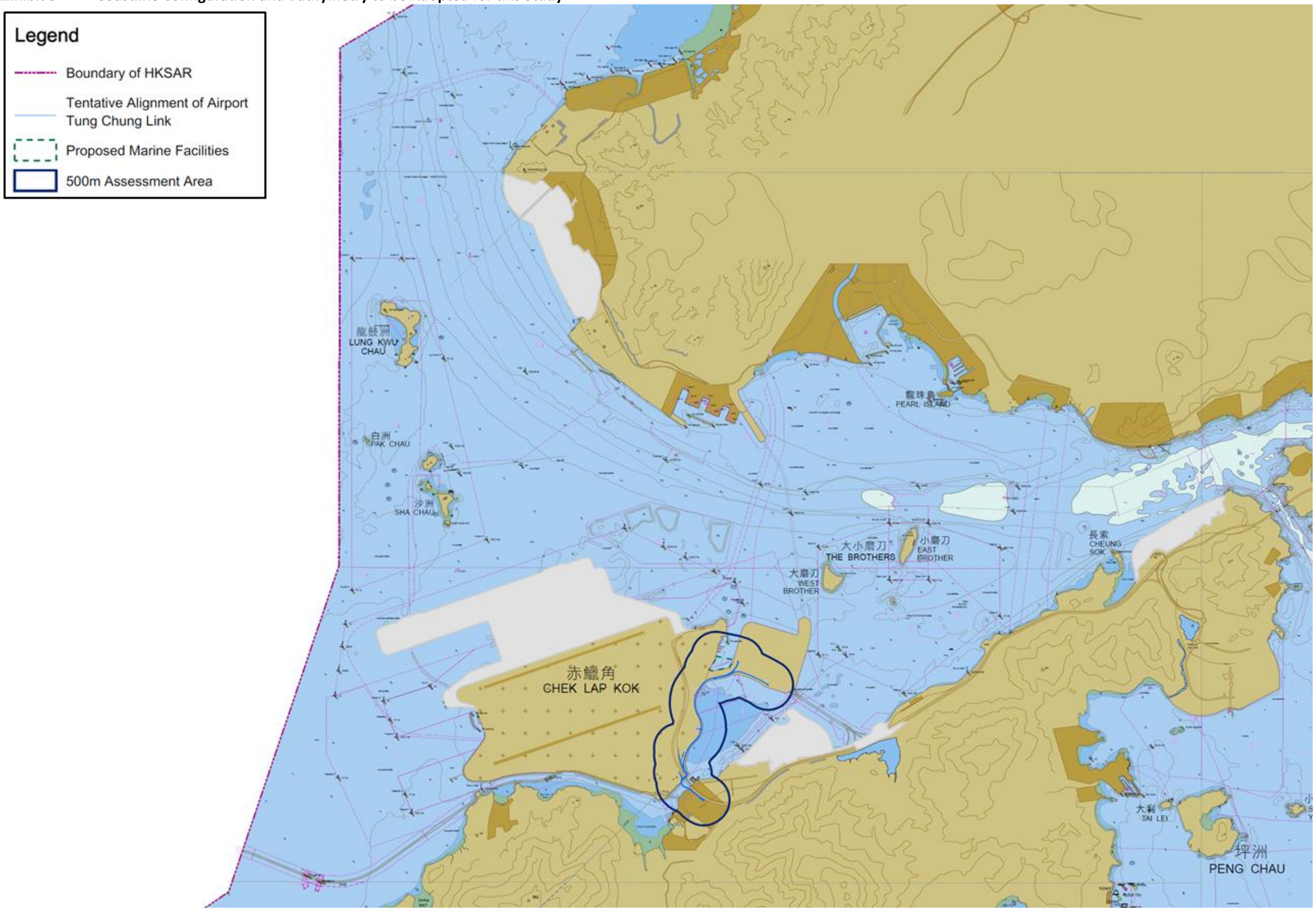
Exhibit 4 Google Earth Imagery dated July 2021 at the Tung Chung East and Road P1 Reclamation



3.3.1.2 **Exhibit 5** shows the coastline configuration and bathymetry data to be adopted for the modelling exercise for this Study. The latest available bathymetry data from the Electronic Nautical Chart published by the Marine Department in 2020 would be adopted to update the modelled area (**Exhibit 5**).

3.3.1.3 It should be noted that there are multiple culverts connecting the bodies of waters south and west of the HK Boundary Crossing Facilities (HKBCF) which allow material exchanges. These culverts have been taken into account accordingly for the hydrodynamic model under this Study, following the settings adopted in the modelling exercise under the 3RS EIA. It should be noted that such feature is not compatible with the Delft3D WAQ and would be excluded in the corresponding modelling exercise. It is deemed conservative and acceptable as reduced flow within the embayment (where the project berthing area is located) would result in less flushing and dilution of sediment from maintenance dredging, thus result in higher impact at the nearest WSRs (C14 and C9 under *Section 4*, which would likely be the most impacted) and limits the maximum allowable dredging rate. Further details on these culverts would be provided in the EIA Report.

Exhibit 5 Coastline Configuration and Bathymetry to be Adopted for this Study



3.4 Boundary Conditions

3.4.1.1 To ensure consistency of model performance with the previously calibrated and validated version of ref-WHM, the same boundary conditions for the ref-WHM as that adopted in the approved 3RS EIA would be adopted for this Project, which is based on water level, salinity and temperature conditions from the Update Model (developed under the Update on *Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool (Agreement No. CE 42/97)*) generated via nesting.

3.5 Ambient Environmental Conditions – Background Temperature and Wind

3.5.1.1 The ambient environmental conditions are closely linked to the processes of hydrodynamic changes. To ensure consistency of model performance with the previously calibrated and validated version of ref-WHM, the same ambient environmental conditions were adopted for background temperature and wind. The wind conditions applied in the hydrodynamic simulation are 5 m/s NE for dry season and 5 m/s SW for the wet season, which is typical in HK and is adopted in both the Update Model as well as the WHM. The air temperatures as well as temperature at discharge of Pearl River in the dry and wet seasons were attributed to be 19°C and 30°C, respectively. Salinity of river discharge Pearl River was assumed to be 0.1 ‰.

3.6 Model Validation

3.6.1.1 Following the specific requirements stipulated in the EIA Study Brief, model validation was done by comparing the model predicted by the ref-WHM version adopted for this Study against the version validated under the 3RS EIA. The following parameters will be reviewed to demonstrate the model performance is consistent with the validated Original Ref-WHM:

- Water level – Root mean square error analysis;
- Water level – Phase error for high and low water;
- Current magnitude – Maximum deviation at Peak Speed;
- Current magnitude – Phase error at Peak Speed;
- Current Direction – Maximum deviation at Peak Speed; and
- Salinity – Maximum deviation

3.6.1.2 Plots and statistics for model validation are presented in *Appendix A*.

3.7 Change in Flow Regime

3.7.1.1 The Project involves piling for floating structures at the proposed berthing, as well as bridge piles at the Airport Channel. These structure could exert drag on the tidal current across the affected bodies of water and result in change in flow regime. To assess the potential change in flow regime, hydrodynamic modelling would be conducted for scenarios with and without the pile structures under this Project. Because bridge piles or other piles for floating structure at the proposed berthing area (in order of meter, final design not confirmed yet when this Working Paper was prepared) is typically smaller than that of the resolution of model grid around Project area (> 50 m), drag on tidal current exerted by these sub-grid structures would be taken into account by the addition of a quadratic friction term in the momentum equations (build-in in Delft3D Flow) on each model grid cells where relevant piles are located. The relevant formulation is detailed in Section 9.10.2 of the Delft3D-FLOW User Manual (https://content.oss.deltares.nl/delft3d/manuals/Delft3D-FLOW_User_Manual.pdf). The energy loss term would be calculated for this Study based on latest available piles structure design once available. In case multiple designs are deemed possible, the most conservative design (i.e. with highest total cross section blocked) would be adopted for assessment.

3.7.1.2 Multiple levels of assessment would be conducted for assessment for change in flow regime. First, the change in tidal current across major channel would be compared under the baseline and project scenario to demonstrate the effect of project in the greater area of the western waters.

3.7.1.3 Locally around the embayment area where the proposed berthing facilities will be located, additional assessment will be conducted to evaluate how the proposed hydraulic structures for the Skycity Link and berth affect the material exchange of the embayment. Given the nature of berthing facilities is to allow safe navigation and berthing, which would slow down of tidal current, there could be an associated change in rate of material exchange of the embayment. Slowing down of material exchange within an embayment could result in accumulation of pollutants and floating refuse, and is considered a water quality concern. To evaluate the level of change in material exchange, a tracer dispersion modelling would be conducted under baseline and project scenarios for both seasons with initial conservative tracer concentration set as 1 mg/L within the embayment while the rest of the model domain is set as 0 mg/L. Conservative tracer would then be flushed out and diluted by tidal current. To account for effect of different tidal status for the start of the tracer dispersion modelling, a total of 8 cases would be modelled through a combination of (high water / low water / flooding tide / ebbing tide) under (spring tide / neap tide). The resulted change in pattern of conservative tracer removal (when compared with the baseline scenarios) would be reviewed in determine the potential risk of reduced flushing and its potential extent.

3.7.1.4 Also, to ensure the results of tracer dispersion modelling is independent of grid configuration or resolution, a grid convergence test would be conducted, which consists of tracer dispersion modelling using three model grids with different grid configuration at the embayment. Other than the adopted model grid described in ***Section 3.2***, one model grid with slightly lower grid resolution within the embayment would be adopted, and one other model grid with higher grid resolution within the embayment would be adopted. The decay curve at the same location within the embayment among three model runs would be compared to demonstrate the esults of tracer dispersion modelling is independent of grid configuration or resolution.

3.7.1.5 For assessment of potential change in flow regime outside of the embayment, time series output of current direction and velocity at several of the nearest WSRs (WSRs M11c, CLK3 and CLK4) would be presented to determine the level of change on the immediate surrounding of the project site.

3.8 Maintenance Dredging

3.8.1.1 At the time when this Working Paper was prepared, the need for maintenance dredging during operation phase was under reviewed. For this Working Paper, it is assumed maintenance dredging would be required and the corresponding modelling approach and assumptions is proposed below for agreement with EPD. Sediment dispersion modelling for maintenance dredging would be conducted upon confirmation by the client.

3.8.1.2 Currently there is no information regarding the scale, location, frequency, rate, and plant(s) for maintenance dredging. A typical average scenario is assumed below to demonstrate the assumption and approach to be adopted. For this Working Paper, it is assumed maintenance dredging would be conducted using a closed grab dredger working at rate of 600 m^3 hr^{-1} without the use of silt curtain under unmitigated scenario.

3.8.1.3 Grab dredgers may release sediment into suspension by the following mechanisms:

- Impact of the grab on the seabed as it is lowered;
- Washing of sediment off the outside of the grab as it is raised through the water column and when it is lowered again after being emptied;
- Leakage of water from the grab as it is hauled above the water surface;
- Spillage of sediment from over-full grabs;
- Loss from grabs which cannot be fully closed due to the presence of debris;
- Release by splashing when loading barges by careless, inaccurate methods; and
- Disturbance of the seabed as the closed grab is removed.

