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11 FISHERIES IMPACT

11.1 Introduction

- 11.1.1 As discussed in **Section 3**, various options and combinations of options for the HKBCF and HKLR have been previously investigated, evaluated, assessed and ranked, and the preferred option has been selected. The fisheries impact assessment for the HKBCF and HKLR was based upon the preferred option.
- 11.1.2 The present Fisheries Impact Assessment (FIA) follows the requirements as stipulated in the EIA Study Brief (ESB-110/2003) for HKLR and EIA Study Brief (ESB-183/2008) for HKBCF.
- 11.1.3 The assessment area for Fisheries Impact Assessment (FIA) is generally the same as the marine water quality impact assessment area. For HKLR, the assessment area includes the following 7 Water Control Zones (WCZ) within HKSAR (**Figure 11.1**), as well as any other areas likely to be impacted by the Project.
- Deep Bay WCZ;
 - North Western WCZ;
 - North Western Supplementary WCZ;
 - Western Buffer WCZ;
 - Victoria Harbour WCZ;
 - Southern WCZ; and
 - Second Southern Supplementary WCZ.
- 11.1.4 For HKBCF, the assessment area is smaller and includes the following 4 Water Control Zones (WCZ) within HKSAR as well as any other areas likely to be impacted by the Project.
- North Western WCZ;
 - North Western Supplementary WCZ;
 - Western Buffer WCZ; and
 - Southern WCZ.
- 11.1.5 As the HKBCF assessment area is completely covered by the larger HKLR assessment area, the present FIA would consider the HKLR assessment area.
- 11.1.6 The FIA comprises three major parts, the establishment of baseline conditions, evaluation and assessment of fisheries impact following the criteria and guidelines in Annexes 9 and 17 of the EIAO-TM, and recommendations of mitigation measures where necessary.
- 11.1.7 Key issues of the FIA required special attention, as stipulated in the EIA Study Brief, include but not limited to the following:
- the potential loss of fishing grounds;
 - important spawning and nursery grounds of commercially important species (e.g. fish and shrimp) within the assessment area;
 - adverse impacts on oyster farming (both raft and bed culture) within Deep Bay;
 - the Ma Wan Fish Culture Zone (FCZ); and

- the artificial reefs deployed within the Chek Lap Kok Marine Exclusion Zone 3 and Sha Chau and Lung Kwu Chau Marine Park.
- 11.1.8 The assessment covers potential impact on both capture and culture fisheries during the construction and operation of the Project, and in combination with any cumulative impacts caused by projects implemented simultaneous with or prior to the Project.
- 11.1.9 The fisheries impact assessment includes the following:
- description of the physical environmental background;
 - description and quantification of existing capture fisheries, culture fisheries and oyster farming activities;
 - description and quantification as far as possible of the existing fisheries resources (e.g. major fisheries products and stocks);
 - identification of parameters (e.g. water quality parameters) and areas (e.g. breeding/spawning grounds and nursery grounds) that are important to fisheries and could be affected;
 - identification and quantification of direct/indirect and on-site/off-site impacts to fisheries (e.g. loss of fishing grounds, reduction of catch/productivity, deterioration of water quality and pollution, if any, caused by surface run-off to mariculture sites);
 - evaluation of impacts and recommendations for environmental mitigation measures with details of justification, description of scope and programme, feasibility as well as manpower and financial implications including those related to subsequent management and maintenance requirements of the proposals; and
 - review of the need for monitoring during the construction and operation phases of the Project and, if necessary, proposals for monitoring and audit programmes.

11.2 Legislation

- 11.2.1 HKSAR Ordinances and Regulations which are relevant to this FIA include the following:
- The Environmental Impact Assessment Ordinance (Cap. 499) and the associated TM;
 - Fisheries Protection Ordinance (Cap. 171) and its subsidiary legislation, the Fisheries Protection Regulations;
 - Marine Fish Culture Ordinance (Cap. 353) and associated subsidiary legislation; and
 - Water Pollution Control Ordinance (Cap. 358) and its supporting regulations and statements.

11.3 Methodology for Baseline Establishment

- 11.3.1 Information on the assessment area was reviewed. A review of Government and private sector reports, independent of Government published literature and academic studies was undertaken to determine the existing conditions of fisheries

in the assessment area, and to identify practices, areas and species of potential fisheries importance which may be affected by the Project. This review included but was not limited to the following:

- Port Survey 2006;
- AFCD annual reports; and
- Other relevant reports from private sectors or Government.

11.3.2 Port Survey is the most comprehensive fisheries study conducted by AFCD every a few years. Different from the approach adopted in previous Port Surveys in which Hong Kong waters were divided into “Fishing Areas” of various sizes, a uniform grid was overlaid on Hong Kong’s waters for Port Survey 2006 and the fisheries related information (e.g. production, vessel number, catch value) was presented in several categories. In this FIA, the fisheries resources within the assessment area were evaluated based upon the information from Port Survey.

11.3.3 AFCD’s annual reports provide the most updated information on the development and trend in Hong Kong fisheries. The latest annual fisheries production is also provided.

11.3.4 Other studies that are relevant include:

- Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment (CCPC 2001);
- Fisheries Resources and Fishing Operations in Hong Kong Waters (ERM 1998); and
- Shenzhen Western Corridor (Arup 2002).

11.3.5 The validity of the information compiled during the literature review has been assessed before it is adopted into the present FIA study.

Data Gap Identification

11.3.6 Existing information regarding the assessment area was reviewed. Based on the review results, the study determined whether there was a data gap and whether there was any need for field surveys.

11.4 Assessment Methodology

Identification of Sensitive Receivers

11.4.1 Sensitive receivers of impacts are defined for this report as resources or sites of fisheries importance and potentially affected by the Project. This implies that project-induced impacts are predicted to exceed the range of fluctuation attributable to natural variation.

Impact Identification and Assessment

11.4.2 Impacts have been assessed in the absence of mitigation. The construction and operational phase impacts on capture fisheries, culture fisheries and oyster farming activities have been assessed individually, then cumulatively, in combination with other existing, committed and proposed developments.

11.4.3 The impact assessment includes:

- identification of parameters (e.g. water quality parameters) and areas (e.g. breeding/spawning grounds and nursery grounds) that are important to fisheries and will be affected;

- identification and quantification of direct/indirect and on-site/off-site impacts to fisheries (e.g. loss of fishing grounds, reduction of catch/productivity, deterioration of water quality and pollution, if any, caused by surface run-off to mariculture activity);
- evaluation of impacts and recommendations for environmental mitigation measures with details on justification, scope description and programme, feasibility as well as manpower and financial implications including those related to subsequent management and maintenance requirements of the proposals; and
- review the need for monitoring during the construction and operation phases of the Project and, if necessary, propose a monitoring and audit programme.

11.4.4 As stipulated in the EIA Study Brief, the FIA follows the criteria and guidelines for evaluating and assessing fisheries impact as stated in Annexes 9 and 17 of the TM.

Criteria to Evaluate Impacts

11.4.5 The significance of fisheries impacts was evaluated based primarily on the criteria set forth in Annex 9 of the EIAO-TM:

- Nature of impact;
- Size of affected area;
- Loss of fisheries resources/production;
- Destruction and disturbance of nursery and spawning grounds;
- Impact on fishing activity; and
- Impact on aquaculture activity.

11.4.6 Impacts are generally ranked as "minor", "moderate" or "severe", although in a few cases a ranking of "insignificant" (less than "minor") may be given. The ranking of a given impact would vary, based on the criteria listed above. Wherever possible, significance of impacts is quantified to allow ready appreciation of relative significance. Quantification is straight forward for certain types of impact, particularly fishing ground loss (usually measured in hectares). Quantification of other types of impact such as those on fishing and aquaculture activities requires the application of professional and value judgment. Such judgment may not be amenable to quantification.

11.4.7 In the present FIA, impacts on capture fisheries was assessed by the extent of fishing ground loss during construction and operational phases, and potential decline in productions due to loss of fishing ground, interferences on fishing operations, and loss of fisheries resources. Impacts on culture fisheries and oyster farming activities were mainly assessed by the levels of changes of marine water quality presented in the Water Quality Assessment for the present EIA study (see **Section 9**).

11.4.8 Efforts would also be made to identify feasible and practicable mitigation measures required, which might be developed to reduce the severity of any negative impacts identified. These measures would be described in terms of scope, programme, feasibility and financial implications during the construction and operation of the project.

11.4.9 Finally, the FIA would conclude whether the mitigation measures could bring the negative impacts caused by the Project and its components within acceptable bounds.

11.4.10 Besides adverse impacts, potential beneficial influences brought by the Project,

such as the additional hard substrate surfaces brought by the artificial rubble-mount seawalls, bridge piers and the associated rock armour protection which could provide similar functions as artificial reefs, would also be considered in the assessment.

Development of Mitigation Measures

- 11.4.11 Efforts would be made to identify feasible and practicable mitigation measures required, that might be developed to reduce the severity of any significant negative impacts to acceptable levels. These measures would be described in terms of their scope, programme, feasibility and financial implications during the construction and operation of the project.
- 11.4.12 Finally, the assessment concludes whether the mitigation measures envisaged could limit the negative impacts of the project and its components to within acceptable bounds. The acceptability of the overall residual impacts is determined.

11.5 Baseline Conditions

Marine Environments

- 11.5.1 The assessment area for fisheries impact assessment is the same as the assessment area for marine water quality which covers seven WCZs. The Project Site is located in North Lantau waters, within the western estuarine zone of Hong Kong waters, to the west of the transitional central and oceanic eastern waters (Morton & Morton 1983). The seabed off north Lantau is shallow, usually less than -20m CD. Lying on the east side of the Pearl River Estuary, north Lantau waters are also heavily influenced by the Pearl River and have a predominantly sandy substrate.

Sites of Fisheries Importance

- 11.5.2 Fishing grounds cover most of the open waters in north Lantau waters, except for shipping fairways and marine exclusion areas. The Project is a marine base project involving reclamation, and would cause loss of fishing grounds in North Lantau waters.
- 11.5.3 Besides the fishing grounds in North Lantau waters, the following sites of fisheries importance are located near the site of the Project within the boundary of the Fisheries Assessment Area and are shown in [Figure 11.2](#).
- Ma Wan Fish Culture Zone (FCZ);
 - Artificial reefs deployed within the Chek Lap Kok Marine Exclusion Zone 3 and Sha Chau and Lung Kwu Chau Marine Park; and
 - Important spawning and nursery grounds of fish and shrimp (in particular the North Lantau waters at the Brothers and Lung Kwu Chau (ERM 1998), and the embayment with mangroves in the vicinity).
- 11.5.4 Another five sites of fisheries importance are also located within the boundary of the Fisheries Assessment Area but at a greater distance from the project site and are also shown in [Figure 11.2](#).
- Cheung Sha Wan Fish Culture Zone;
 - Lo Tik Wan Fish Culture Zone;
 - Sok Kwu Wan Fish Culture Zone;
 - Po Toi Fish Culture Zone; and

- Oyster farming sites in Deep Bay.

11.5.5 No other designated or recognized sites of fisheries importance lie within the fisheries assessment area.

Capture Fisheries

11.5.6 The local fishing industry makes an important contribution to Hong Kong marine fish supply. In 2008, it produced an estimated 158,000 tonnes of fisheries production valued at \$1,780 million. The industry now consists of some 3,800 fishing vessels and some 7,900 fishermen working aboard and provides employment in ancillary sectors servicing the fishing industry, such as fish wholesale and retail marketing, fuel and fishing gear supply and ice manufacturing (information from AFCD website).

11.5.7 Detailed data on recent HKSAR capture fisheries in the fisheries assessment area were taken from the results of Port Survey 2006. Port Survey is the most comprehensive fisheries study conducted by AFCD every a few years. The Port Survey consisted of an interview programme. About 36% of the local fishing fleet which accounted for all homeports (i.e. places at which local fishing vessels are based, 38 ports) and vessel types (10 types, including stern trawler, pair trawler, shrimp trawler, hang trawler, gill netter, long liner, hang liner, purse seiner, sampan and miscellaneous craft) was interviewed. During the interviews, particulars (e.g. vessel length, type and its homeport) of the fishing vessels were recorded and information about their fishing operations and fisheries production in Hong Kong waters was collected.