3.8.1.4 In the transport of dredged materials, sediment may be lost through leakage from barges. However, dumping permits in Hong Kong include requirements that barges used for the transport of dredging materials have bottom-doors that are properly maintained and have tight-fitting seals in order to prevent leakage. Given this requirement, sediment release during transport is not proposed for modelling and its impact on water quality will not be addressed under this EIA study.

3.8.1.5 Sediment is also lost to the water column when discharging material at disposal sites. The amount that is lost depends on a number of factors including material characteristics, the speed and manner in which it is discharged from the vessel, and the characteristics of the disposal sites. It is considered that potential water quality issues associated with disposal at the intended government disposal site(s) have already been assessed by Civil Engineering and Development Department (CEDD) and permitted by EPD, hence and the environmental acceptability of such disposal operations is demonstrated. Therefore modelling of impacts at disposal sites does not need to be addressed.

3.8.1.6 Loss rates have been taken from previously accepted EIAs in Hong Kong [(1)(2)(3)(4)(5)] and have been based on a review of worldwide data on loss rates from dredging operations undertaken as part of assessing the impacts of dredging areas of Kellett Bank for mooring buoys [(6)]. The assessment concluded that for 8 m^3 (minimum) grab dredgers working in areas with significant amounts of debris on the seabed (such as in the vicinity of existing mooring buoys) that the loss rates would be 25 kg m^{-3} dredged, while the grab dredger bucket size in areas where debris is less likely to hinder operations would be 17 kg m^{-3}. In comparison, the Contaminated Spoil Management Study (Mott MacDonald, 1991, Table 6.12) reviewed relevant literature and concluded that losses from closed grab dredgers were estimated at 11

(1) ERM - Hong Kong, Ltd (2006) *EIA Study for Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities.* For CAPCO. Register No.: AEIAR-106/2007, http://www.epd.gov.hk/eia/register/report/eiareport/eia_1252006/html/index.htm

(2) ERM (2005). *Detailed Site Selection Study for a Contaminated Mud Disposal Facility within the Airport East/East of Sha Chau Area. EIA and Final Site Selection Report*. For CEDD. Approved on 1 September 2005. Register No.: AEIAR-089/2005, http://www.epd.gov.hk/eia/register/report/eiareport/eia_1062005/index.htm

(3) ERM (2000). *Construction of an International Theme Park in Penny's Bay of North Lantau together with its Essential Associated Infrastructures – Final EIA Report*. For CEDD. Approved on 28 April 2000. Register No.: AEIAR-032/2000 http://www.epd.gov.hk/eia/register/report/eiareport/eia_0412000/index.html

(4) ERM - Hong Kong, Ltd (2010) EIA Study for Black Point Gas Supply Project. For CAPCO. Register No. AEIAR-150/2010, http://www.epd.gov.hk/eia/register/report/eiareport/eia_1782009/index.html

(5) ERM - Hong Kong, Ltd (2018) EIA Study for Hong Kong Offshore LNG Terminal. For CLP. Register No. AEIAR-256/2018, https://www.epd.gov.hk/eia/register/report/eiareport/eia_2562018/HTML/0359722_EIA_TOC%20v3.htm

(6) ERM (1997). *EIA: Dredging an Area of Kellett Bank for Reprovisioning of Six Government Mooring Bays. Working Paper on Design Scenarios*. For CEDD. https://www.epd.gov.hk/eia/register/report/eiareport/eia_00698.pdf

– 20 kg m^{-3}. For conservative reason, the value of 20 kg m^{-3} will be used for this Study.

3.8.1.7 For one grab dredger working at 600 m^3 hr^{-1}, the rate of release (in kg s^{-1}) of sediment is calculated as follows:

Loss Rate (kg/s)
= Dredging Rate (m^3 s^{-1}) × Loss Rate (kg m^{-3})
= 0.1667 m^3 s^{-1}× 20 kg m^{-3}
= 3.3333 kg s^{-1}

3.8.1.8 Therefore, a continuous release rate of 3.3333 kg s^{-1} for one dredger working at 600 m^3 hr^{-1}. In case dredging rate becomes available later in this study, the sediment loss rate for modelling would be adjusted accordingly. Sediment source for grab dredger would be modelled as a stationary source close to the nearest WSR for a conservative assessment.

3.8.1.9 Sediment dispersion modelling would be conducted using Delft3D-WAQ module. For simulating sediment impacts the following general parameters will be assumed:

- Settling velocity – 0.5 mm s^{-1}
- Critical shear stress for deposition – 0.2 N m^{-2}
- Critical shear stress for erosion – 0.3 N m^{-2}
- Minimum depth where deposition allowed – 0.1 m
- Resuspension rate – 30 g m^{-2} d^{-1}

3.8.1.10 The above parameters have been used to simulate the impacts from sediment plumes in Hong Kong associated with uncontaminated mud disposal into the Brothers MBA (7), dredging for the Permanent Aviation Fuel Facility at Sha Chau (8), dredging and jetting for the Development of an Offshore Wind Farm in Hong Kong (9), the Additional Gas-fired Generation Units Project (10), and the recently approved EIA of Hong Kong Offshore LNG Terminal (11). The critical shear stress values for erosion and deposition were determined by laboratory testing of a large sample of marine mud from Hong Kong as part of the original Water Quality and Hydraulic Mathematical Model (WAHMO) studies associated with the new airport at Chek Lap

(7) Mouchel (2002a). Environmental Assessment Study for Backfilling of Marine Borrow Pits at North of the Brothers. Environmental Assessment Report.

(8) Mouchel (2002b). Permanent Aviation Fuel Facility. EIA Report. Register No. AEIAR-107/2007

(9) BMT Asia Pacific Ltd (2009). EIA for Hong Kong Offshore Wind Farm in Southeastern Waters. For HK Offshore Wind Limited. Register No.: AEIAR-140/2009

(10) ERM (2016). Additional Gas-fired Generation Units Project. EIA Report. Environmental Permit EP-507/2016

(11) ERM - Hong Kong, Ltd (2018) EIA Study for Hong Kong Offshore LNG Terminal. For CLP. Register No. AEIAR-256/2018

Kok.

3.8.1.11 Dissolved oxygen (DO) depletion will be calculated using the modelled maximum SS concentrations as well as the maximum chemical oxygen demand at nearby EPD sediment quality monitoring station NS3 (23,000 mg kg^{-1}). This method has been adopted in past approved EIAs in the nearby area [12] [13]. Accordingly, the dissolved oxygen levels at WSRs would be estimated based on the 10^{th}-percentile dissolved oxygen levels minus the maximum elevation times the maximum chemical oxygen demand (i.e. DO at WSR = 10^{th}-percentile DO level – maximum SS elevation × 23,000 mg kg^{-1}).

3.8.1.12 Total inorganic nitrogen (TIN), unionized ammonia (UIA), heavy metals and organic compounds released from disturbed sediment will be modelled as inert tracers which release at the same time and at the same rate as the disturbed sediment for conservative reason. Prediction of TIN and UIA level would be based on modelled concentration of conservative tracer as well as the elutriate test results conducted under the sediment sampling and testing exercise under this Project, assumed 100% of TKN released would be converted into TIN immediately. Elutriate test typically involve the extraction of sediment-bounded nutrients / contaminants from 1 kg of sediment sample using 4 litres of marine water. The release-able contaminants from the elutriate can then be scaled to the dredging rate modelled for estimated of nutrients / contaminant levels using the conservative tracer concentration at WSRs (i.e. nutrients / contaminants concentration at WSR = conservative tracer concentration × release-able nutrients / contaminant content per unit mass of sediment) Elevation of UIA is then calculated accordingly from the TIN elevation prediction assuming (1) 100% of the release TIN presence as ammonia nitrogen and (2) the fraction of ammonia nitrogen presented as UIA follows the long term average of the 3.7%.

3.8.1.13 Prediction on other sediment-bounded contaminants (including metals, metalloid and trace organic contaminants) would be based on modelled concentration of conservative tracer as well as results of elutriate test conducted under the sediment sampling and testing exercise for this Study. The same method for estimating nutrient elevation based on elutriate testing results and conservative tracer concentration would be adopted for estimation of elevation of contaminant levels.

3.9 Uncertainties in Change in Flow Regime Assessment

3.9.1.1 Uncertainties in flow regime change modelling would likely be around detailed project design, particularly on pile locations and dimension. To address such uncertainty, the potential design with the highest level of cross section blocked

[12] ERM (2016). Additional Gas-fired Generation Units Project. EIA Report. Environmental Permit EP-507/2016
[13] ERM - Hong Kong, Ltd (2018) EIA Study for Hong Kong Offshore LNG Terminal. For CLP. Register No. AEIAR-256/2018

would be assessed to ensure conservative assessment.

3.10 Uncertainties in Maintenance Dredging Assessment

3.10.1.1 Uncertainties in the assessment of the impacts from suspended sediment plumes will be considered when drawing conclusions from the assessment. In carrying out the assessment, the worst case assumptions have been made in order to provide a conservative assessment of environmental impacts. These assumptions are as follows:

- The calculations of loss rates of sediment to suspension are based on conservative estimates for the types of plant and methods of working; and
- While it is possible to simulate the dredging at various part of the dredging area as moving sources, such approach may not be able to capture the worst case scenario in term of tide conditions. By simulating the dredging as a stationary source close to the nearest WSR for 2 continuous 15-day spring-neap cycles, the worst case scenario in terms of tide condition as well as background build-up would be captured.

3.10.1.2 The following uncertainties have not been included in the maintenance dredging modelling assessment:

- *Ad hoc* navigation of marine traffic;
- Propeller scour of seabed sediments from vessels;
- Near shore scouring of bottom sediment; and
- Access of marine barges back and from the site.

4 WATER SENSITIVE RECEIVERS

4.1.1.1 Water Sensitive Receivers (WSRs) in the vicinity of the Project site are identified as below, including coral communities, gazetted and non-gazetted bathing beaches, seawater intakes, fish spawning grounds, dolphin habitats, corals / artificial reef, sites of special scientific interest (SSSIs), horseshoe crab habitats, mangrove stands and existing / planned / potential marine park. For consistencies, all WSRs within the NWWCZ identified in the 3RS EIA are taken into account for this Study. In addition, a number of artificial reefs locations north to the embayment area are also identified as WSRs for this Study. These WSRs are listed in ***Table 2*** and shown in **Figure *2***.

Table 2 Water Sensitive Receivers

Description	Location	Model Output Location	Geodesic Distance from Berth Area (km)	Geodesic Distance from Bridge Area (km)
Fisheries Sensitive Receivers				
Fishing/Spawning Grounds	Fishing/Spawning Grounds in North Lantau	F1	6.0	7.6
Marine Ecological Sensitive Receivers				
Marine Park	Sha Chau and Lung Kwu Chau Marine Park	E1	7.9	9.2
Marine Park	The Brothers Marine Park	E2	3.9	6.4
SSSI	Tai Ho Bay, Near Tai Ho Stream SSSI	E4	3.8	4.2
SSSI	San Tau Beach SSSI	E5	3.6	1.2
Horseshoe Crab Habitat	Hau Hok Wan	E6	4.1	2.7
Horseshoe Crab Habitat	Sha Lo Wan	E7	5.0	3.7
Horseshoe Crab Habitat, Mangrove Stand	Sham Wat Wan	E8	7.5	5.7
Horseshoe Crab Habitat, Mangrove Stand	Yam O Wan	E9	7.7	9.3

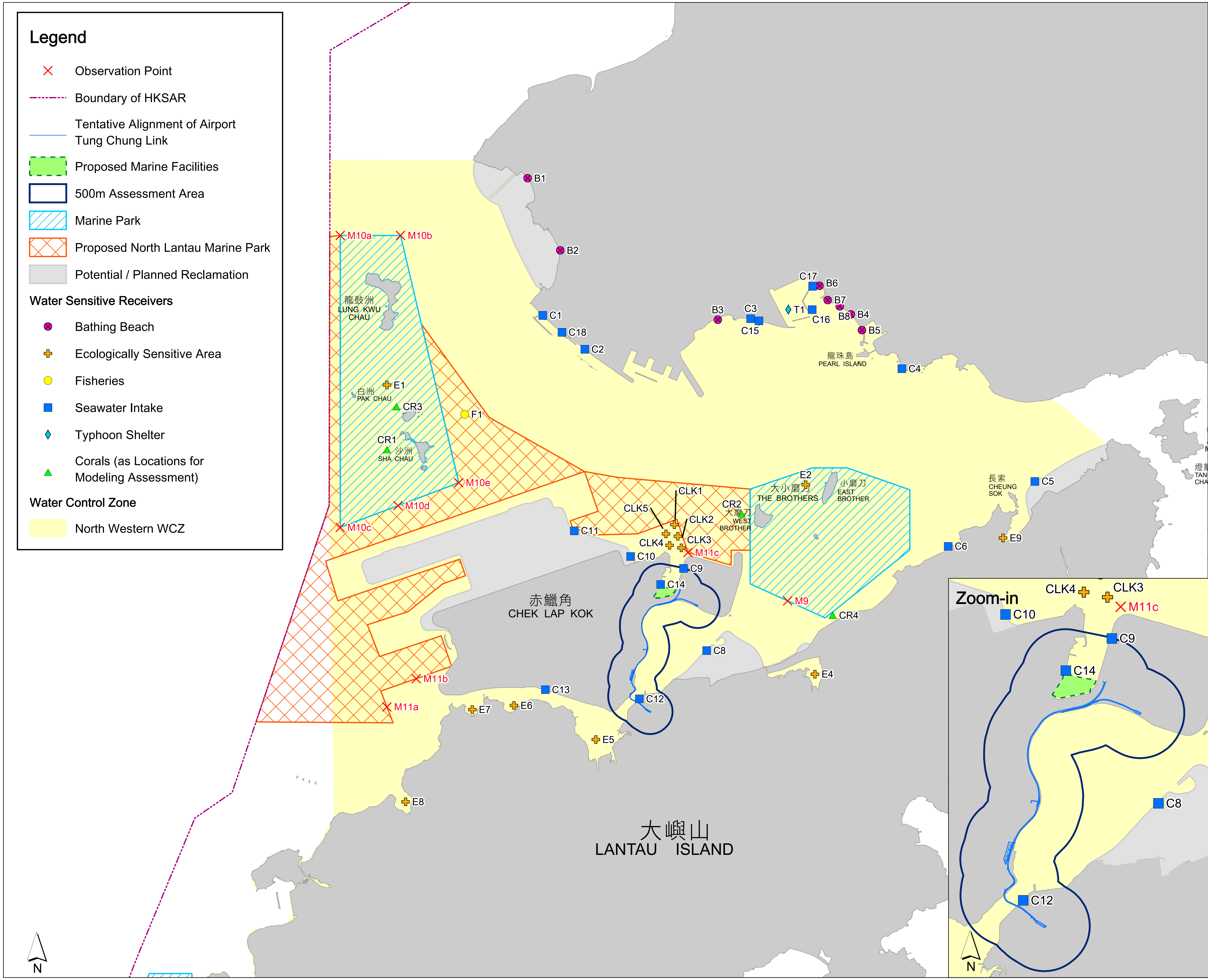
Description	Location	Model Output Location	Geodesic Distance from Berth Area (km)	Geodesic Distance from Bridge Area (km)
Artificial Reef and coral communities	Sha Chau and Lung Kwu Chau Marine Park	CR1	7.1	8.0
Coral communities	The Brothers Islands (West Brother)	CR2	2.3	5.0
Coral communities	North of Sheung Sha Chau	CR3	7.4	8.6
Coral communities	Sham Shui Kok	CR4	3.7	5.0
Artificial Reef	HKIA Approach Area	CLK1	1.5	4.1
Artificial Reef	HKIA Approach Area	CLK2	1.2	3.9
Artificial Reef	HKIA Approach Area	CLK3	1.0	3.6
Artificial Reef	HKIA Approach Area	CLK4	1.0	3.6
Artificial Reef	HKIA Approach Area	CLK5	1.2	3.9
Water Quality Sensitive Receivers				
Non-gazetted beach	Lung Kwu Sheung Tan	B1	9.9	12.3
Non-gazetted beach	Lung Tsai / Lung Kwu Tan	B2	8.1	10.5
Gazetted Beach	Butterfly Beach	B3	6.4	9.1
Gazetted Beach	Cafeteria New Beach	B4	7.5	10.2
Gazetted Beach	Gold Coast Marina / Golden Beach	B5	7.4	10.1
Gazetted Beach	Castle Peak Beach	B6	7.8	10.5
Gazetted Beach	Kadoorie Beach	B7	7.6	10.3
Gazetted Beach	Cafeteria Old Beach	B8	7.6	10.3
Seawater Intake	Castle Peak Power Station Cooling Water Intake	C1	6.8	9.1
Seawater Intake	Cooling Water Intake for Shiu Wing Steel Mills	C2	5.8	8.1

Description	Location	Model Output Location	Geodesic Distance from Berth Area (km)	Geodesic Distance from Bridge Area (km)
Seawater Intake	WSD Seawater Intake at Tuen Mun	C3	6.5	9.2
Seawater Intake	Proposed Lok On Pai Intake (Pumping Station)	C4	7.3	9.9
Seawater Intake	Future seawater intake point for Sunny Bay	C5	8.7	10.6
Seawater Intake	Proposed Ta Pang Po Intake (Pumping Station)	C6	6.4	8.1
Seawater Intake	Future seawater intake point for Tung Chung East	C8	1.5	2.0
Seawater Intake	HKP Intake	C9	0.5	3.2
Seawater Intake	Cooling water intake at HKIA North	C10	1.0	3.2
Seawater Intake	Future Seawater Intake at HKIA East	C11	2.4	4.1
Seawater Intake	Seawater intake at Tung Chung	C12	2.4	0.1
Seawater Intake	Cooling water intake at HKIA South	C13	3.3	2.0
Seawater Intake	ATCL Planned Seawater Intake	C14	0.0	2.7
Seawater Intake	LRT Tuen Mun Ferry Pier Terminus	C15	6.5	9.2
Seawater Intake	Tuen Mun Hospital	C16	7.2	9.9
Seawater Intake	Sam Shing Estate	C17	7.7	10.4
Seawater Intake	China Cement Plant	C18	6.3	8.6
Typhoon Shelter	Tuen Mun	T1	7.0	9.7
Observation Points				

Description	Location	Model Output Location	Geodesic Distance from Berth Area (km)	Geodesic Distance from Bridge Area (km)
Boundary of Marine Park	The Brothers Marine Park	M9	2.6	4.2
Boundary of Marine Park	Sha Chau and Lung Kwu Chau Marine Park	M10a	11.0	12.6
Boundary of Marine Park	Sha Chau and Lung Kwu Chau Marine Park	M10b	10.1	12.0
Boundary of Marine Park	Sha Chau and Lung Kwu Chau Marine Park	M10c	7.5	7.8
Boundary of Marine Park	Sha Chau and Lung Kwu Chau Marine Park	M10d	6.3	7.0
Boundary of Marine Park	Sha Chau and Lung Kwu Chau Marine Park	M10e	5.3	6.4
Boundary of Marine Park	Proposed North Lantau Marine Park	M11a	6.7	5.7
Boundary of Marine Park	Proposed North Lantau Marine Park	M11b	5.7	5.0
Boundary of Marine Park	Proposed North Lantau Marine Park	M11c	0.9	3.6

Note: Sham Shui Kok was included as a dolphin habitat WSRs due to high Chinese White Dolphin activities in the past. According to more recent Marine Mammal Monitoring Reports by AFCD (Available at: https://www.afcd.gov.hk/english/conservation/con_mar/con_mar_chi/con_mar_chi_chi/con_mar_chi_chi.html), Sham Shui Kok is no longer a hotspot for CWD activities since 2012. Thus Sham Shui Kok is not included as WSR under this Study.

4.1.1.2 Note that there are some other WSRs, such as secondary contact recreation subzones cover large swath of marine waters in HK. No separate observation points would be set for these WSRs. Instead, these WSRs are represented by observation points of other WSRs within their area.



Rev	Date	Descriptions	Check

香港國際機場 HONG KONG INTERNATIONAL AIRPORT

HONG KONG INTERNATIONAL AIRPORT

Consultant

MEINHARDT

in association with

OTC ERM

Consultant's Signatures for Approval	Date
Design Supervisor	
Checkers	
Authorized Representative	

Title
Water Sensitive Receivers

Drawing No.
Figure 2

Date:2/8/2022

Status	Scale	Rev
	1:80,000 @A3	

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5 ASSESSMENT CRITERIA

5.1.1.1 Water Quality Objectives (WQOs) in WCZs of the Study Area will be used to assess water quality impacts in SS, DO, TIN and UIA released in the process of dredging (**Table 3**).

Table 3 Summary of Assessment WQO Criteria for Maintenance Dredging

Parameters	North Western WCZ
Dissolved Oxygen (Bottom) (mg/L)	Not less than 2 mg/L for 90% of samples for all WCZs
Dissolved Oxygen (Depth-averaged) (mg/L)	Not less than 4 mg/L for 90% of samples for all WCZs
Total Inorganic Nitrogen (mg/L)	Annual average not exceed < 0.3 mg/L at Castle Peak Bay Subzone Annual average not exceed < 0.5 mg/L remaining marine water
Unionized Ammonia (mg/L)	< 0.021 mg/L for all WCZs
Suspended Solids (mg/L)	Not to raise the natural ambient level by 30%

5.1.1.2 Criterion for maximum sedimentation of 200 g m^{-2} day^{-1} is adopted at the artificial reef deployment area and coral assemblages [14].

5.1.1.3 For the existing seawater intakes for BPPS and Castle Peak Power Station (CPPS), the criterion for maximum allowable elevation of suspended solids is 700 mg/L. These levels have been adopted in the approved EIA of the Black Point Gas Supply Project [15] and also the more recent Additional Gas-fired Generation Units Project [16]. There are no known water quality criteria for other remaining non-WSD seawater intakes. The above WQO criteria for SS would be adopted for water quality assessment for these two seawater intakes.

5.1.1.4 There are no existing regulatory standards or guidelines for dissolved metals and organic contaminants in the marine waters of Hong Kong. It is thus proposed to make reference to relevant international standards and this approach has been adopted in recently approved EIA of the New Contaminated Sediment Disposal Facility to the West of Lamma Island (AEIAR-241/2022. Table 4 shows the assessment criteria for dissolved metals and organic pollutants for this Study.