11.5.8 In earlier Port Surveys, Hong Kong waters were divided into fishing areas of various sizes and shapes, and these fishing areas were further grouped into 12 sectors.

11.5.9 In the latest Port Survey in 2006, a uniform grid of 720 ha cell size was overlaid on Hong Kong waters and the fisheries related information (e.g. production, vessel number, catch value) was presented in several categories. For easy reference, in the present FIA study the rows and columns of the grid are named by number and alphabetic order respectively, and a reference number is assigned to each cell (**Figures 11.3 – 11.6**).

11.5.10 Within HKSAR waters, the highest yields for local fisheries were mainly derived from the eastern and southern coasts as indicated in the distribution of overall fisheries production on adult fish (see **Figure 11.3**), while the western waters were comparatively less productive.

11.5.11 Within the Fisheries Assessment Area, the majority of the waters from south Lantau to Po Toi are of high adult fish production. There are also some other smaller areas of higher production inside Victoria Harbour. But all these areas are far away from the Project and unlikely to be influenced by the Project.

11.5.12 There are three areas of relatively higher fish production in Northwest Lantau waters which are more relevant to the Project, including:

- Lung Kwu Chau (Grid cells C9, C10, C11, D9, D10, D11);
- Brothers Islands (Grid cells F11, F12, G11, G12) ; and
- Northwest Lantau near Tai O (Grid cells B14, B15, C14, C15).

11.5.13 Although the fisheries assessment area covers the above mentioned extent, it is anticipated that the focal area for capture fisheries issues would be the footprint of the Project itself (including reclamation area and bridge alignment). The reclamation area for HKBCF is located at Northeast Airport Island. The majority of it falls within Grid Cell F12 (part of the area in Brothers Islands with relatively higher fish production described in **Section 11.5.12**) and with a small portion inside Grid Cell F13 (see **Figure 11.3**). While the HKLR alignment goes through

Grid Cells B14, C14, D14, D13 and E13, there is also a smaller reclamation for HKLR in Grid Cell E13.

- 11.5.14 In Port Survey, grid cells are categorised into one of the 6 classes, i.e. > 0-50 kg/ha; 50-100 kg/ha; 100-200 kg/ha; 200-400 kg/ha; 400-600 kg/ha; and 600-1000 kg/ha, in accordance with their overall adult fish production. For HKBCF, as reported in the Port Survey 2006 (see [Figure 11.3](#) and AFCD website), the catches from Grid Cells F12 and F13 (the direct impact grid cells) were ranked moderate and very low in Hong Kong respectively (200-400 kg/ha in F12, the middle class, and 50-100 kg/ha in F13, the second lowest class). These figures demonstrate that the direct impact cells are of moderate and low importance to capture fishing operations in Hong Kong.
- 11.5.15 The results of Port Survey 2006 indicated that fry collection has become very limited and localized throughout Hong Kong waters. Fish fry production was concentrated in the eastern waters (Mirs Bay, Tolo Harbour and Channel, Port Shelter and Po Toi), with a smaller contribution from the East Lamma Channel ([Figure 11.4](#)). No fish fry production was recorded in the entire North Lantau waters including F12 and F13.
- 11.5.16 The fishing operation in grid cells is also categorized into 6 classes, i.e. > 0-10 vessels; 10-50 vessels; 50-100 vessels; 100-400 vessels; 400-700 vessels; and 700-1,000 vessels. The production is mainly contributed by larger fishing vessels (> 15m in length). There were on average 50-100 fishing vessels longer than 15m operated in Grid Cell F12 and about 10-50 operated in Grid Cell F13 ([Figure 11.5](#)). While the small vessels (<15m) were much more common in these two grid cells (100-400 vessels in F12 and 50-100 vessels in F13, see [Figure 11.6](#)). But the contributions from the larger vessels are more significant. If only considering the vessels over 15m in length, the production would already be 200-400 kg/ha in F12, and < 50 kg/ha in F13 (see AFCD website).
- 11.5.17 Among the 10 species of major fisheries products, the most abundant species are scad and croaker, of which 20-40 kg/ha were produced in F12. The values of fish production range from HK\$2,000 – 5,000 per ha in F12 and HK\$1,000-2,000 per ha in F13 (see AFCD website).
- 11.5.18 For HKLR reclamation, the catches from Grid Cell E13 (the direct impact grid cell) was ranked very low in Hong Kong (<50 kg/ha in E13, the lowest category, see [Figure 11.3](#)). This indicates that the direct impact cell is of low importance to capture fishing operations in Hong Kong.
- 11.5.19 The production in Grid Cell E13 is all contributed by smaller fishing vessels (<15m in length) ([Figures 11.5 - 11.6](#)). There were only 10-50 fishing vessels operated in Grid Cell E13 and all of them are smaller than 15m. Species of major fisheries products included seabream, sardine, mullet, crab, croaker, and rabbit fish. But their productions are all less than 5 kg/ha. The values of fish production range from HK\$500 – 1,000 per ha in E13 (see AFCD website).
- 11.5.20 For HKLR alignment, the catches from Grid Cells B14, C14, D13, D14, and E13 (the direct impact grid cells) were ranked moderate to very low in Hong Kong (200-400 kg/ha in B14 and C14, 100-200 kg/ha in D13, 50-100 kg/ha in D14, and <50 kg/ha in E13) (see [Figure 11.3](#)). These figures demonstrate that the direct impact cells are of moderate to very low to capture fishing operations in Hong Kong. No fish fry production was recorded within these grid cells ([Figure 11.4](#)).
- 11.5.21 The production is mainly contributed by larger fishing vessels (>15m in length). There were on average 50-100 fishing vessels longer than 15m operated in Grid Cell B14 and C14 ([Figure 11.5](#)), and about 10-50 operated in Grid Cell D13 and D14, and none in E13. While the small vessels (<15m) were much more common in these grid cells (100-400 vessels in B14 and C14, 10-50 vessels in D13, D14 and E13, see [Figure 11.6](#)). But the contributions on production from the larger vessels (>15m) are more significant. If only considering the vessels

over 15m in length, the production would already be 200-400 kg/ha in B14 and C14, 50-100 kg/ha in D13, <50 kg/ha in D14, while none from E13. The production from vessels smaller than 15m are however only 50-100 kg/ha in B14 and C14, <50 kg/ha for D13, D14 and E13. ,

- 11.5.22 The values of fish production range from HK\$5,000 – 10,000 per ha in B14 and C14, and HK\$1,000-2,000 per ha in D13 and D14, while <500 in E13 (see AFCD website).
- 11.5.23 The North Lantau waters between the Brothers Islands and Lung Kwu Chau were identified as important spawning grounds of fish and shrimp during a fisheries study in Hong Kong (ERM 1998). The spawning area is approximately 10km (from the Brothers Islands to Lung Kwu Chau) x 5km (from Castle Peak to the Northeast corner of Airport Island). Major species included Pony fish *Leiognathus brevirostris*, Sea bass *Lateolabrax japonicus*, and Gizzard shad *Clupanodon punctatus*.
- 11.5.24 Embayment, especially those with mangroves and intertidal mudflats are considered as important spawning and breeding grounds for marine organisms, including species of commercial value (ERM 2000). There are several such embayments on the north Lantau shore, namely Tai Ho Wan, Tung Chung Bay, Hau Hok Wan, Sha Lo Wan and Sham Wat. Tung Chung Bay is the one nearest to the proposed reclamations.

Culture Fisheries

- 11.5.25 As the Project is a marine base project and there is no fishpond on Airport Island which is the only land area to be directly affected by the Project, pond fish culture is not an issue for the present FIA, and the culture fisheries only focus on mariculture. The predominant type of mariculture in Hong Kong is marine fish culture which involves rearing of marine fish from fry or fingerlings to marketable size in cages suspended from floating rafts usually in sheltered coastal areas. Common species under culture include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, red snapper, star snapper and pompano (Information from AFCD website 2009).
- 11.5.26 Marine fish culture is protected and regulated by the Marine Fish Culture Ordinance (Cap. 353), which requires all marine fish culture activity to operate under licence in designated fish culture zones. Currently, there are 26 fish culture zones occupying a total sea area of 209 ha with some 1,060 licensed operators. In 2008, the production from local marine fish culture was 1,370 tonnes (of value HK\$82 million), constituting 10% of the local demand for live marine fish (Information from AFCD website 2009).
- 11.5.27 Water quality within Marine FCZs is regulated under the WPCO and its supporting regulations and statements. Within Fish Culture Subzones, the dissolved oxygen level should not be less than 5 mg l⁻¹ for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre below surface, mid-depth and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg l⁻¹ per litre within 2 metres of the seabed for 90% of the sampling occasions during the year, and the annual geometric mean of E. coli should not exceed 610/100 ml.
- 11.5.28 There are no Fish Culture Zones (FCZs) within the footprint (both reclamation area and bridge alignment) for the Project or in the vicinity. Of the 26 gazetted FCZs zones in Hong Kong, five occur within the fisheries assessment area, including Ma Wan FCZ, Cheung Sha Wan FCZ, Po Toi FCZ, Sok Kwu Wan FCZ, and Lo Tik Wan FCZ (Information from AFCD website). Ma Wan FCZ is the nearest FCZ to the Project area and is located about 10 km to the east.
- 11.5.29 Oyster farming is another type of mariculture in Hong Kong. Hong Kong's oyster farming operations occur in Deep Bay only. The oyster beds and rafts between

Tsim Bei Tsui and Ha Pak Nai are also the only marine culture fisheries sites inside Deep Bay WCZ. In 2008, the production was 211 tonnes valued at \$11 million (Information from AFCD website 2009).

- 11.5.30 Though they have no direct relation with the settlement and growth of oysters, the mudflats provide a substrate for the deployment of oyster cultches. Cultches on mudflats are rearranged 2 to 3 times a year to maintain the angle favouring oyster growth. The average diameter of each oyster cultch with oysters is about 0.2 m. The spacing between rows of cultch in oyster beds is about 1 m, and the spacing between two oyster cultches is about 0.3 m. Normally it takes about three years for the oysters to mature to a marketable size (ARUP 2002).
- 11.5.31 In the subtidal zone, rafts are used for oyster cultivation. Most oyster rafts measure about 80 - 96 m², while some are smaller in size (about 24 m²) (ARUP 2002). The rafts are constructed of bamboo or wood poles with floats attached. Oysters are suspended from the rafts such that the oysters are above the seabed even during low tide. This system enhances the contact time period of oysters with the water and thus reduces the growth time in comparison with oysters on cultches in the intertidal zone.
- 11.5.32 There were no oyster beds or rafts within the footprint (both reclamation area and bridge alignment) for the Project or in the vicinity. Deep Bay opening is over 12 km from the Project Site and the oyster farming locations are further away.

Artificial Reefs

- 11.5.33 Artificial reefs, a fisheries resource enhancement measure, have been deployed near the northeast corner of Airport Island within Marine Exclusion Zone 3 and at Sha Chau and Lung Kwu Chau Marine Park. Though primarily postulated as feeding stations for Chinese White Dolphin, these artificial reefs also help to enhance habitat quality and marine resources, including fisheries resources. Both ARs were deployed in 2000. While the ARs in the Marine Park is quite distant, the ARs in Marine Exclusion Zone is the nearest fisheries sensitive receiver and is approximately 300m from the HKBCF reclamation and 1.5km from HKLR reclamation. It had a footprint of 1,200 m² and occupied 3,600 m³.

Fisheries Sensitive Receivers

- 11.5.34 Identified fisheries sensitive receivers include the following:
- Fishing ground in the Grid Cells F12 and F13 (for HKBCF), Grid Cells E13 (for HKLR reclamation and alignment), Grid Cells B14, C14, D13, D14 and E13 (for HKLR alignment) ;
 - Ma Wan Fish Culture Zone;
 - Artificial reefs deployed in North Lantau (in particular the ones inside Marine Exclusion Zone 3);
 - Important spawning ground in North Lantau waters;
 - Oyster farming sites in Deep Bay; and
 - Embayments in north Lantau shore.