Table 4 Summary of Assessment Criteria for Dissolved Metals and Organic Compounds for Maintenance Dredging

Contaminant	UCEL (mg/kg)	Assessment Criteria (μg/L)

(14) The recommended assessment criteria were adopted in both approved EIAs in the Western Waters (e.g. Hong Kong Boundary Crossing Facilities) and in the Southern Waters (e.g. Integrated Waste Management Facilities).

(15) ERM – Hong Kong (2009). EIA for Black Point Gas Supply Project. For CAPCO. Register No.: AEIAR-150/2010

(16) ERM – Hong Kong (2016). EIA for Additional Gas-fired Generation Units Project. For CAPCO. . Register No.: AEIAR-197/2016

Arsenic	42	13 [1]
Cadmium	4	5.5 [1]
Chromium	160	4.4 [1]
Copper	110	1.3 [1]
Lead	110	4.4 [1]
Mercury	1	0.4 [1]
Nickel	40	70 [1]
Silver	2	1.4 [1]
Zinc	270	8 [1]
Total PCBs	0.18	0.03 [2]
LMW PAH	3.16	0.2 [2]
HMW PAH	9.6	
TBT (in interstitial water)	0.15 mg/L	0.006 [2]

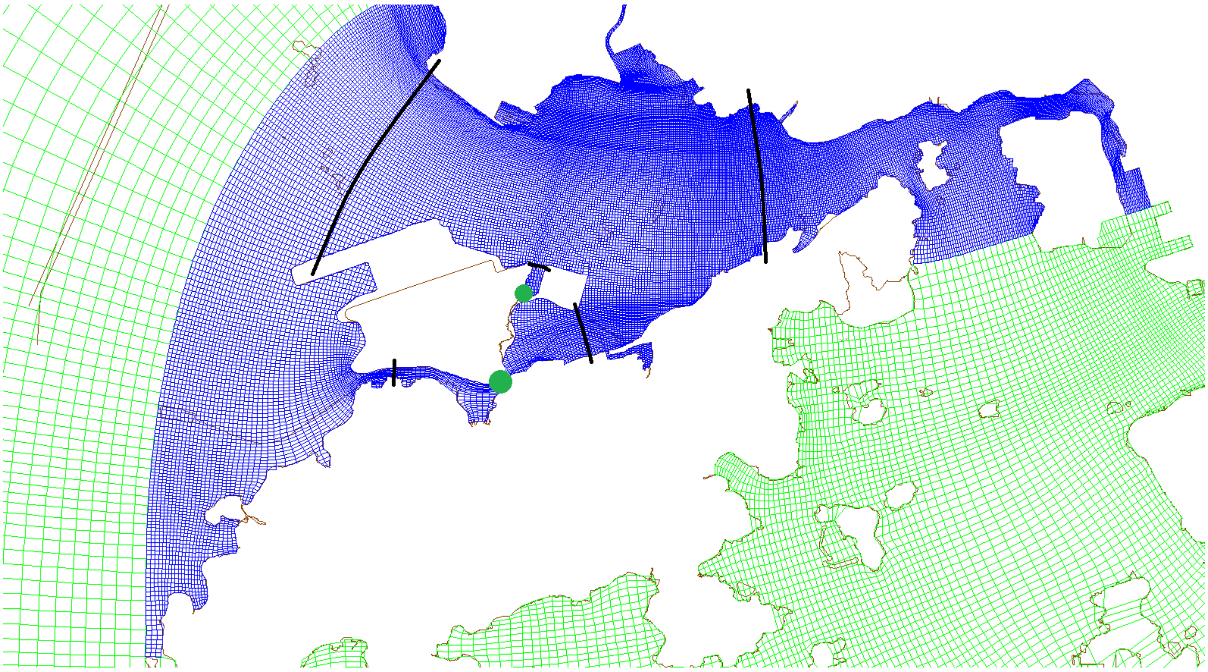
Notes:

(1) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Default guideline value for protection for 95% Species in Marine water. Available at: https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/water-quality-toxicants/search
For chromium, the more stringent standard for Cr(VI) is adopted. For arsenic, there is no standard for marine water, standard for freshwater for As(V) was thus adopted which is more conservative than that for As(III).

(2) U.S. Environmental Protection Agency, National Recommended Water Quality Criteria, 2009. (https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table). The Criteria Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water (ie saltwater) to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. CCC is used as the criterion of the respective compounds in this study.

5.1.1.5 Indicative locations of cross sections for assessing the change in tidal current are shown in **Exhibit 6**.

Exhibit 6 Indicative Locations for Cross-section Output for Flow Regime Assessment shown in Black Line, Green Dots indicates Project Element that could Affect Flow Regime



6 CONCURRENT PROJECTS

6.1 General

6.1.1.1 There are a few concurrent projects that could have significant effect on flow regime and sediment elevation within the North Western WCZ which should be considered in this Study. They are listed and further discussed below.

6.2 Expansion of Hong Kong International Airport into a Three-Runway System

6.2.1.1 As discussed in previous section, the majority of reclamation works for HKIA 3RS has been completed by mid-2021. For this modelling Study, the completed reclamation would be taken into account in all scenarios to account for its effect on flow regime. Other discharges from the Hong Kong International Airport (including those from the 3RS operation) would be taken into account. Also seawater intakes for the expanded HKIA has been included as WSRs.

6.3 Tung Chung New Town Extension and Road P1

6.3.1.1 The latest construction work schedule of the Tung Chung New Tung Extension (TCNTE) project (dated Jan 2021; available online at https://env.tcnte.hk/ep-submissions/202101%20CWSLP/Construction%20Works%20Schedule%20and%20Location%20Plans_Jan%202021_final.html) indicated the last stage of reclamation (stage 4, including reclamation for Road P1) would be completed by mid-2022. Given the existing progress of the TCNTE and Road P1 as discussed in previous section, it is suitable to consider the reclamation under these two projects be completed for the operation phase assessment under this Study for cumulative assessment. Also seawater intakes for the TCNTE project has been included as WSRs.

6.4 Tung Chung Line Extension

6.4.1.1 According to the project profile of the captioned project (ESB-329/2020), the proposed Tung Chung Line (TCL) Extension is an extension of the existing Tung Chung Line westward by 1.3 km from its existing terminus, Tung Chung (TUC) Station, to a new station in Tung Chung West with an intermediate station, Tung Chung East Station, by diverting the existing TCL near the Tung Chung New Town Extension (East) (TCNTE (East)) reclamation.

6.4.1.2 No marine work, including reclamation is proposed for this project. There is also no proposed discharge of cooling water or other major effluent for this project. No notable cumulative impact from this project is anticipated.

6.5 SkyPier Terminal (SPT) Bonded Bridge (formerly known as Intermodal Transfer Terminal - Bonded Vehicular Bridge and Associated Roads)

6.5.1.1 This project involves the installation of a vehicular bridge connecting the Airport Island and the HKP Island, which requires the installation of a few bridge piles in the embayed water in between. This project has been completed by 2022 and thus will not have concurrent marine construction works. Request has been made to the project proponent to obtain the footprint of the piles and the effect of the presence of the bridge piles would be taken into account in the operation phase hydrodynamic modelling for cumulative assessment.

6.6 Airportcity Link (formerly known as Airport City Link)

6.6.1.1 The Project involves another bridge that runs parallel to the SPT Bonded Bridge discussed in the previous section to connect the SKYCITY and the HKP Island. Bridge piles will be installed and would align with that of the SPT Bonded Bridge. The Project is expected to be completed by 2024. Request has been made to the project proponent to obtain the footprint of the piles. The effect of the presence of the bridge piles would be taken into account in the operation phase hydrodynamic modelling for cumulative assessment. Also, it is not expected that maintenance dredging for ATCL would be required as early as 2024, therefore, cumulative impact for maintenance dredging is not anticipated.

6.7 SKYCITY

6.7.1.1 Hong Kong SKYCITY is a business and entertainment complex adjacent to HKIA. Project include the AsiaWorld-Expo, the SkyPier, the Hong Kong Skycity Marriott Hotel, as well as some other facilities under development.

6.7.1.2 Project construction of the remaining elements is entirely land-based. No cumulative water quality impact from this project is anticipated.

6.8 East Coast Support Area

6.8.1.1 The East Coast Supporting Area is the proposed development at the east coast of the Airport Island. The development including mainly office buildings and hotels. Project construction is expected to be 2025 to 2035 and would be entirely land-based. No cumulative water quality impact from this project is anticipated.

6.9 Potential Reclamation Site at Lung Kwu Tan

6.9.1.1 The proposed reclamation at Lung Kwu Tan (and the associated replanning of Tuen

Mun West Area) is currently being studies by CEDD. LegCo Paper [(23)] dated early 2020 indicated the reclamation would be about 220 ha. Given its significant size, its presence would be taken into account in the operation phase modelling assessment for change in flow regime. The reclamation footprint from the 2020 LegCo Paper would be adopted. On the other hand, given its vast distance from the Project (>7 km), it is anticipated that there will be limited level of cumulative SS elevation from the construction of the Lung Kwu Tan Reclamation Project. Therefore, sediment loss from the construction of the Lung Kwu Tan Reclamation Project would not be taken into account in the sediment dispersion modelling assessment for maintenance dredging.

6.10 Potential Reclamation Site at Sunny Bay

6.10.1.1 According to the *Reclamation Outside Victoria Harbour and Rock Cavern Development - Strategic Environmental Assessment Report - Reclamation Sites Executive Summary* [(24)], the proposed Sunny Bay Reclamation could cover an area of around 82.70 hectares (based on reclamation outline shown in Figure 9 of the above report). Given its significant size, its presence would be taken into account in the operation phase modelling assessment for change in flow regime. The reclamation footprint from *Reclamation Outside Victoria Harbour and Rock Cavern Development - Strategic Environmental Assessment Report - Reclamation Sites Executive Summary* would be adopted. On the other hand, given its vast distance from the Project (>8 km), it is anticipated that there will be limited level of cumulative SS elevation from the construction of the Sunny Bay Reclamation Project. Therefore, sediment loss from the construction of the Sunny Bay Reclamation Project would not be taken into account in the sediment dispersion modelling assessment for maintenance dredging.

6.11 Contaminated Mud Disposal Facilities at East of Sha Chau South Brothers

6.11.1.1 According to CEDD's recent EIA project profile for the New Contaminated Sediment Disposal Facility to the West of Lamma Island (ESB-328/2019), the capacity of the existing contaminated mud pits (CMPs) at east of Sha Chau and south of the Brothers would be exhausted by 2027. This means it is unlikely that there will be significant overlapping for the sediment disposal and capping (capping typically completed after exhaustion of capacity of each pit) under at the CMP and the maintenance dredging under this Study. Therefore, sediment loss from the operation of the CMP would not be taken into account in the sediment dispersion modelling assessment for maintenance dredging. For hydrodynamic modelling for the change in flow regime, the final capped level the East of Sha Chau and South Brothers CMP would

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(23) https://www.legco.gov.hk/yr19-20/english/panels/dev/papers/dev20200120cb1-328-3-e.pdf

(24) Reclamation Outside Victoria Harbour and Rock Cavern Development - Strategic Environmental Assessment Report - Reclamation Sites Executive Summary, CEDD 2013. Available at: https://www.cedd.gov.hk/filemanager/eng/content_961/4/Executive_Summary_on_Final_Report_for_Reclamation.pdf

be taken into account.

7 SUMMARY OF MODELLING SCENARIOS

7.1.1 A summary of modelling scenarios to be conducted is provided **Table 5** below.

Table 5 Modelling Scenarios to be conducted under this Study

Scenario ID	Description	Key Modelled Setting
V1	Model validation run – Original ref-WHM from 3RS EIA	2021 coastline, including completed 3RS, TCNTE and Road P1 reclamation
V2	Model validation run – Update ref-WHM for this Study	2021 coastline, including completed 3RS, TCNTE and Road P1 reclamation
O1	Operation phase baseline scenario – Update ref-WHM for this Study	Same as V2 with additional reclamation at Sunny Bay and Lung Kwun Tan Effect of bridge piles of ITT
O2	Operation phase project scenario – Update ref-WHM for this Study	Same as O1 with effect of bridge piles at the Airport Channel, as well as effect of piled structures at the proposed berth area.
M1	Maintenance Dredging Scenario	Maintenance dredging at rate of 600 m^3 hr^{-1} (or other rate specified) based on hydrodynamic of O2.

Appendix A Model Validation

Figure 1 Locations of Observation Points for Validation

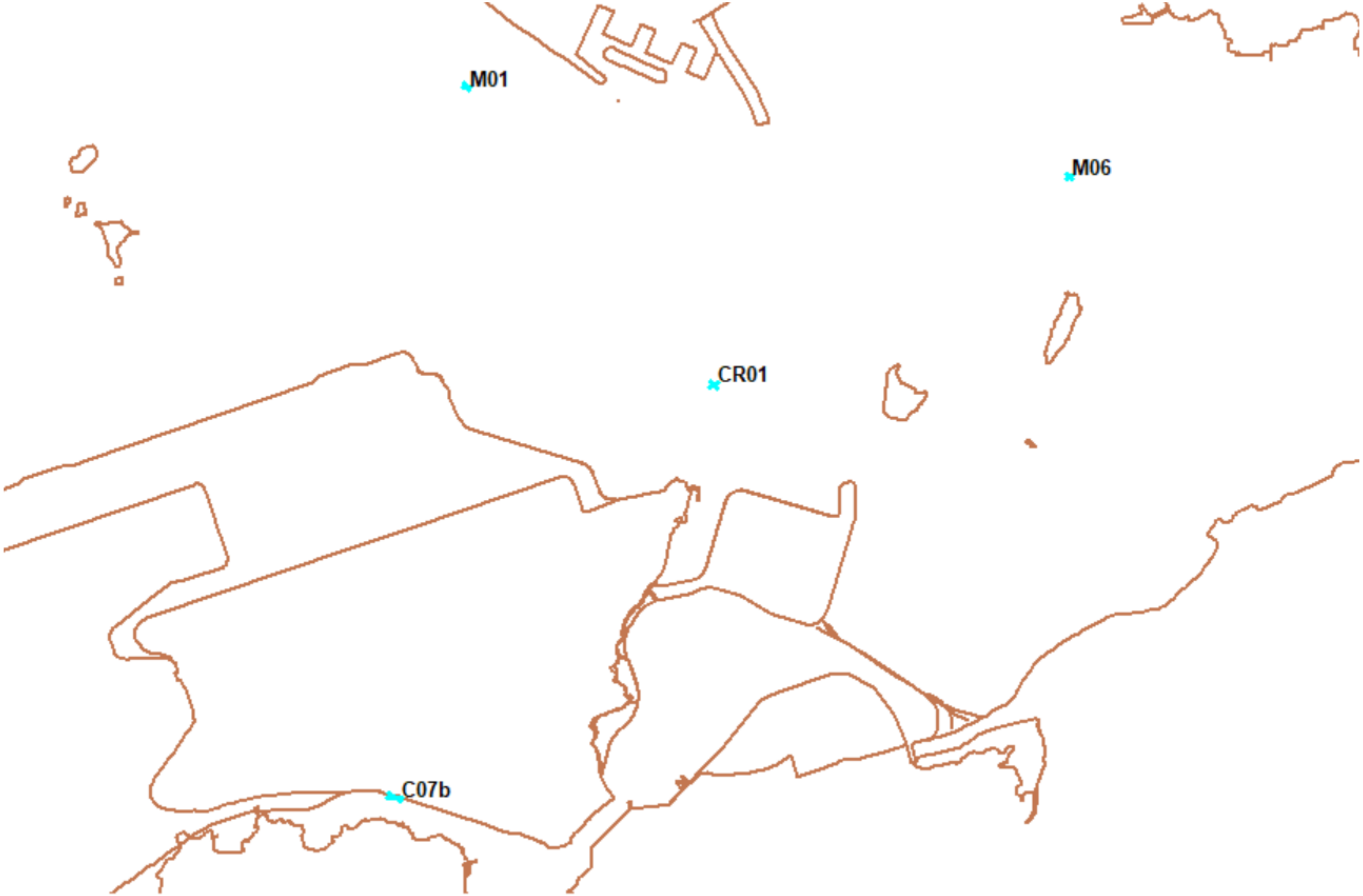
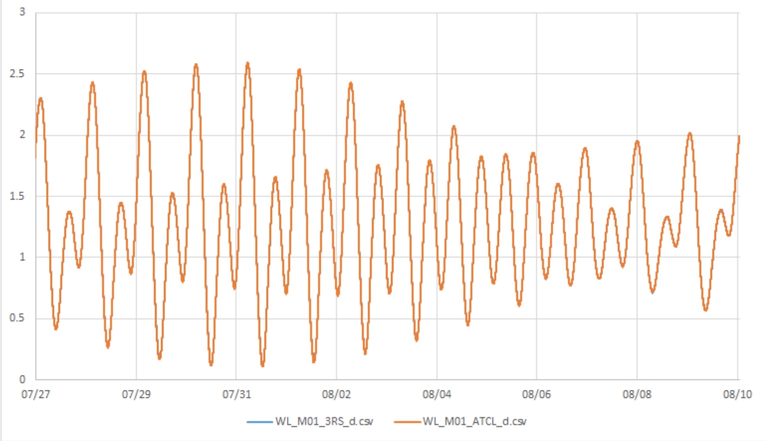
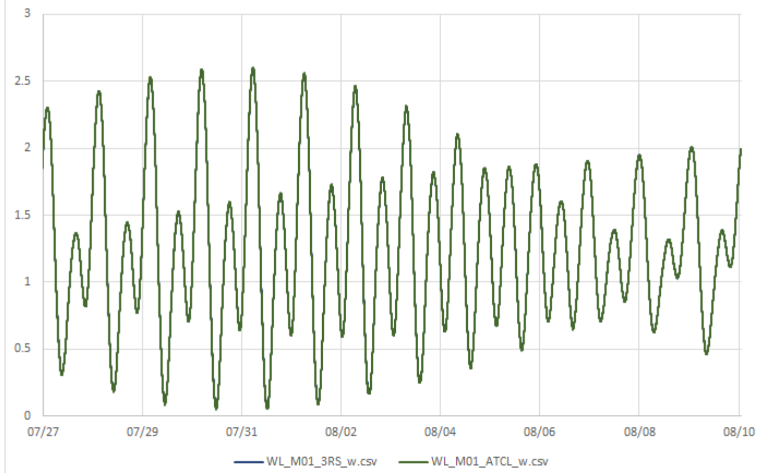
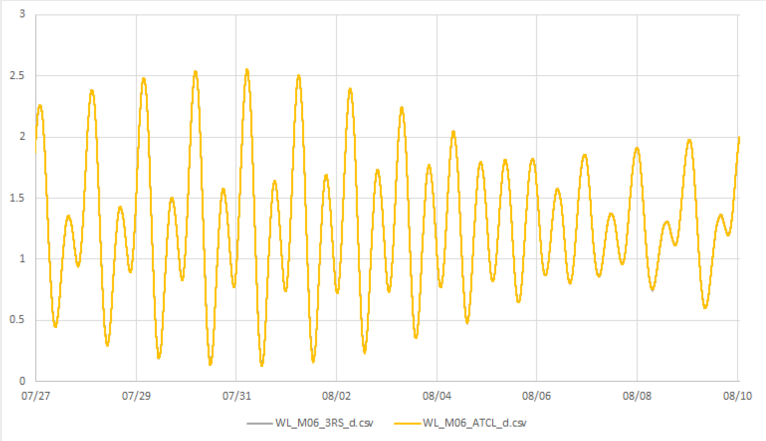
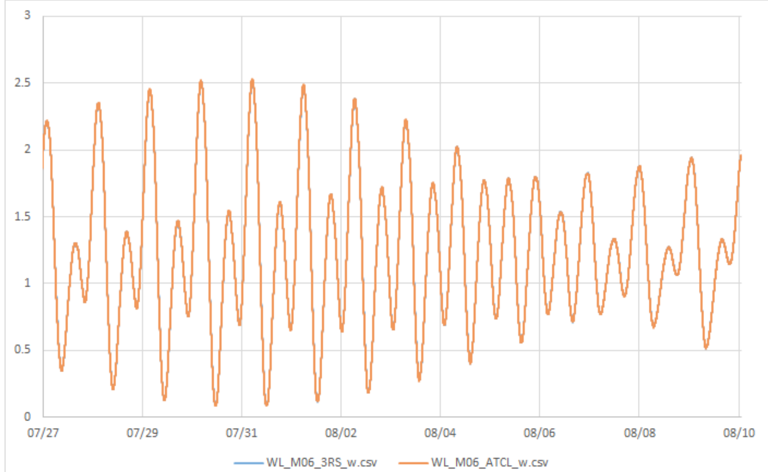
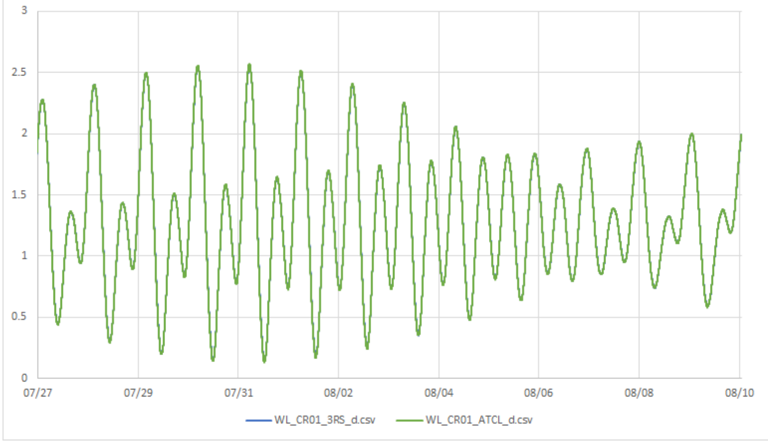
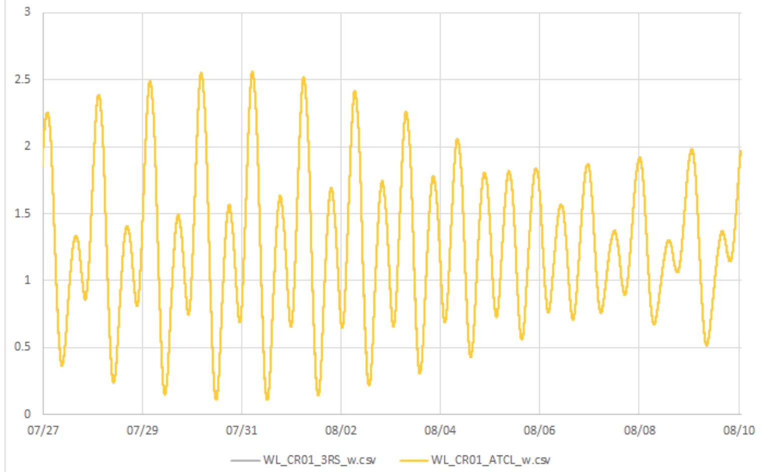
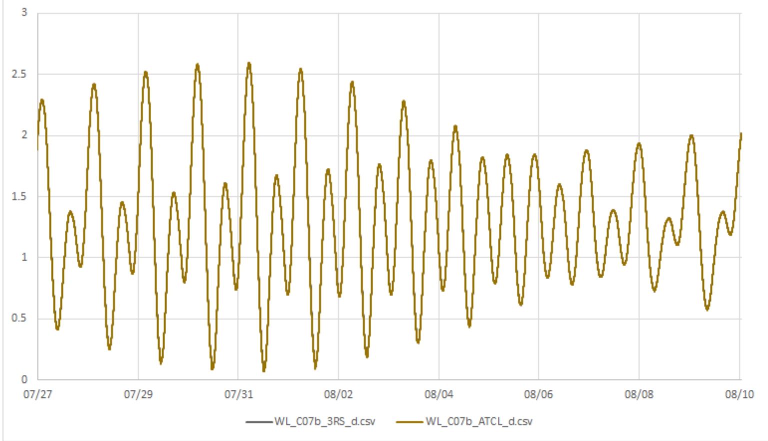
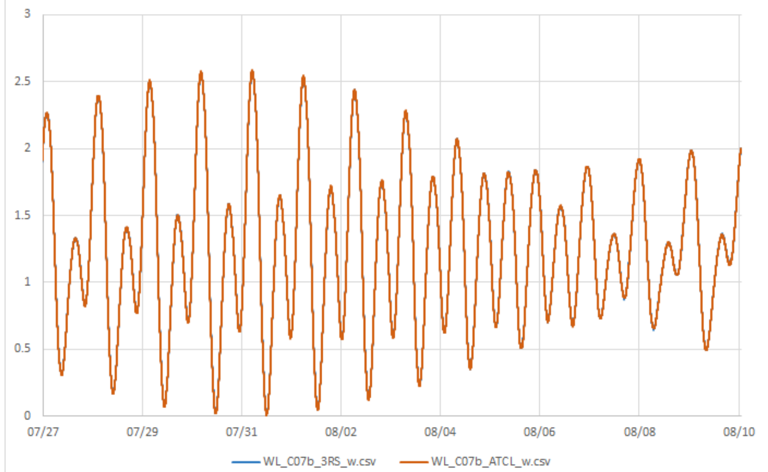
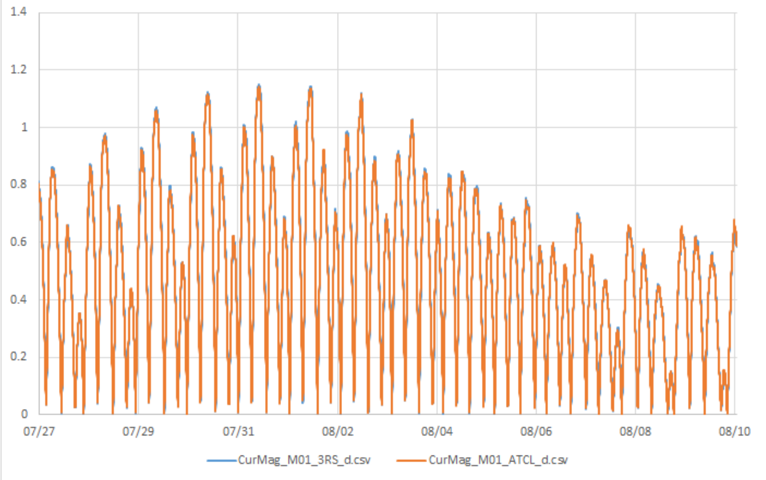
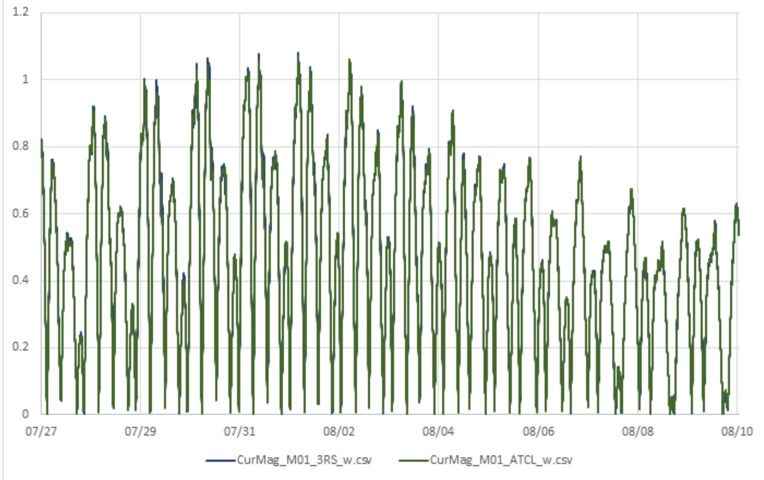
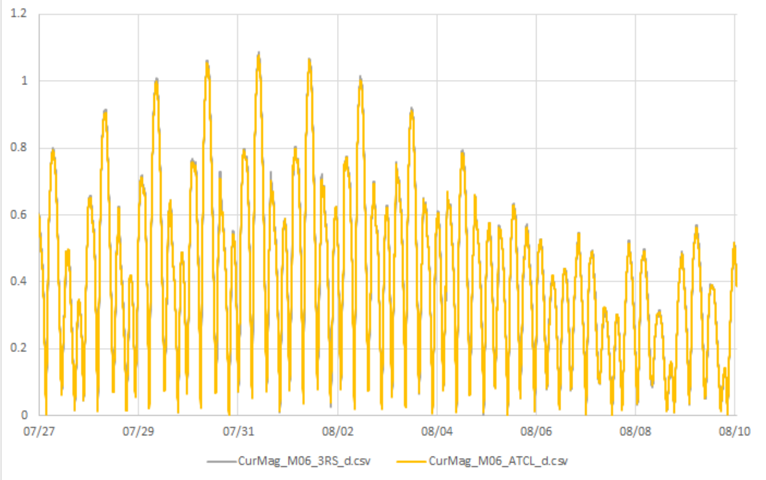
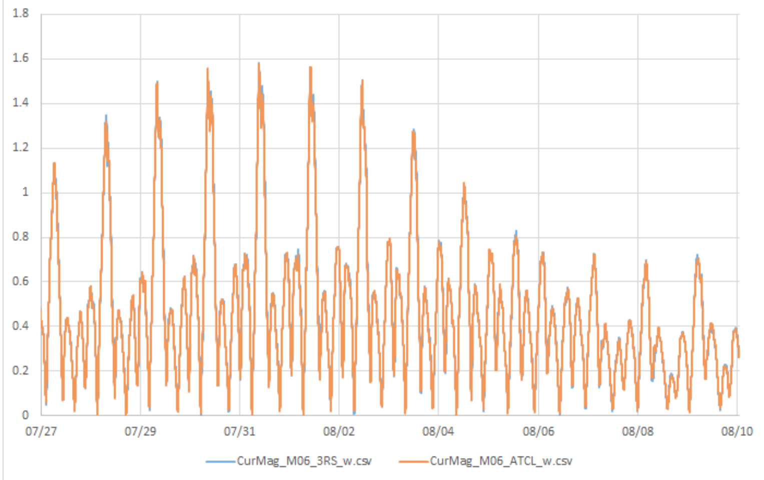
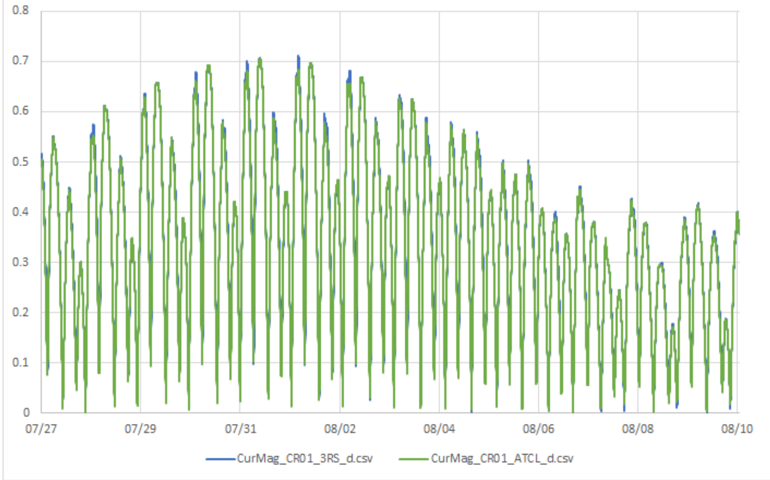
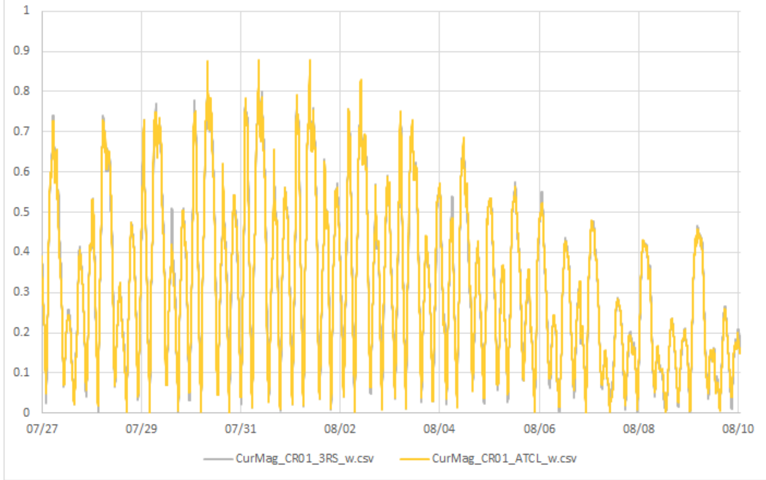
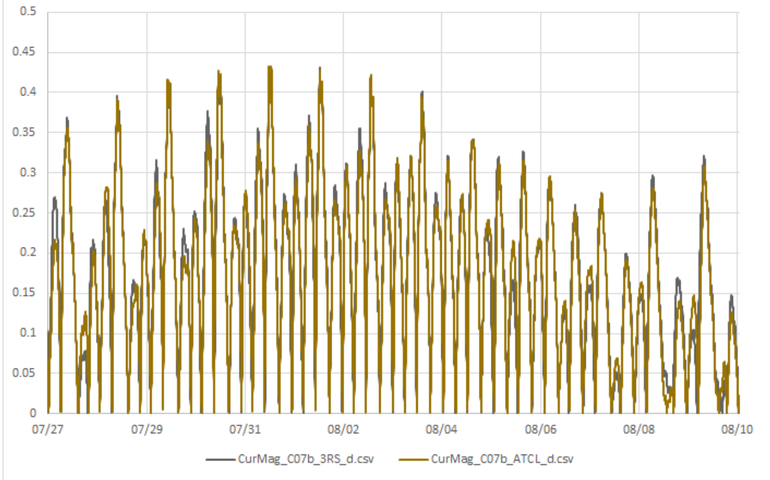
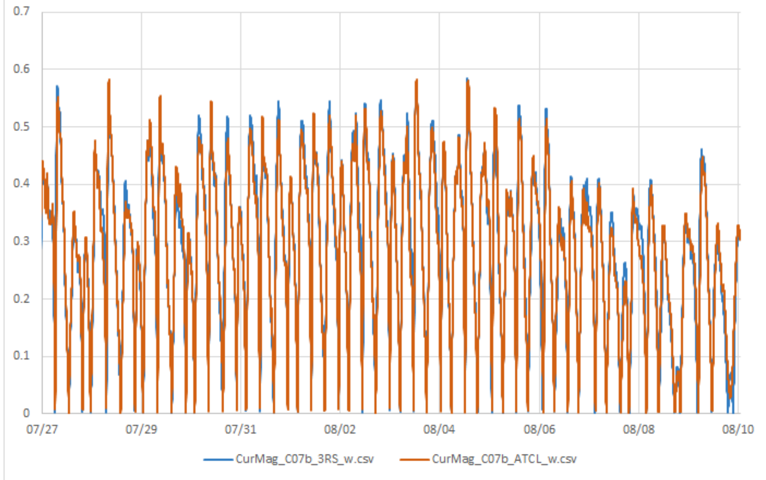