Identification of Data Gap

- 11.5.35 This fisheries impact assessment aims at providing sufficient and accurate data to allow complete and objective prediction and evaluation of the potential fisheries impacts. Desk-top study has produced a complete picture of the fisheries resources of the assessment area. The Port Survey and the consultancy study on fisheries resources have provided information sufficient for fisheries impact assessments in most EIA studies in Hong Kong SAR, and were considered adequate for assessment of impacts of the present Project. No data gap in fisheries baseline was identified in terms of fisheries assessment and therefore

no field survey for fisheries was needed.

11.6 Impact Identification and Evaluation

Descriptions of the Project

- 11.6.1 The connection point between HZMB Main Section and HKLR would be on the western HKSAR boundary. The connection point lies on the HKSAR boundary about 4 km west of Sham Wat and 2.5 km north of Tai O pier.
- 11.6.2 From the connection point, the HKLR will run eastward through the open sea of western Hong Kong waters, and run towards the Airport Channel. Approaching the western mouth of the Airport Channel, the alignment will span over the headland at San Shek Wan / Sha Lo Wan and run near the southern bank of the Airport Channel to avoid getting close to the touch down zone of southern runway and the Government Flying Service (GFS) headquarters. The supporting piers in this section are still located in subtidal zone as other piers in open sea. After passing the GFS headquarters near Hau Hok Wan, the alignment will cross the Airport Channel and land on the seawall at the southern shore of Airport Island.
- 11.6.3 After landing on Airport Island, the HKLR will comprise several sections of different forms. HKLR will run in viaduct form, first alongside the Airport Island artificial seawall, and then through developed area, until it reaches Scenic Hill at the southeast end of Airport Island. HKLR will go through Scenic Hill in tunnel form, and then change into at-grade road on a new reclamation area along the southeast shore of Airport Island. At the end of this at-grade road, HKLR will connect the HKBCF, which is formed on a new reclamation near the northeast Airport Island.
- 11.6.4 TMCLKL provides road connection between HKBCF, Tuen Mun, Airport and Tai Ho. Its southern landfall reclamation will be attached to the east of HKBCF. The details of TMCLKL were provided in a separate EIA study.
- 11.6.5 In assessing impacts of the HKLR and HKBCF on fisheries, three major components need to be addressed
- 1) The section of HKLR from the HKSAR boundary to the landing point on Airport Island, i.e. the marine section of HKLR;
 - 2) The section of HKLR from the landing point on Airport Island, through Scenic Hill, and up to the connection with HKBCF, i.e. the land section of HKLR; and
 - 3) The HKBCF.
- 11.6.6 HKLR and the first phase of HKBCF would be constructed from 2010-2014 while the remaining of HKBCF would be completed in 2016.

General Environmental Impacts

- 11.6.7 The assessment and sensitive receivers largely focused in the North Lantau waters where the Project is located. For the fisheries resources which are more distant from the Project footprint, the water quality assessment results would be able to demonstrate whether they are subject to indirect impacts from the Project.
- 11.6.8 The key impact sources associated with the Project with respect to fisheries included the loss of sea areas and water quality impacts from the reclamations and the piers of the viaducts.
- 11.6.9 The reclamations under this Project include two parts, 138 ha for the HKBCF, and 27 ha for the tunnel cum at-grade road section of HKLR adjacent to Airport Island.

- 11.6.10 The alignment of HKLR consists of both land and marine sections. The land section is mainly on Airport Island and the new reclamation land, while the marine section of HKLR will be a viaduct over sea areas supported by piers. Though relatively small when compared with reclamation, sea areas will be occupied by the piers and thus some permanent seabed loss will result at each pier site. The HKLR marine section would be around 7.6 km in length (about 5.6km in the open sea to the west of Airport and about 2km inside the Airport Channel). If the 50m pier spacing is adopted in the open sea on western waters and 100m spacing is adopted in the Airport Channel as shown in engineering layout **Section 4**, the number of pier sites would be about 112 nos. in the open sea on western waters and about 20 nos. in the Airport Channel. At each pier site two piers would be constructed side-by-side, and thus two sets of 4 piles (each of about 2m diameter) would be bored through the seabed sediment to reach a solid (rock) substrate. Atop each set of 4 piles a concrete pilecap will be constructed near the water surface to support the bridge pier. The size of each pilecap would be approximately 8m x 12m. Though only the piles would actually occupy the seabed, we adopt the most conservative approach in our assessment, assuming that the seabed beneath/above the pilecap is permanently lost in all cases. The seabed area to be lost at each pier site (for both open sea and inside the Airport Channel) would be $8 \times 12 \times 2 = 192 \text{ m}^2$ (about 200 m^2). The total permanent seabed loss in the marine section of HKLR would be $(112 + 20) \text{ piers} \times 200 \text{ m}^2 = 26,400 \text{ m}^2$, i.e. 2.64 ha or approximately 3ha.
- 11.6.11 Besides the permanent loss caused by the marine structures of the Project, marine works areas along the alignment and around the reclamation sites will be established during the construction phase. These marine works area would not be available for fishing operations during construction phase, and thus are considered a temporary fishing ground loss. Marine works areas will be established in 100m from both sides of the HKLR marine viaduct (see **Figure 11.7**). For the marine section of HKLR, the marine works areas would approximately cover 176 ha. The marine works areas for the HKLR reclamation site would extend 200m from the seaward boundary of the reclamation footprint (see **Figure 11.7**), and cover 37 ha. For HKBCF reclamation site, 250m marine works areas will be established (see **Figure 11.7**). The area of the marine works areas would be approximately 88 ha (excluding those overlapping with the works areas of TMCLKL southern reclamation).
- 11.6.12 Potential sources of impact during the construction phase include:
- Temporary and permanent loss of fishing grounds;
 - Disturbance of fishing operation;
 - Marine water quality impact caused by dredging and filling and associated impacts on fisheries resources, nursery grounds, FCZ, artificial reefs and oyster beds and rafts.
- 11.6.13 Potential sources of impact during the operation phase include:
- Changes to local hydrodynamic regime and consequential water quality impacts caused by the reclamations;
 - Marine water quality degradation caused by activities on the reclamations;
 - Restrictions on fishing operation.

Construction Phase – Direct Impacts

- 11.6.14 Reclamation would cause a net loss of 168 ha (with 138 ha from HKBCF, 27 ha from HKLR reclamation, and less than 3 ha of seabed and water column from the piers of HKLR). In addition, there will be another 301 ha (213 ha from HKLR marine section and 88 ha from HKBCF reclamation) not available for fishing operation during the construction phase (2010-2016).

- 11.6.15 When compared with the 1,651 km² of Hong Kong' total marine waters (EPD 2005) which is mostly available for fishing, the temporary (maximally 301 ha for six years) and permanent (168 ha after construction) fishing ground loss caused by the Project is not considered to be severe (i.e. about 0.2 % for the temporary loss and 0.1 % for the permanent loss).
- 11.6.16 The sea areas of the temporary and permanent loss are of very low to moderate production output. For HKBCF, the reclamation is located in F12 and F13. If based upon the production of Grid Cell F12 (the grid cell of higher production, 200-400 kg/ha), the maximum loss from the 138 ha would be 55,200 kg per year. Physical loss of fishing ground therefore should not be a critical issue for fisheries. This impact is therefore considered **minor** and hence mitigation is not required.
- 11.6.17 For HKLR reclamation, the reclamation is located in E13. If based upon the production of Grid Cell E13 (< 50 kg/ha), the maximum loss from the 27 ha would be 1,350 kg per year. This impact is **insignificant** and mitigation is not required.
- 11.6.18 For HKLR alignment, the reclamation is located in B14, C14, D13, D14 and E13. If based upon the production of Grid Cell C13 (the grid cell of higher production, 200-400 kg/ha), the maximum loss from the less than 3 ha would be less than 1,200 kg per year. This impact is **insignificant** and mitigation is not required.
- 11.6.19 For the temporary fishing ground loss, a conservative approach is also adopted. Though the works areas distribute in various Grid cells with production ranging from <50 to 200-400 kg/ha, the assessment would assume they are all located within grid cell of higher production. If based upon the production of Grid Cell C14 (the grid cell of higher production, 200-400 kg/ha), the maximum loss from the 301 ha of works areas would be 120,400 kg per year. Although the construction programme covers six years from 2010 to 2016, the construction works will be conducted in two phases and thus not all the works areas will be occupied throughout the six years. The viaduct of HKLR will also be constructed portion by portion (totally in three portions for the open sea part and two portions for the Airport Channel part). The construction of one portion in one part would not overlap with other portions in the same part. The works areas at any given time would thus be much smaller than the conservative estimation of 301 ha. This impact is therefore considered **minor** and hence mitigation is not required.
- 11.6.20 Besides the impacts on Hong Kong's overall fisheries production, some local fishermen may habitually fish in the project area and these specific fishermen might be subject to higher impacts than other fishermen. These local fishermen would be part of the small sized fishing vessels mentioned in **Section 11.5.16** above. Though the small vessels (<15m) were much more common in the affected grid cells (100-400 vessels in F12 and 50-100 vessels in F13, see **Figure 11.6**). But their contributions to the production were less significant. If only considering the vessels less than 15m in length, the production would be 100-200 kg/ha in F12, and 50-100 kg/ha in F13 (see AFCD website). Furthermore, alternative fishing grounds of similar annual production rate (such as the Brothers Islands) are available in the North Lantau waters.
- 11.6.21 Five embayments (Tai Ho Wan, Tung Chung Bay, Hau Hok Wan, Sha Lo Wan & Sham Wat) have been identified as important to fisheries due to their potential functions as breeding and nursery grounds for marine organisms (**Figure 11.2**). These five areas all comprise a large proportion of the intertidal zone. If these areas are encroached by the construction works, their functions might be jeopardized.
- 11.6.22 None of the embayments functioning as fisheries spawning and breeding ground would be affected, as the construction works for the Project would not encroach any of the embayments.

Construction Phase – Indirect Impacts

Water Quality impact

- 11.6.23 The major potential activities that could cause water quality impacts during the construction phase of the Project include:
- Dredging of marine deposit and backfilling;
 - Construction site runoff; and
 - Wastewater from construction activities.
- 11.6.24 Besides these activities, sewage generated by the workforce and accidental spillage of works site chemicals might also cause water quality impacts but would be, if any, at an extremely small scale.
- 11.6.25 During construction phase, this project would involve dredging (for seawall foundation, reclamation and pier construction) and backfilling (see **Section 4** for details on construction methodology). Both dredging and filling works are potential sources of suspended solids. In the modelling for the water quality impact assessment, the Year 2010 is considered a baseline year. The tidal flow simulations have been chosen to represent the worst case scenarios during both the construction and operational phases of the project. As the project works will last over some years, several interim construction stages were considered beside the final operation phase (see **Section 9.8.3.4**), including:
- Year 2011 Construction Scenario 1: when the construction of the HKBCF and HKLR has begun and the potential sediment loss rates from dredging and filling were at their maximum.
 - Year 2012, Construction Scenario 2: when the construction of the TMCLKL, HKBCF and HKLR would be well under way and would have had the potential to modify tidal currents.
 - Year 2013, Construction Scenario 3: when the construction of the TMCLKL, HKBCF and HKLR would be nearing completion and would have had the potential to modify tidal currents.
 - Year 2026: The Completed Scenario: It is anticipated that the TMCLKL+HKBCF and HKLR will be completed in 2016. In order to assess long term operational impacts, the target year of 2026 has been selected to allow for completion of all other expected reclamations. This scenario includes the completed TMCLKL+HKBCF+HKLR reclamations and associated bridges, the HKLR and HZMB bridges and artificial islands. This scenario also considered the completion year of 2026 for all committed projects, such as Road P1, the increased water depths in the Kwai Tsing Container Basin and associated fairways, the LLP completed reclamations (72ha and 40ha), and the completed Tung Chung East and West Reclamations.
- 11.6.26 As the Year 2011 is the peak period for dredging and filling, to take a more conservative approach, the water quality impact on fisheries will consider this scenario. The assessment will also focus on the three nearest fisheries sensitive receivers to the Project, i.e. Artificial reefs in Northeast Airport (= WSR41), Ma Wan Fish Culture Zone (= WSR 20), and Tung Chung Bay (represented by WSR 27 San Tau Beach SSSI). If these three nearest locations are not affected by water quality impact, then it is assumed that other fisheries sensitive receivers more distant to the Project will not be affected.
- 11.6.27 The reclamation method and sequence are illustrated in **Sections 4 & 9**. In general, the dredging and filling for the seawall foundation would be carried out

first. Closed-grab dredging and slit curtain around the dredging and filling sites of seawall would be used. The use of a layer of stand (floating) type silt curtains surrounding each reclamation site (while taking into account the need for marine access), combined with a cage-type silt curtain around each grab dredger to be used (referred as the (1+1) silt curtain system), has been recommended and modelled. This (1+1) silt curtain system is expected to reduce the overall potential sediment loss to the surrounding water columns by 72% in the 2011 scenario year (with the maximal potential sediment loss rates from dredging and filling, see **Section 9, Table 9.16b**). In this case, the associated water quality impacts would be localized, and these measures would effectively reduce the sediment release. The Artificial Reef at NE Airport (WSR 41) is very close to (about 300m from the HKBCF and about 1km from the TMCLKL) and downstream (during flood tide) of the project site. If without mitigation, this WSR would be subject to exceedances of the calculated WQO in terms of the predicted maximum depth average SS elevations (see **Section 9, Table 9.19**). After the implementation of mitigation measure, WQO exceedances are reduced but still present (see **Section 9, Table 9.20**). Hence, mitigation measures for the Artificial Reef at NE Airport (WSR 41) are required (see below sections on mitigation measures).

- 11.6.28 After sufficient length of seawall is constructed, the dredging and filling of reclamation would be carried out at the areas where the leading edge of seawall is about 200 m as far as practicable. The provision of leading edge of seawall for the reclamation dredging and filling activities could effectively reduce the dispersion of the sediment and prevent any significant deterioration of water quality. In addition, closed-grab dredging and silt curtain for the dredging and filling would also be used. The measures would effectively prevent any significant deterioration of water quality.
- 11.6.29 It was found from the water modelling results that even under an unmitigated conditions, no observable plumes at Ma Wan FCZ (WSR 20) are expected as the predicted elevation is <1 mg/L and not exceeding the WQC /WQO levels (see **Section 9, Table 9.19**). And the predicted elevation is even as low as <0.5mg/L after the implementation of mitigation measures (see **Section 9, Table 9.20**). Details of the water quality assessment are given in the **Section 9**. In view of the above measures, the impacts on suspended solids and dissolved oxygen could be controlled to acceptable level.
- 11.6.30 Apart from the reclamation, construction of piers for the marine viaducts is required in this project and these activities are the potential sources of water quality impacts. The HKLR alignment would pass through natural seabed where limited dredging and bored piling would be required for construction of piers. The pier locations would be enclosed by cofferdams and silt curtains. If closed-grab dredging and bored piling enclosed by cofferdams is used, the resulting water quality impacts would be highly localised. Furthermore, the construction works for all pier sites would not be conducted at the same time. The number of work fronts would be smaller than if all construction works were to be conducted at the same time. Use of these construction methods and protective measures would minimize impacts from suspended solids and/or dissolved oxygen.
- 11.6.31 The dredging would also cause secondary impacts on the dredged/excavated material disposal sites and marine borrow areas. The scale of these works and the exact locations for disposal and fill material collection would be determined during the detailed design stage. The disposal of dredged materials and dredging of marine sand are controlled by regulations and guidelines from CEDD, and the water quality in the disposal sites and marine borrow areas is protected. The disposal of dredged materials and dredging of marine sand in the present Project will follow the practices in other infrastructure projects in Hong Kong.
- 11.6.32 Resuspension of highly contaminated sediments may lead to the adsorption of contaminants into the water column that may eventually be taken up into food chains that are linked to fisheries resources, and thus affected fisheries. Water

quality assessment has been conducted for the potential release of contaminants during sediment dredging (**Section 9.10.6**). Results indicate that the impacts would comply with statutory requirements.

- 11.6.33 Degradation of marine water quality due to dredging and filling and associated impacts might also potentially affect marine fauna, including juveniles of species with commercial values, inside embayment on North Lantau shore such as Tung Chung Bay. However, the water quality assessment results indicate that if the above recommended mitigation measures such as silt curtains are provided, the increased concentrations of suspended solids caused by the dredging and filling works at all the water sensitive receivers, including those nearest to the reclamation such as Tung Chung Bay (represented by San Tau Beach, WSR 27) would be within the statutory requirements of 30% (the increases in maximum SS at WSR 27 would be 0.1 mg/L, lower than assessment criteria, (see **Section 9, Table 9.20**). This increase has included the contributions of other concurrent projects that would have a bearing on the water quality during the construction phase of the Project (the worst case scenario, see cumulative impacts in below sections).
- 11.6.34 Tung Chung Bay (represented by WSR 27 San Tau Beach which is at the mouth of Tung Chung Bay) is the nearest embayment for the project which might serve as breeding and nursery ground for fisheries species. As Tung Chung Bay would not be subject to adverse water quality from the Project, other embayments along the north Lantau shore, such as Tai Ho Wan, would not be affected by the SS from the Project construction. **Figures 11.8 – 11.10** show the maximum sediment plumes under mitigated scenario for Years 2011 to 2013. It is clear shown that the project related sediment plumes are predicted to be confined to the sheltered East Tung Chung Bay and often the plumes are confined to within the project site. It also demonstrate that with the implementation of silt curtain system which effectively encloses the entire project sites, the SS elevation band at around 500m of the site would be largely reduced to less than 30 mg/L. Nonetheless, some transient exceedance of the WQO will remain in the close vicinity of the works area but these will be in areas where fishing operations will not be continuing during the construction phase and would not have any significant impacts on fisheries resources. In addition, the sediment has been shown to be not contaminated overall (**Section 9, Appendix 9D1**) and, as such, significant impacts associated with contaminants getting into the food chain would not be expected. It is likely that fish will generally avoid disturbed areas (as fish are typically highly mobile) or adapt to local conditions (i.e., the high suspended sediment loads carried in the water column and/or the re-suspension of soft-bottom sediments characteristic of the North-western waters). Thus, fish species are unlikely to be significantly impacted. Spawning activities are, thus, also, unlikely to be disrupted. Significant impacts to fisheries resources in the study area are not expected based upon the fact that the mitigation measures recommended to protect water quality sensitive receivers would, also, be adequate to prevent adverse impacts to fisheries resources.
- 11.6.35 Other fisheries sensitive receivers for the Project, including Ma Wan FCZ and other FCZs within the assessment area, the artificial reefs in Sha Chau and Lung Kwu Chau Marine Park, the oyster farming sites in Deep Bay, are located much farther away from the reclamation area than those embayments, and also would not be subject to adverse water quality from the Project.
- 11.6.36 The potential water quality impacts due to site runoff, sewage from workforce and wastewater from various construction activities, and accidental spillage would be controlled through the implementation of suitable mitigation measures, including temporary drainage system, chemical toilets, etc (See **Section 9.11.1.5**).
- 11.6.37 There is an increased risk of small-scale oil or chemical (construction works solvent) spills from vessels due to the increased number of vessels working in the area. Because of the small volumes of such materials involved, this risk is considered insignificant.

- 11.6.38 The impact from water quality deterioration on fisheries resources and most fisheries sensitive receivers (except the artificial reefs discussed in below sections) is thus ranked as **Minor** and specific mitigation is not required other than the water quality measures.
- 11.6.39 The artificial reefs near the northeast corner of Airport Island within the Marine Exclusion Area are the nearest fisheries sensitive receiver to the HKBCF reclamation (only about 300m, see [Figure 11.11](#)). These reefs are outside the HKBCF footprint and thus would not be directly impacted, but they are potentially subject to water quality impact from the reclamation. The seawalls would be constructed prior to the filling where possible and water mitigation measures will be adopted during the dredging for seawall construction. The maximum SS elevations at this WSR are predicted even after the implementation of mitigation measure in the 2011 scenario (see [Section 9, Table 9.20](#)). The potential of the artificial reefs influenced by the works, however, is high even with the mitigation measures in place given the close distance. This impact is ranked as **Moderate** and mitigation is recommended for the artificial reefs.

Disturbance on Fishing Operation

- 11.6.40 In the vicinity of the reclamation areas, fishing operation might be disturbed by the increased marine traffic of working vessels for the Project. The disturbance impact however would be temporary. As the majority of fishing vessels operating in the vicinity are small-sized vessels (on average fewer than 10 fishing vessels longer than 15m operated in Grid Cell G13 and about 50-100 operated in Grid Cell G14, [Section 11.5.9](#) above), these small vessels would have higher flexibility in their operations and less sensitive to disturbance from marine traffic. Given the low fishing production in the vicinity, this temporary impact would be **insignificant**. No mitigation is required.

Operational phase – Indirect Impacts

Changes to Hydrodynamic Regime and Water Quality

- 11.6.41 After the HKLR and the two phases of HKBCF finished in 2016, and with the Tung Chung East and West Reclamation in place, will give the worst scenario of the operational phase.
- 11.6.42 The HKBCF and the HKLR might cause some changes to the local hydrodynamic regime in response to the physical presence of the reclamations. The hydrodynamic regime of the Pearl River Estuary as a whole, however, is not likely to be significantly affected by the Project when compared with the entire estuary. The reclamation should not have significant effect on the hydrodynamic regime of the Pearl River Estuary. The water quality of the area should not be significantly affected after construction is completed.
- 11.6.43 During the operational phase, the reclamation would change the flowing pattern in the North Lantau waters. Significant reduction in residual flows may indicate the reduction in flushing and assimilative capacity of a water body. For both wet and dry seasons, however, peak flood and ebb flow across Ma Wan were found to reduce by only about 2.1% and 1.7% respectively, while the residual flow is reduced by only about 3.6% (see [Section 9, Table 9.17](#)). With the support of the water quality model results, these minor reductions in the tidal discharges are concluded not to have significant adverse impacts on water quality. It is thus anticipated that these changes would not adversely affect the functions of North Lantau waters as spawning ground and fishing ground, as well as the mariculture operations in Ma Wan and Deep Bay.
- 11.6.44 Hydrodynamic and sequential water quality impacts on Artificial reefs in the Marine Exclusion Zone 3 and the important spawning and nursery grounds of fish and shrimp in the North Lantau waters at the Brothers and Lung Kwu Chau, caused by the reclamation site are also a concern in fisheries assessment. Hydrodynamic modelling results indicate that there is no significant change in the

velocity vector in the open water. In both the wet and dry season, the peak flood and ebb flow at Artificial reefs in the Marine Exclusion Zone 3 (WSR41) located north of the HKBCF reclamation, were found to reduce by about 2.3% and 1.7% respectively, while the residual flows were reduced by about 4.5% (see **Section 9, Table 9.17**). In terms of flow velocities, the average speed north of the Airport Island decreases by 11% (from 43 cm/s to 39 cm/s) in wet season and 3% (from 37 cm/s to 36 cm/s) in dry season (see **Section 9.9.2.3**). It is therefore anticipated that the environment in these areas can be maintained.