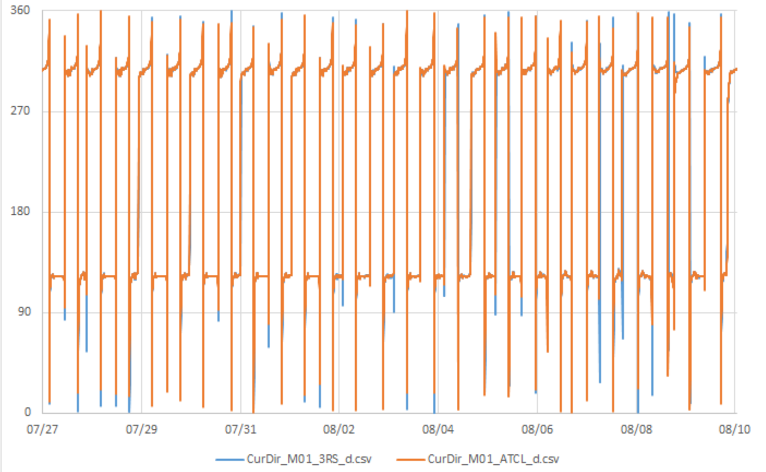
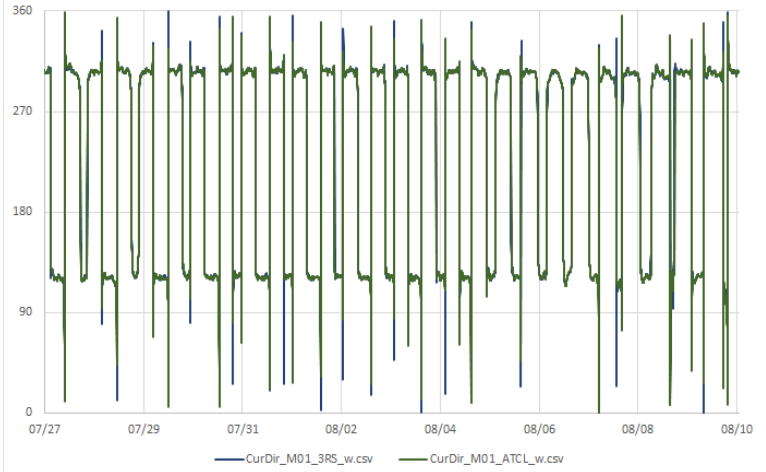
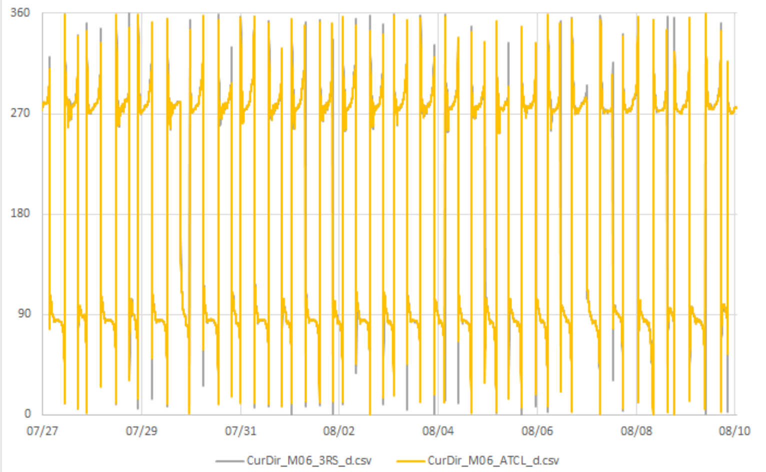
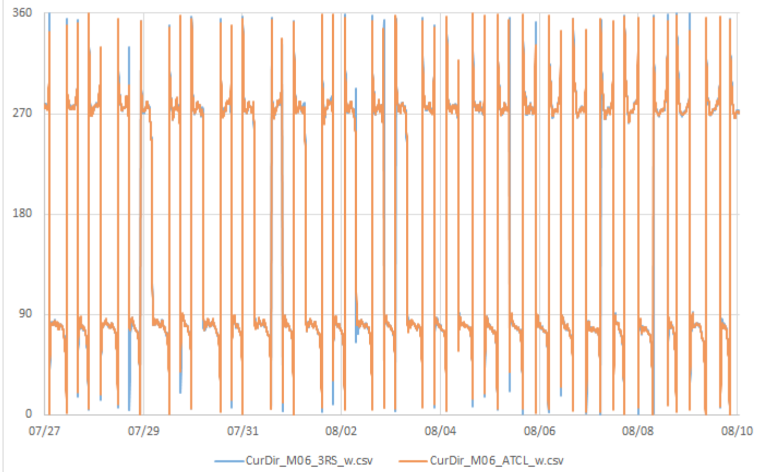
Table 1 Comparison of Select Hydrodynamic Parameters at Selected Locations for Model Validations (WHMr under 3RS EIA vs that under this Study)

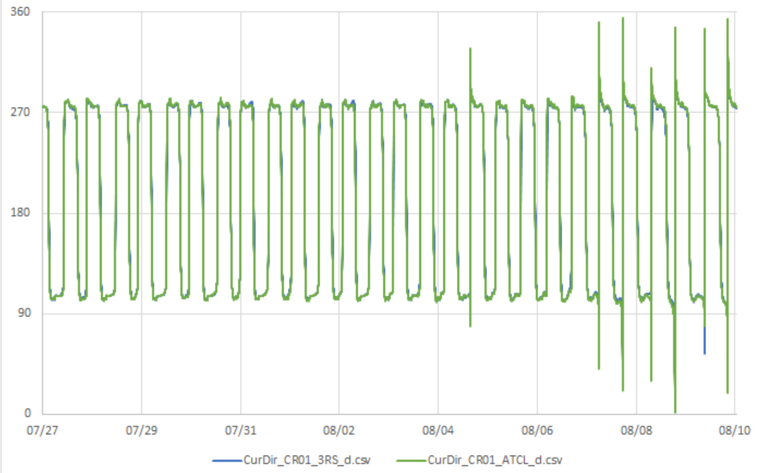
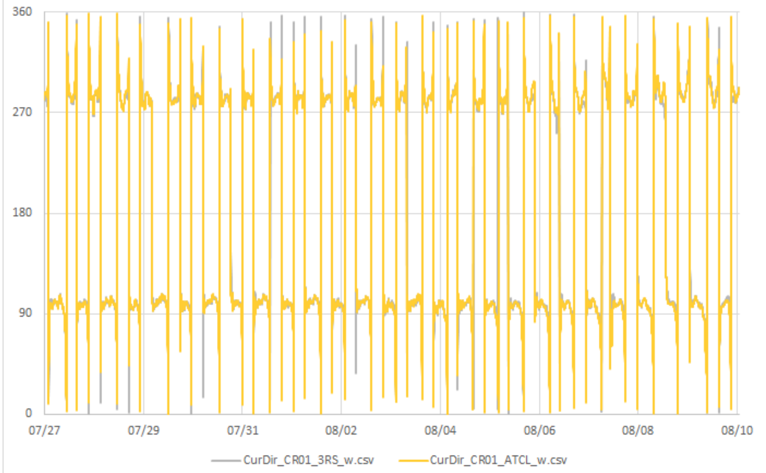
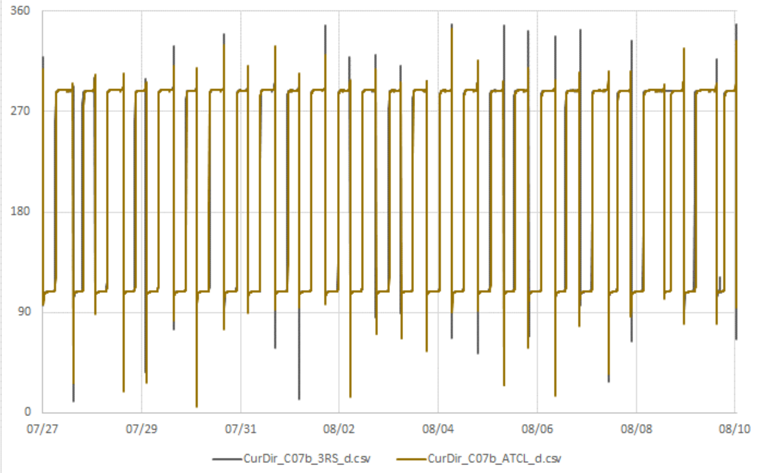
Parameters	Locations	Dry Season	Wet Season
Water Level (m)	M01 <u>RMSE%:</u> 0.25% (dry) 0.22% (wet) <u>Max. Phase Error:</u> 9 min (dry) 15 min (wet)		
	M06 <u>RMSE%:</u> 0.19% (dry) 0.16% (wet) <u>Max. Phase Error:</u> 12 min (dry) 15 min (wet)		