- 11.6.45 Major water quality parameters, including salinity, DO, SS, BOD5 and E. coli, all would comply with the WQO. Levels of Dissolved oxygen (DO) do not significantly change as a result of the implementation of the project. All results for both the scenarios with and without projects in 2026 show that the DO levels will comply with the DO criteria (depth average ≥ 4 mg/L, bottom level ≥ 2 mg/L) (see **Section 9.9.3.9**). As a result, it can be concluded that the implementation of the project will not significantly affect DO levels and no sensitive receivers, including fisheries, will be affected by the implementation of the project. The impact of the Project on water quality in these areas would therefore be acceptable. Detailed assessment results are given in **Section 9**.
- 11.6.46 The North Lantau spawning ground and the artificial reefs in Marine Exclusion Zone 3 are the nearest fisheries sensitive receiver for the project. As it is expected that they would not be subject to adverse water quality from the Project, other fisheries sensitive receivers including fish culture zones and oyster farming sites would be similarly unaffected.
- 11.6.47 The results of the water quality modelling showed that the presence of the reclamations would not significantly impact the water quality in the sites of fisheries importance, including the 5 FCZs within the assessment area, which are all far away from the project site, as well as the spawning and nursery ground in North Lantau waters and embayment, where the changes in water quality would be minor.

Marine Water Quality Deterioration due to Surface Runoff

- 11.6.48 There is potential for marine water quality degradation by surface runoff from the future HKBCF reclamation site which might contain some harmful materials and chemicals (fuel residues, rubber residues, gasoline, and diesel fuel). However, the amounts of those chemicals and materials would be limited, and this is not anticipated to be a severe issue. Furthermore, silt-grease traps could prevent a direct input of surface runoff to the marine waters. No significant impact is anticipated. No further mitigation is needed.

Restrictions on Fishing Operation

- 11.6.49 As there will be no marine restricted area for both HKLR and HKBCF, fishing operations are basically not restricted by the operation of the Project.

Potential Positive Effect

- 11.6.50 There would be an increase in the total length of artificial coastline (in the form as inclined rubble-mount seawalls) from the HKBCF and HKLR on-grade road after the reclamation are finished. These artificial seawalls are of some fisheries value due to the artificial reef like function. The influence is considered potentially positive.

Table 11.1 Construction and Operation Stage Impacts

Impact	Source	Receiver	Criteria						Severity	Mitigation Required
			Nature of impact	Size of affected area	Loss of fisheries resources/ production	Destruction and disturbance of nursery and spawning grounds	Impact on fishing activities	Impact on aquaculture activity		
Construction phase										
Fishing ground loss	HKBCF Reclamation site	Fishing ground near northeast Airport Island	Permanent	138 ha	Yes	Do not encroach on important spawning and nursery ground.	The reclamation area not available for fishing operation	No	Minor	No, but there will be additional enhancement measures of deploying additional Artificial Reefs.
	HKLR reclamation site	Fishing ground near southeast Airport Island	Permanent	27 ha	Yes	Do not encroach on important spawning and nursery ground.	The reclamation area not available for fishing operation	No	Insignificant	No
	HKLR pier sites	Fishing ground to the west of Airport Island	Permanent	Less than 3 ha	Yes	Do not encroach on important spawning and nursery ground.	The pier sites not available for fishing operation	No	Insignificant	No
	Works area	Fishing ground near the HKLR alignment and near the reclamation sites	Temporary	301 ha (213 ha for HKLR + 88 ha for HKBC)	Yes	Do not encroach on important spawning and nursery ground.	The works areas not available for fishing operation	No	Minor	No
Marine water quality deterioration	Dredging and filling Reclamation	Other fisheries resources and fisheries sensitive receivers	Temporary	North Lantau waters	No	Potentially disturbed important spawning and nursery ground, but only temporary and minor	No	No	Minor	No. Only water quality mitigation measures and monitoring
		Artificial Reefs in Marine Exclusion Zone 3	Temporary	N/A	No	The functions of the artificial reefs might be affected.	No	No	Moderate	Yes, to provide replacement artificial reefs.

Impact	Source	Receiver	Criteria						Severity	Mitigation Required
			Nature of impact	Size of affected area	Loss of fisheries resources/ production	Destruction and disturbance of nursery and spawning grounds	Impact on fishing activities	Impact on aquaculture activity		
Disturbance on fishing operations	Marine traffic from construction	Fishing vessels	Temporary	Near the works area	No	No	Yes	No	Insignificant	No
Operation phase										
Change of hydrodynamic regime	Marine structures (Reclamation and Piers)	Fisheries resources and fisheries sensitive receivers	Permanent	North Lantau waters	No	No	No	No	Insignificant	No. Only water quality monitoring
Marine water quality deterioration	Surface runoff	Fisheries resources and fisheries sensitive receivers	Permanent	North Lantau waters	No	No	No	No	Insignificant	Silt-grease traps and storm water drainage systems

11.6.51 Construction and Operational phase impacts on fisheries are summarised in **Table 11.1** above. There are no insurmountable impacts on fisheries from the construction and operation of the Project. There would also be no unacceptable impact during the construction and operation phases on the fisheries sensitive receivers within the assessment area.

Overall Cumulative Impacts with other developments

11.6.52 As stipulated in Section 4.3.3 of EIAO-TM, the assessment of cumulative environmental impacts is required in three circumstances:

- the impacts arising from the project are predicted to extend beyond the boundaries of the project or over a long period of time;
- there may be interactions between the environmental impacts of the project, affecting the sum total of its environmental impacts; or
- there may be interactions between the environmental impacts of the project and those of other developments, and this could result in accumulation of impacts, which would affect the total effect.

11.6.53 The potential interactions between the construction and operational phase impacts of the Project were examined in previous sections. This section examines whether there might be interactions between the environmental impacts of the Project and those of other developments whose construction or operational phases would overlap with the HKLR and HKBCF, thereby resulting in cumulative impacts whose effects would exceed in severity those of the various projects taken individually. **Section 1** has listed out all the concurrent projects during the construction and operational phases of HKLR and HKBCF respectively. Nearby projects that would have potential cumulative fisheries impacts (mainly water quality and seabed loss) are shown in **Table 11.2** below.

Table 11.2 Concurrent Projects with Implications on Fisheries

Proposed Development	Nature of the projects	Impacts to be Considered		Seabed loss	Schedule
		Construction	Operation		
HKLR	Connecting HZMB Main Bridge and Hong Kong	✓	✓	Temporary loss : (213+30=) 243 ha during construction Permanent loss : 30 ha marine piers and reclamation seabed loss	Commence in 2010, for completion in 2016
HKBCF	Boundary Crossing Facilities in Hong Kong	✓	✓	Temporary loss : (88+138=) 226 ha during construction Permanent loss : 138 ha reclamation seabed loss	Commence in 2010, for completion in 2016
Tuen Mun-Chek Lap Kok Link	a dual-two-lane carriageway about 9km long connecting Tuen Mun Western Bypass in the north and with the proposed HKBCF and North Lantau in the south.	✓	✓	Temporary loss : (93+48=) 141 ha during construction Permanent loss : 48 ha marine piers and reclamation seabed loss	Commence in 2010, for completion in 2016

Proposed Development	Nature of the projects	Impacts to be Considered		Seabed loss	Schedule
		Construction	Operation		
New Contaminated Mud Disposal Facilities at South of Brothers / East of Sha Chau	to accommodate contaminated sediment	✓		Temporary loss : about 164 ha and 106 ha of seabed will be dredged for the South Brothers and East Sha Chau Mud Pits (estimated based on the footprint of the pits)	Though the timing of the new pits at South of Brothers is not yet decided, to plan for the worst scenario on water quality impact assessment, it would be considered as concurrent with the construction of the HKLR and HKBCF
Existing Mud Disposal Facilities at East of Sha Chau (Existing East Sha Chau Confined Marine Sediment Disposal Area)	the existing mud disposal facilities at East Sha Chau are currently in use	✓	✓	Temporary loss : about 101 ha will be dredged (estimated based on the footprint of the pits)	Existing facilities
Existing Mud Disposal Facilities at North of Brothers (Suspended North Brothers Open Sea Sediment Disposal Area to be re-opened).	the North Brothers' is scheduled to be re-opened (date not yet confirmed)		✓	Temporary loss : about 290 ha will be dredged (estimated based on the footprint of the pits)	Existing suspended facilities (scheduled to be re-opened, date not yet confirmed)
Kwai Tsing Container Basin Dredging	involves the deepening of the existing seabed to facilitate safe navigation of new generation of ultra large containerhips to KCTC	✓	✓	Temporary loss : about 415 ha will be dredged	commence construction in 2010 and for completion in 2013.
Proposed Lantau Logistics Park (LLP)	at Siu Ho Wan	✓	✓	Temporary loss : (58+72=) 130 ha during construction (Assuming 100m works limit) Permanent loss : 72 ha for reclamation	2010-2012
Possible LLP Extension	possible Logistics Park extension or other compatible uses		✓	Permanent loss : 40 ha	no confirmed implementation programme
Future Tung Chung East and West Development	New Town Extension and the Possible Theme Park Recreational Uses		✓	Permanent loss : 110 ha and 50 ha	commence by either end 2015 or early 2016 and the construction would be completed beyond 2017
Road P1, Sham Shui Kok to Sunny Bay	one of the possible road projects in the Revised Concept Plan for Lantau	✓	✓	Permanent loss : 9.5 ha	Completed by 2026

Notes :

- Construction projects outside Hong Kong waters (e.g., Tonggu Channel maintenance dredging and the mainland

- section of HZMB) were not included in the assessment as these projects will not affect the availability of fishing grounds in Hong Kong.
2. Because the works are at major navigation areas, it is unlikely the entire dredging footprint will be closed simultaneously and thus additional area from works limit not assumed.

- 11.6.54 The water quality assessment has taken into account of all these concurrent projects. If the construction programmes of these projects overlap with that for the HKBCF and HKLR, there might be cumulative environmental impacts from the construction of those projects. The outcome would depend on the mitigation measures implemented by these projects. The construction phase impacts might be enhanced and further mitigation measures might be required. The above nearby projects were assessed for potential cumulative impacts with the present project in **Section 9**. The results indicate that the water quality parameters caused by the dredging and filling operation would be mostly within the statutory requirements of 30% with the above recommended mitigation measures in place. The sediment plumes from the TMCLKL+HKBCF+HKLR are generally confined to within the sheltered East Tung Chung Bay and do not merge with sediment plumes from the other concurrent projects. The plumes could, however, under certain tidal conditions, slightly mix with the plumes from the (unmitigated) LLP. The predicted cumulative maximum SS elevation, however, is still low although it will infrequently exceed the WQO. It is expected that the LLP will have extensive mitigation measures in place to avoid cumulative impacts with other projects and, thus, it is not expected that the plume would merge during actual construction. For the contaminated mud disposal facilities, based on the EM&A programme for the existing contaminated mud disposal site at East of Sha Chau between 2001-2005 (Meinhardt under preparation), 2680 fisheries samples (including fish, prawn and shrimps, crabs and squids) were analysed for contaminants including PCBs and PAHs. The result indicated that PCBs and PAHs were below analytical detection limits and the average detection frequency was only 1.7% indicating these contaminants were generally not bio-accumulated. As the proposed mud disposal facilities is of the same nature of operation and with similar size of pits, the impact raising from the new facilities is also expected to be minor.
- 11.6.55 Besides the cumulative water quality impacts, there would be cumulative fishing ground loss from some of these projects. For cumulative temporary loss :
- (a) The works areas for and project footprint HKLR and HKBCF will contribute to the temporary fishing ground loss of about (243 + 226 =) 469 ha.
 - (b) The works areas and project footprint for TMCLKL (about 141 ha) will also contribute to the temporary fishing ground loss.
 - (c) While the mud pit projects would not cause permanent seabed loss, the areas within the footprint of the mud pits will be sequentially dredged and not available for fishing during the dredging, filling and capping time period. Temporary loss of approximately 270 ha will be resulted from the proposed contaminated Mud Disposal Facility at South of Brothers (164 ha) and East of Sha Chau (106 ha). It should also be noted that these mud pits will not be operated at the same time, the estimated 270 ha temporary loss is in conservative side. The loss in fisheries as demonstrated in the EIA study (ERM 2005) are considered to be low. Once dredging, filling and capping works are completed, the seabed and hydrodynamic regime is expected to restore to their original condition (*ibid*). It could be expected that the nature of the temporary fishing ground loss would be similar in other dredging projects such as other mud pits and the Kwai Tsing Container Basin & Approach Channel project.
 - (d) For the existing mud pits in operation, temporary fishing ground loss is expected due to the operation of the disposal facilities. The temporary loss of approximately 391 ha will be resulted from the Existing Mud Disposal Facilities at East of Sha Chau (101 ha) and Suspended facilities at North

Brothers (290 ha). It should also be noted that these mud pits will not be operated at the same time, the estimated 391 ha temporary loss is in conservative side. Compliance environmental monitoring has been conducted since operation of these existing mud pits and is confirmed that there is no adverse impact on the environment. The operation of the existing mud pits is not expected to have any impact on fish resources in the area.

- (e) The Kwai Tsing Container Basin & Approach Channel project, though it will involve a larger area of 415 ha, it is mainly located in Rambler Channel which is not a major fishing ground, and the influences on fisheries would be very limited.
- (f) The proposed Lantau Logistic Park will involve a temporary loss of about 130 ha, it is located in the northern shore of Siu Ho Wan which is not a major fishing ground, and the influences on fisheries would be very limited.

It should be noted that the HKBCF and HKLR works will be conducted in phases and by portions, other concurrent projects such as existing / proposed mud pits will not be operated at the same time. To take a conservative approach, the worst case for the cumulative impacts from different potentially concurrent projects would be the maximum area in each project to become not available for fishing at the same time (i.e. about $469 + 141 + 270 + 391 + 415 + 130 = 1,816$ ha from the above projects).

- 11.6.56 For cumulative permanent fishing ground loss, HKLR and HKBCF will have a loss of $(30+138=)$ 168ha, TMCLKL will have a loss of 48 ha, LLP will have a seabed loss of 112 ha from its two development phases, the Tung Chung East and West Development will a sea bed loss of 110 ha from the east and 50 ha from the west developments, and the Road P1 reclamation is about 9.5ha. The total seabed loss from all these projects would be about $(168 + 48 + 112 + 110 + 50 + 9.5 =)$ 498 ha. While the southern reclamation of the TMCLKL (25.4 out of the 48 ha) would be adjacent to HKBCF and inside area of moderate fishing production (i.e. 200-400 kg/ha), all other losses are inside areas of low fishing production (<50 kg/ha or 50-100 kg/ha). The impact of cumulative permanent fishing ground loss would not be severe. Cumulative spawning/nursery ground loss from these projects however are not anticipated as these projects are not located in important spawning grounds or known nursery grounds.

Summary

- 11.6.57 The reclamation would cause a net loss of 168 ha (i.e. 138 ha from HKBCF, and 27 ha from HKLR reclamation and 3 ha from HKLR pier sites) in sea area (seabed and water column) in North Lantau waters. When compared with the 1,651 km² of Hong Kong's total marine waters which is mostly available for fishing, the fishing ground loss caused by the two Projects is considered to be small. This loss would therefore be minor. Besides the permanent loss, the works areas of about $(213 + 88 =)$ 301 ha (about 0.2 % of Hong Kong's total marine waters) would be sequentially not available for fishing operation during the 6-year construction phase. This impact is temporary and thus is also of minor significance.
- 11.6.58 On average, the loss of sea area from the 168 ha permanent loss would cause an estimated reduction in adult fish production maximally of 57,750 kg (55,200 kg + 1,350 kg + 1,200 kg). Physical loss of fishing ground therefore should not be a critical issue for fisheries. This impact is therefore considered acceptable. Besides the impacts on Hong Kong's overall fisheries production, some local fishermen may habitually fish in the project area and these specific fishermen might be subject to higher impacts than other fishermen. Their contributions to the production from the area were less significant, and alternative fishing grounds of similar annual production rate are available in the North Lantau waters.
- 11.6.59 For the cumulative fishing ground loss, temporary loss of fishing ground during

construction is about 1,816 ha. (This is on conservative side taken into account that cumulative impacts from different potentially concurrent projects would be constructed/operated at the same time and all areas become not available for fishing). Comparing with the available 165,000ha for Hong Kong as a whole, the temporary loss is relatively small. The HKBCF and HKLR works will be conducted in phases and by portions, other concurrent projects such as existing / proposed mud pits will not be operated at the same time. It should also be noted that these temporary losses represent a short-term un-availability of fishing grounds to fishing operations rather than loss of fisheries resources. As fishermen are generally free to fish in the whole of Hong Kong waters without restriction, except at special areas like marine park, reserves or major navigation channels. The temporary un-availability of fishing grounds in the North-western waters would not represent an impact in real terms of fisheries catches but represent more a need to change usual fishing patterns and areas.

- 11.6.60 The cumulative permanent loss of sea area from this project and other concurrent projects is estimated to be 498 ha. While the southern reclamation of the TMCLKL (25.4 out of the 47 ha) would be adjacent to HKBCF and inside area of moderate fishing production (i.e. 200-400 kg/ha), all other losses are inside areas of low fishing production (<50 kg/ha or 50-100 kg/ha). All concurrent projects would cause an estimated reduction in adult fish production maximally of (57,750 + 10,160 + 29,360=) 97,270 kg. The cumulative loss of fishing ground (about 487ha) compared with the available 165,000ha for Hong Kong as a whole is relatively small and represents a potential loss of about 100 tonnes production, which would not be considered significant when compared to the estimated total fisheries production by Hong Kong fishing vessels in 2008.
- 11.6.61 Fisheries mitigation plan is however required for the Artificial Reefs inside Airport Marine Exclusion 3, given its close proximity to the HKBCF reclamation site.

11.7 Mitigation of Impacts

- 11.7.1 The following paragraphs identify feasible and practicable mitigation measures for the construction and operational and phases to reduce the severity of any negative impacts identified in the previous sections.

Construction phase – Direct Impacts

- 11.7.2 There would be permanent loss of fishing ground due to the HKBCF and HKLR, but the impact is considered minor. Mitigation is thus not required. On the other hand, some additional artificial reefs will be deployed as an additional fisheries enhancement measures (see below sections).

Construction phase – Indirect Impacts

- 11.7.3 The affected artificial reefs (ARs) near the HKBCF reclamation had been deployed there for over eight years and it is considered that the relocation process would not keep the ARs intact once they are mechanically disturbed. As such, it might be more practicable to deploy replacement ARs as a compensation of the disturbance on ARs by the HKBCF reclamation works.
- 11.7.4 Areas currently not available for fishing operations would be suitable for deploying the new ARs, such as the Sha Chau and Lung Kwu Chau Marine Park could be a possible option for deploying the new ARs.
- 11.7.5 The new ARs should have at least three times the volume of the existing ARs inside the Marine Exclusion Zone (i.e. 3,600 m³). Among them, 1,200 m³ would be to compensate the existing ARs in Northeast Airport, while the remaining 2,400 m³ would be an additional enhancement measures.
- 11.7.6 **Reduce re-suspension of sediments** – Any significant changes in water quality or

turbidity should be avoided. This could be mitigated through construction methods. The amount to be dredged should be minimized as far as possible (e.g. limit the dredging to the seawall foundation only). This also includes measures such as using closed-grab dredging, and using silt curtains around the work areas. To conclude, the number of concurrent dredging/filling work fronts should be limited, closed-grab dredging and silt curtains should be used, and the seawall should be constructed prior to the filling works.

- 11.7.7 **Good Site Practices:** – The condition and effectiveness of all silt curtains should be regularly inspected. Effluent monitoring should be incorporated to make sure that the discharged effluent from construction sites meets the effluent discharge guidelines of the Hong Kong SAR government.
- 11.7.8 **Strict enforcement on no-dumping:** – Restrictions prohibiting dumping of rubbish, food, oil, or chemicals should be strictly enforced. This should also be covered in the contractor briefings.
- 11.7.9 **Spill response plan** - There will also be a spill response plan if vessels operating in the works areas will be transporting oil or other hazardous chemicals. The oil spill response plan will have specific provisions for protecting marine ecology. Given these measures, the marine ecosystem as well as fisheries resources in the area would be protected.
- 11.7.10 Mitigation measures for the construction impacts are summarised in **Table 11.3** below:

Table 11.3 Mitigation Measures for Construction Phase

Impacts	Mitigation Measures and Effects
ARs in Marine Exclusion Zone	Reprovision of 1,200 m ³ replacement ARs in Marine Park. Another 2,400 m ³ artificial reefs will also be deployed as additional enhancement measure.
Water quality	Silt curtains, closed-grab dredging
	Minimised dredging works; filling after completion of seawall; limit the works fronts; using closed grab; employing silt curtains.
	Good site practices
	No dumping policy
	Spill response plan
	Silt – grease traps; Stormwater drainage systems

Operational phase – Indirect Impacts

- 11.7.11 Silt-grease traps should be deployed to prevent a direct discharge of HKLR road surface runoff to the marine waters.
- 11.7.12 Stormwater drainage systems would be provided to collect stormwater from the HKBCF site. The collected stormwater would enter silt traps for removal of silt and grit prior to discharging into the sea. It is anticipated that water pollution from stormwater runoff would not be an issue provided that all necessary design components of drainage systems are incorporated into the design and construction. Sewerage systems should also be provided to collect sewage generated from the development. Treatment and disposal of treated effluent would be in the nearest public sewage treatment works. It is not anticipated that sewage generation during the operational phase of the project would cause water pollution.
- 11.7.13 In addition, to enhance the Chinese White Dolphins (CWD) habitat, the Administration has made a firm commitment to seek to designate the Brothers Islands as a marine park in accordance with the statutory process stipulated in the Marine Parks Ordinance. A study will be conducted to work out the details of the proposed marine park before the commencement of the statutory procedures

as stipulated in the Marine Parks Ordinance. The designation of the proposed marine park would proceed after the completion of these projects. With the establishment of the new marine park and implementation of management measures, the fisheries resource of the area will be better managed and together with the other ecological enhancement measures, will enhance the long-term sustainability of the fisheries industry in the area.

11.8 Residual Impacts

- 11.8.1 The Project will result in some loss of fishing ground. However, the fishing ground loss is relatively small. This loss will result in an estimated reduction in total adult fish production of 57,750 kg in maximum, and is therefore not expected to have a significant negative impact on capture fisheries. Residual impacts of fishing ground loss are acceptable.
- 11.8.2 Provided that the mitigation measures for water quality are implemented, no significant residual impacts are predicted during the construction and operation phases on capture fisheries or mariculture.

11.9 Environmental Monitoring and Audit

- 11.9.1 Other than a water quality monitoring programme, no specific fisheries EM&A programme would be required during the construction and operation phases of the Project.
- 11.9.2 There will be a water quality monitoring programme for the construction and operation of the Project, with action and limit level criteria to safeguard the marine water quality in the area. No specific fisheries EM&A programme would thus be required during the construction and operation phases of the HKBCF and HKLR project.

11.10 Conclusion

- 11.10.1 The construction and operation of HKLR and HKBCF would cause fishing ground loss, but the lost area is not significant compared with the fishing ground in Hong Kong waters.
- 11.10.2 Further, the areas to be reclaimed are not of high production rate, whilst the water quality impacts during construction could be mitigated. Except the Artificial Reefs (ARs) inside Marine Exclusion Zone, impacts on other fisheries sensitive receivers, such as the nearby fish and shrimp spawning ground, have been assessed as acceptable.
- 11.10.3 There would be minor changes in water quality, all of which comply with Water Quality Objectives during the operation phase. Other than the ARs inside Marine Exclusion Zone, impacts on the fish and shrimp spawning ground in North Lantau waters and Tung Chung Bay (i.e. the next nearest sites of fisheries sensitive receivers) are assessed as not significant; impacts on other more distant sites would be even less. Re-provision of ARs will be implemented as a mitigation measure for the existing ARs inside Marine Exclusion Zone. Additional volume of ARs will also be deployed as an additional enhancement measure for fisheries resources. A well-planned program of water quality protection activities should enable avoidance of most of these potential impacts to capture fisheries and mariculture. Besides water quality monitoring, no specific fisheries monitoring programme would be required.