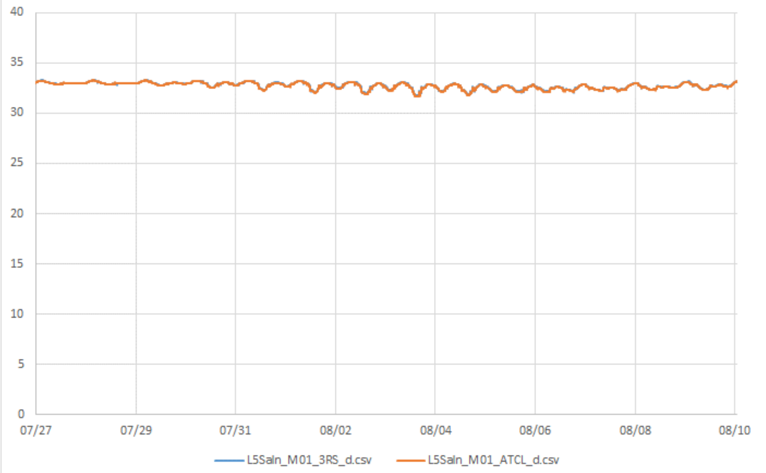
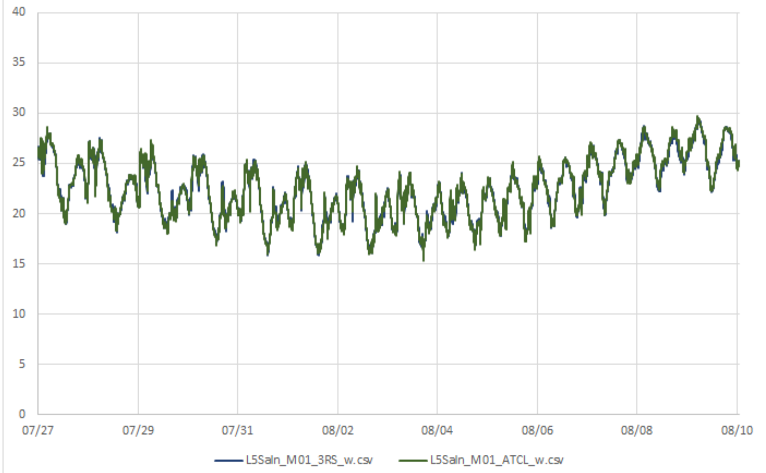
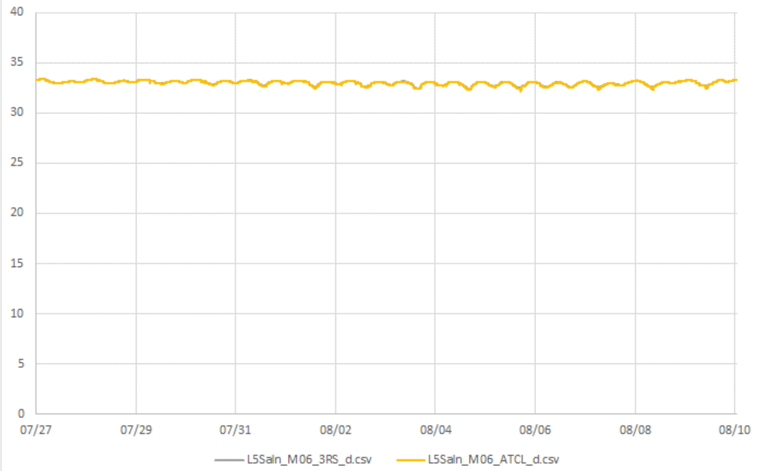
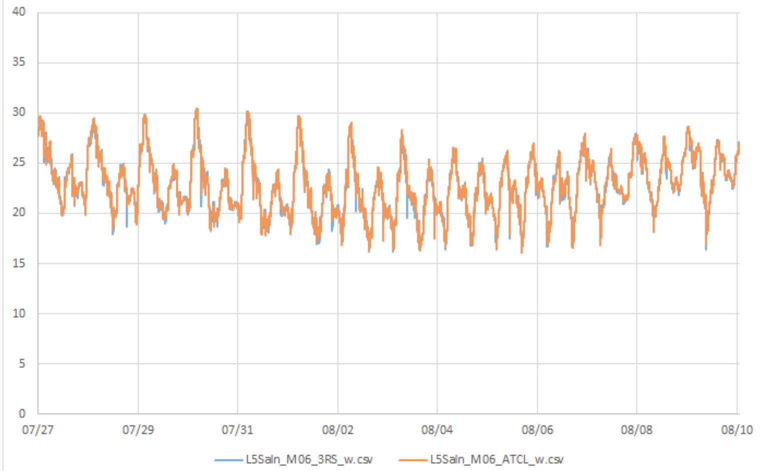
Parameters	Locations	Dry Season	Wet Season
	CR01 <u>RMSE%:</u> 0.23% (dry) 0.19% (wet) <u>Max. Phase Error:</u> 9 min (dry) 9 min (wet)		
	C07b <u>RMSE%:</u> 0.25% (dry) 0.21% (wet) <u>Max. Phase Error:</u> 18 min (dry) 15 min (wet)		

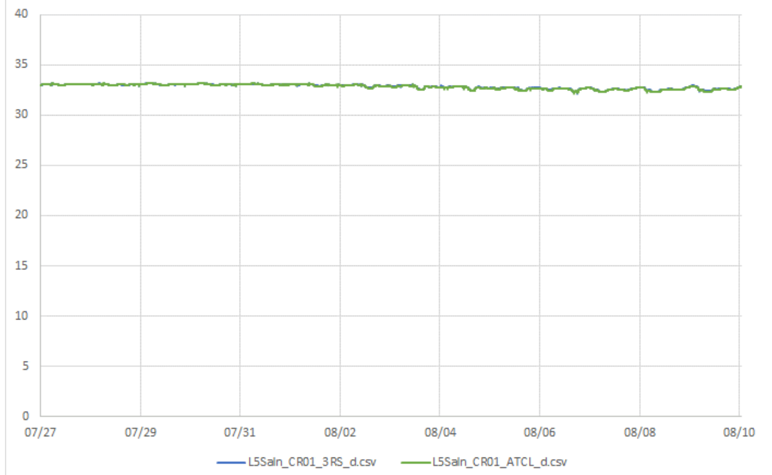
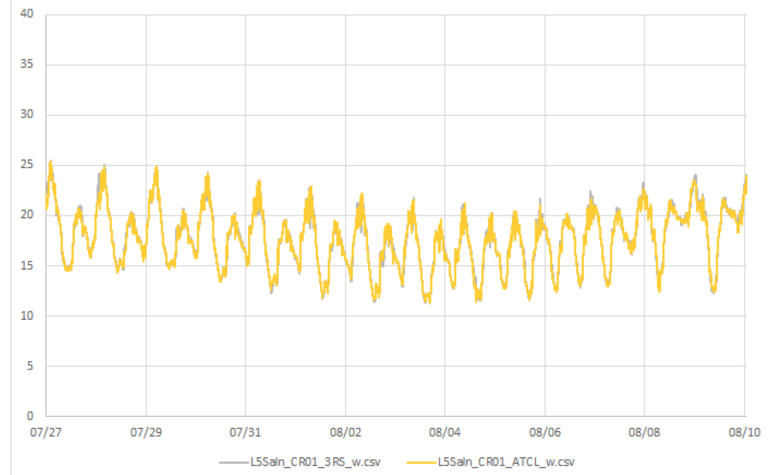
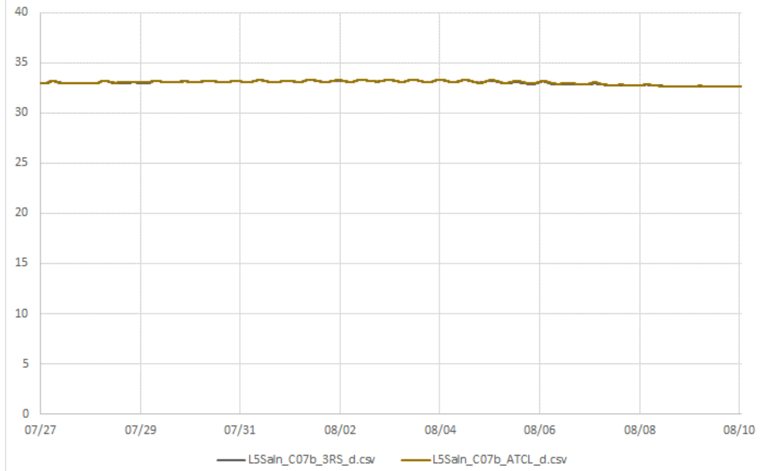
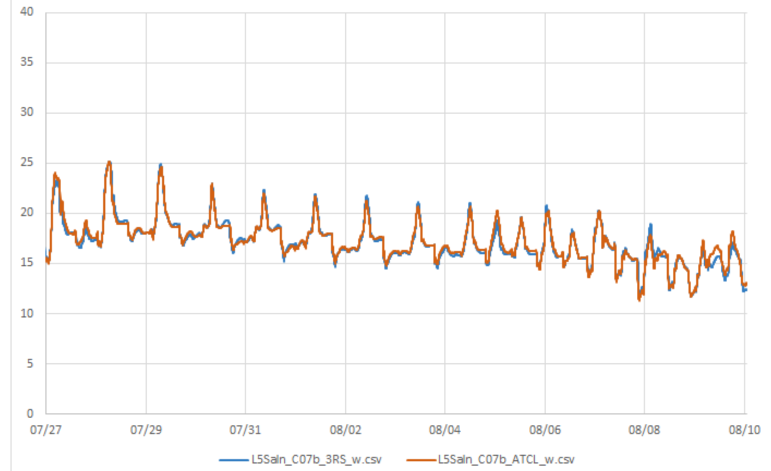
Parameters	Locations	Dry Season	Wet Season
Depth-Averaged Current Magnitude (m/s)	M01 Max. Cur. Speed Deviation: 2.3% (dry) 1.3% (wet) Max. Phase Error: 12 min (dry) 27 min (wet)		
	M06 Max. Cur. Speed Deviation: 2.2% (dry) 2.2% (wet) Max. Phase Error: 6 min (dry) 27 min (wet)*		

Parameters	Locations	Dry Season	Wet Season
	CR01 Max. Cur. Speed Deviation: 3.0% (dry) 8.9% (wet) Max. Phase Error: 24 min (dry) 24 min (wet)*		
	C07b Max. Cur. Speed Deviation: 6.7% (dry) 6.6% (wet) Max. Phase Error: 15 min (dry) 27 min (wet)*		

Parameters	Locations	Dry Season	Wet Season
Depth-Averaged Current Direction (Deg.N)	M01 Max. Dir. Error at Peak Speed: 0° (dry) 0° (wet)		
	M06 Max. Dir. Error at Peak Speed: 0° (dry) 0° (wet)		

Parameters	Locations	Dry Season	Wet Season
	CR01 Max. Dir. Error at Peak Speed: 0° (dry) 0° (wet)		
	C07b Max. Dir. Error at Peak Speed: 0° (dry) 0° (wet)		

Parameters	Locations	Dry Season	Wet Season
Mid-depth Salinity (PPT)	M01 <u>Max. Salinity Deviation:</u> 0.23 ppt (dry) 1.52 ppt (wet)		
	M06 <u>Max. Salinity Deviation:</u> 0.20 ppt (dry) 2.84 ppt (wet)		

Parameters	Locations	Dry Season	Wet Season
	CR01 <u>Max. Salinity Deviation:</u> 0.14 ppt (dry) 2.88 ppt (wet)		
	CR07b <u>Max. Salinity Deviation:</u> 0.13 ppt (dry) 2.39 ppt (wet)		

* Note: The EIA Study Brief requires the model be calibrated and validated against applicable existing and/or newly collected field data. No new field data was collected for this Study, and thus model prediction from the validated WHMr was adopted as surrogate for model validation. The predicted phase error at peak speed as well as maximum salinity deviation are higher than the 20 min criterion and 2.5 PPT specified in the EIA Study Brief, even though the model prediction from both models match very well in general. Close inspection indicated the incidents of phase error exceeding 20 min occurred only twice at M06 in wet season and only once for other locations and in other season. For salinity, the occurrence for deviation exceeding 2.5 PPT is also rare (0.04% of time at M06 in wet season and 0.10% of time at CR01 in wet season). In view of

the general compliance of all other technical criteria stipulated in the EIA Study Brief as well as compliance at other locations and other tide conditions, the limited deviation from the technical criteria is deemed acceptable.