- 11.10.4 In addition, to enhance the Chinese White Dolphins (CWD) habitat, the Administration has made a firm commitment to seek to designate the Brothers Islands as a marine park in accordance with the statutory process stipulated in the Marine Parks Ordinance. A study will be conducted to work out the details of the proposed marine park before the commencement of the statutory procedures as stipulated in the Marine Parks Ordinance. The designation of the proposed marine park would proceed after the completion of these projects. With the establishment of the new marine park and implementation of management measures, the fisheries resource of the area will be better managed and together with the other ecological enhancement measures, will enhance the long-term sustainability of the fisheries industry in the area.

11.11 References

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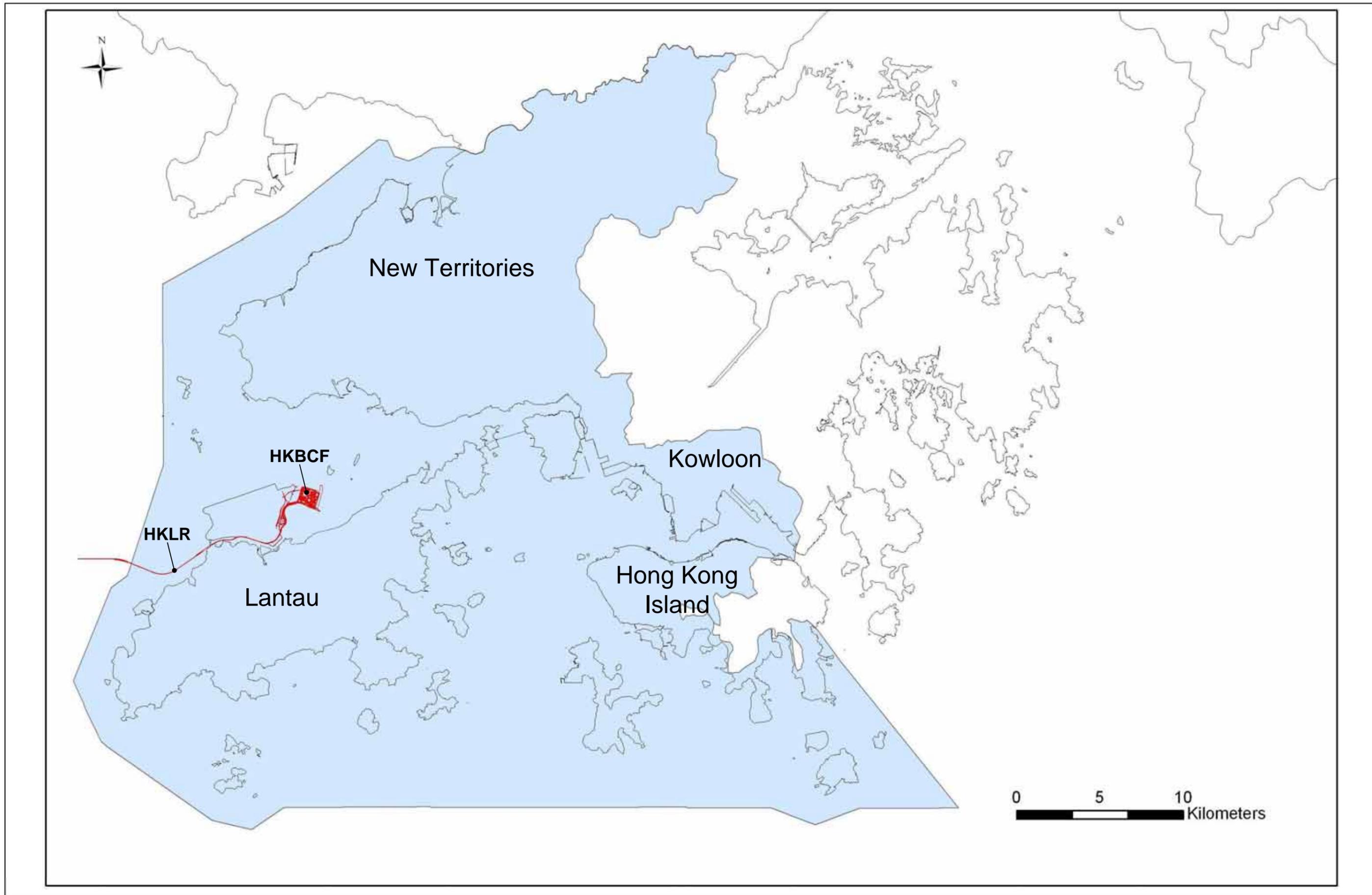
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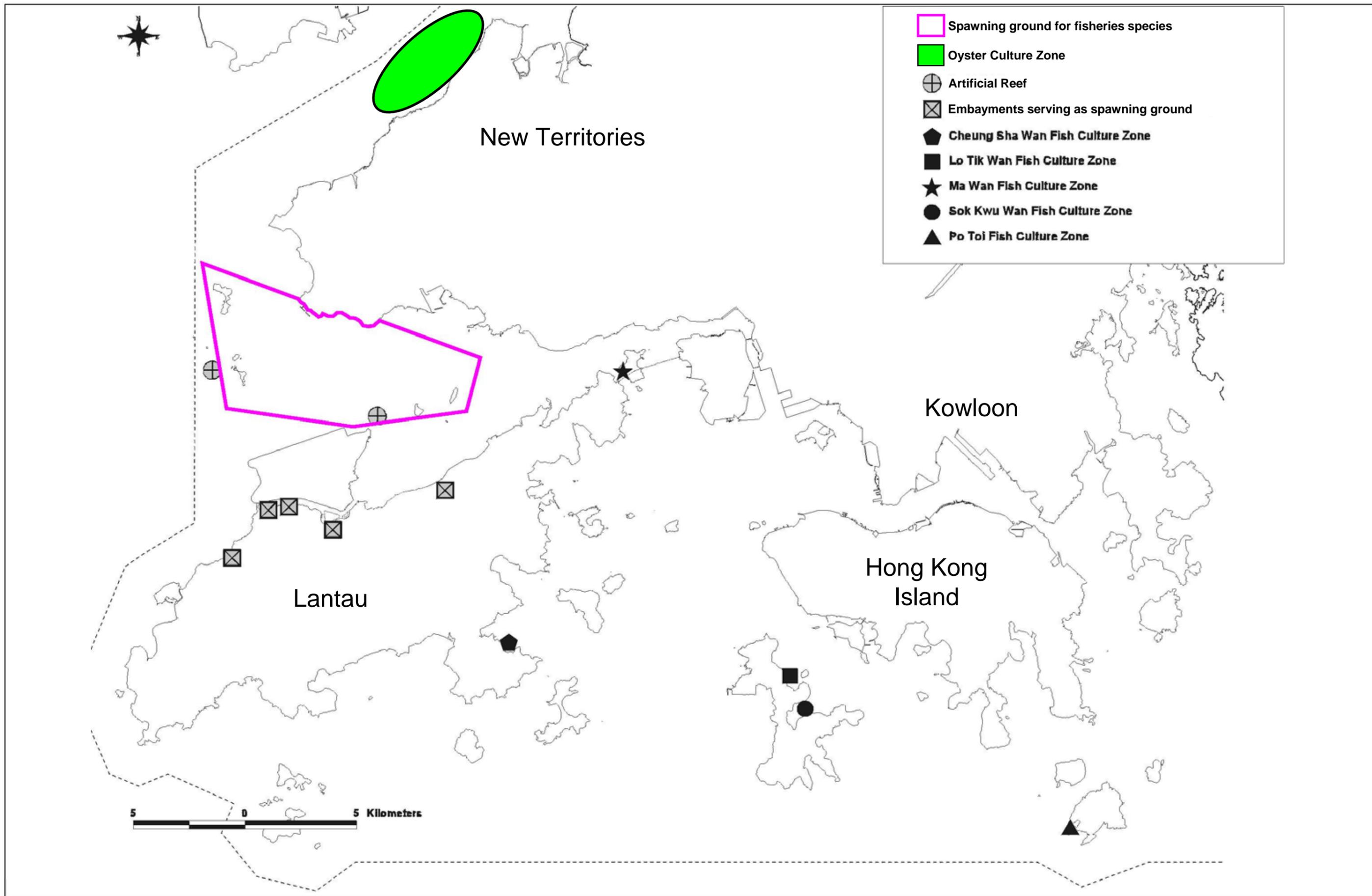
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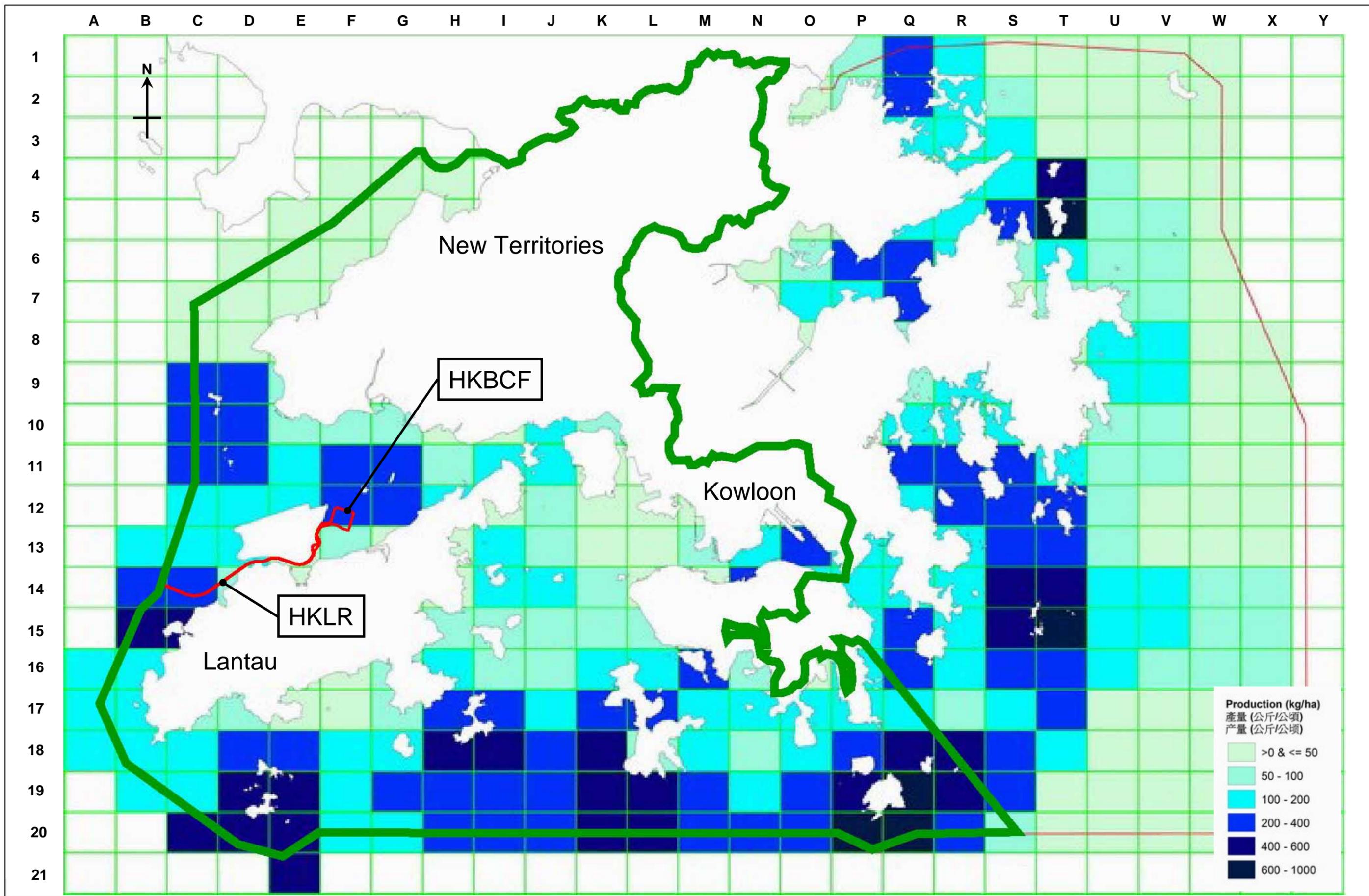
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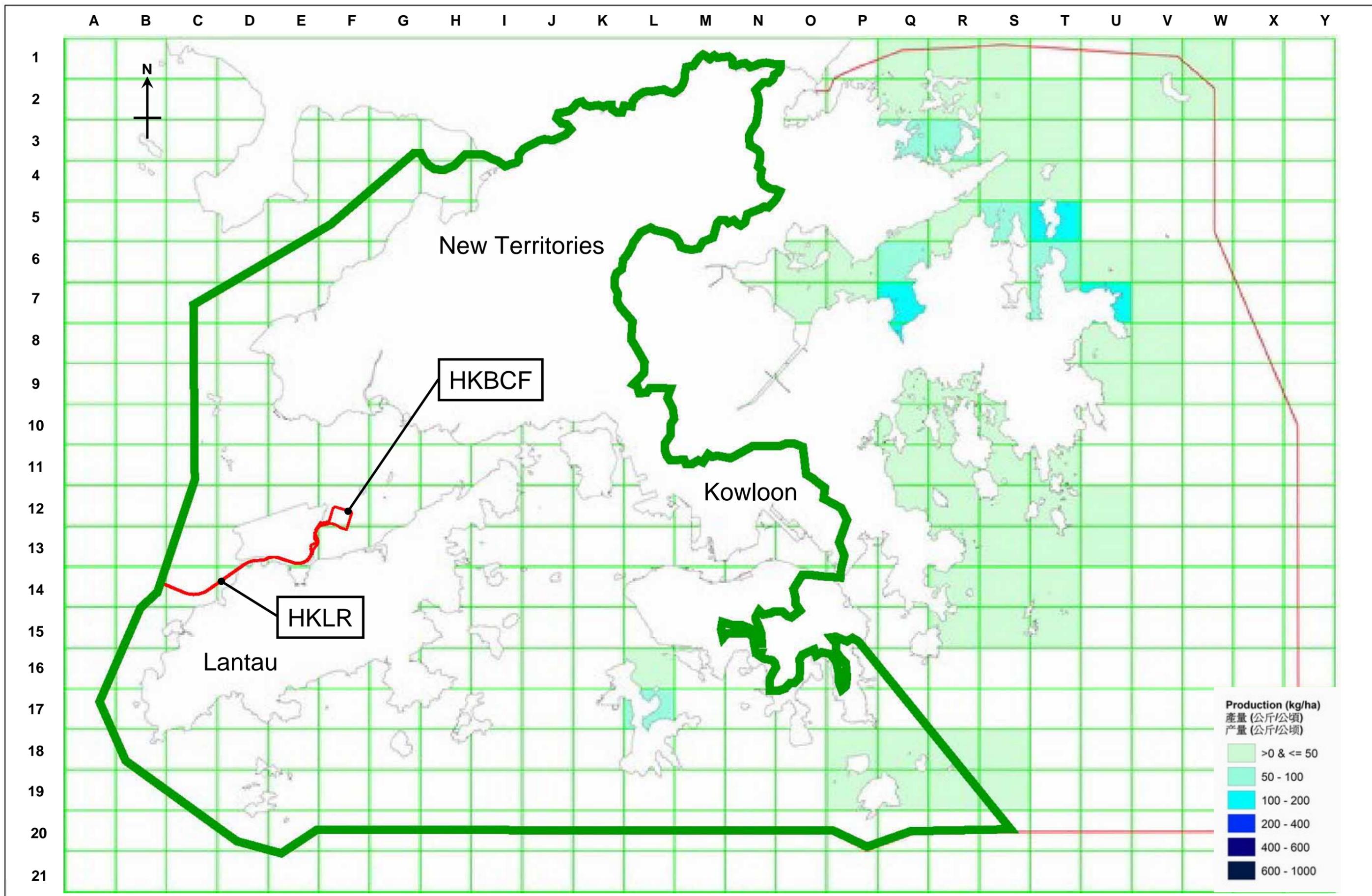
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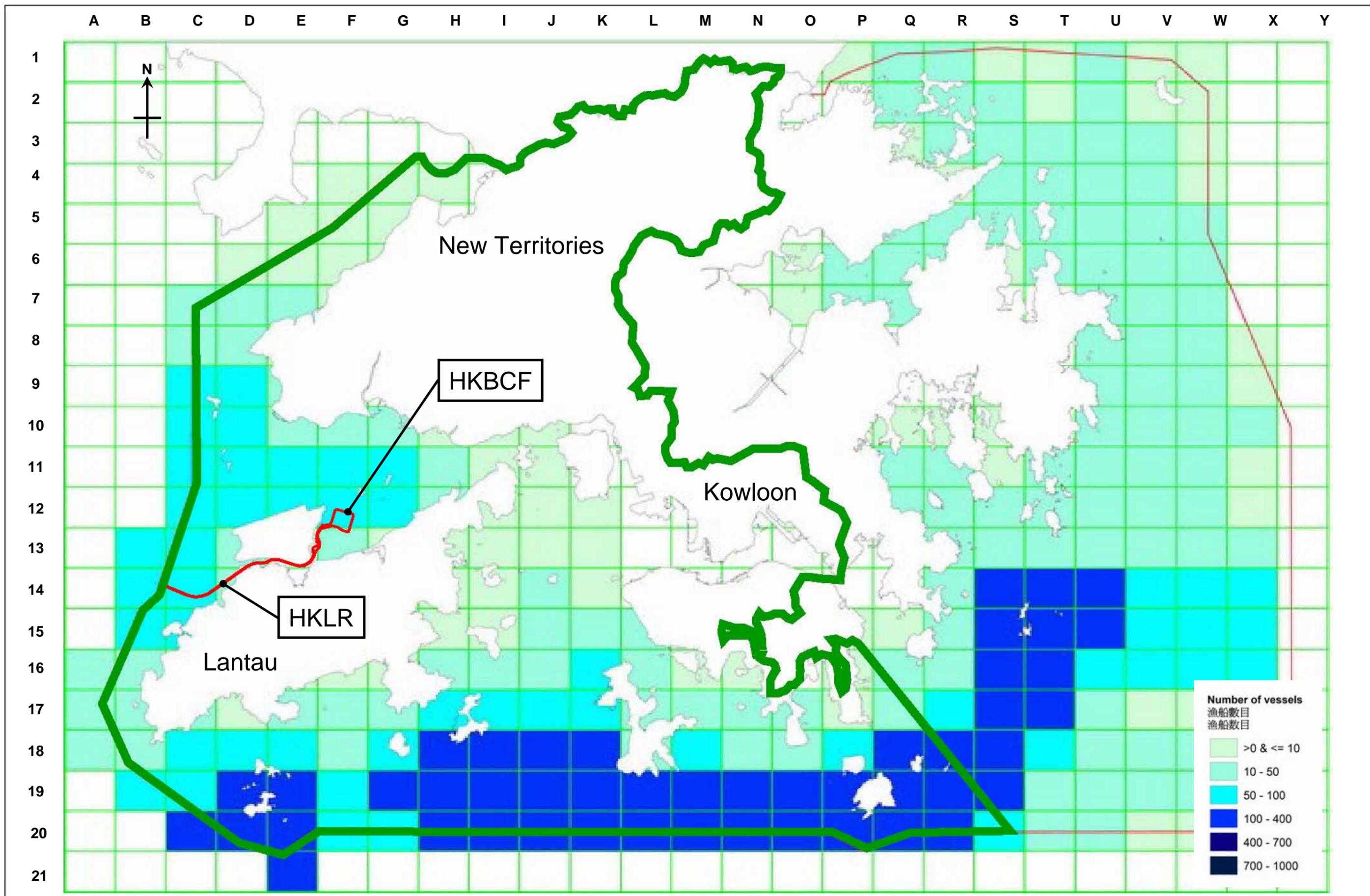
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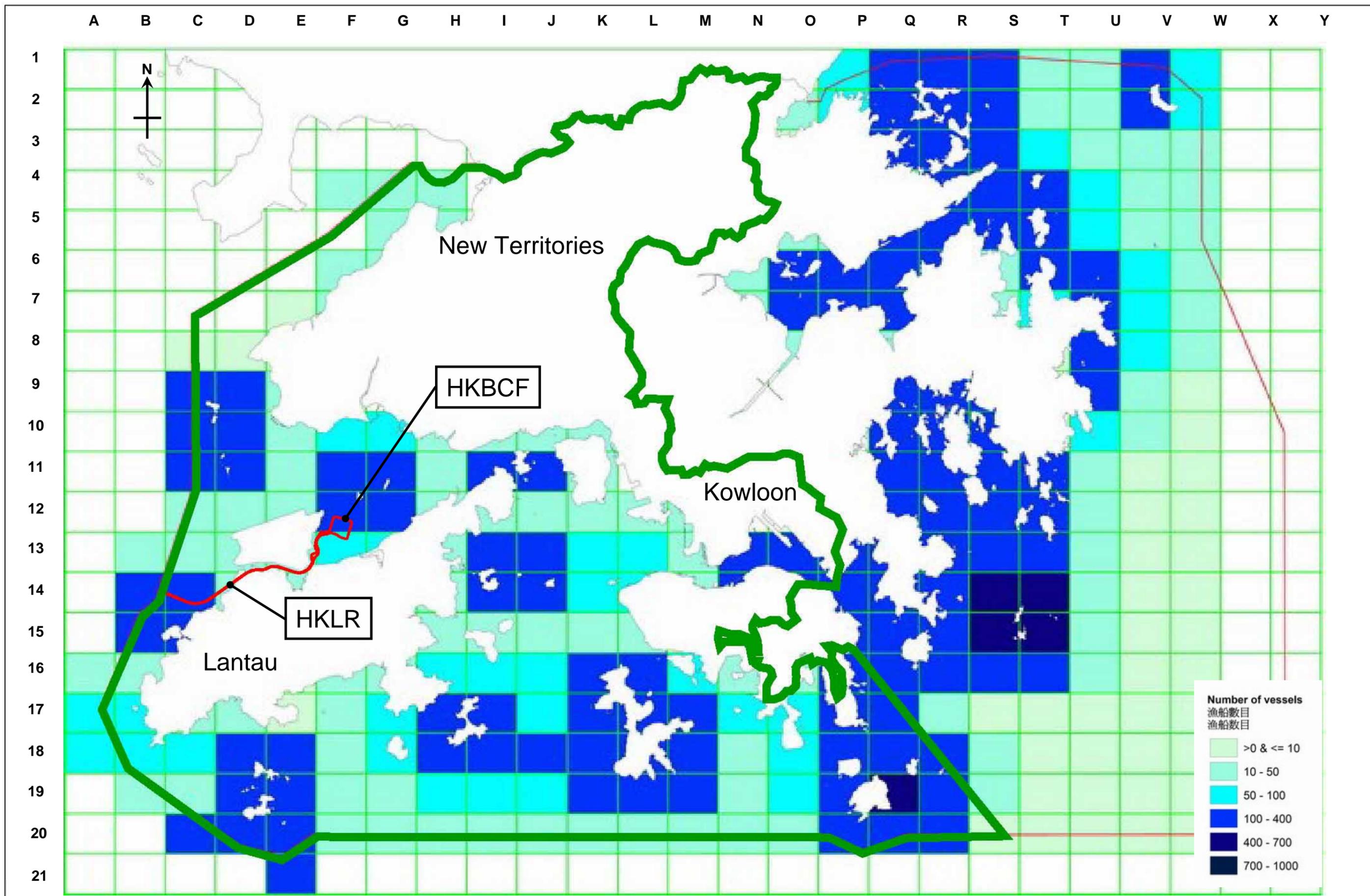


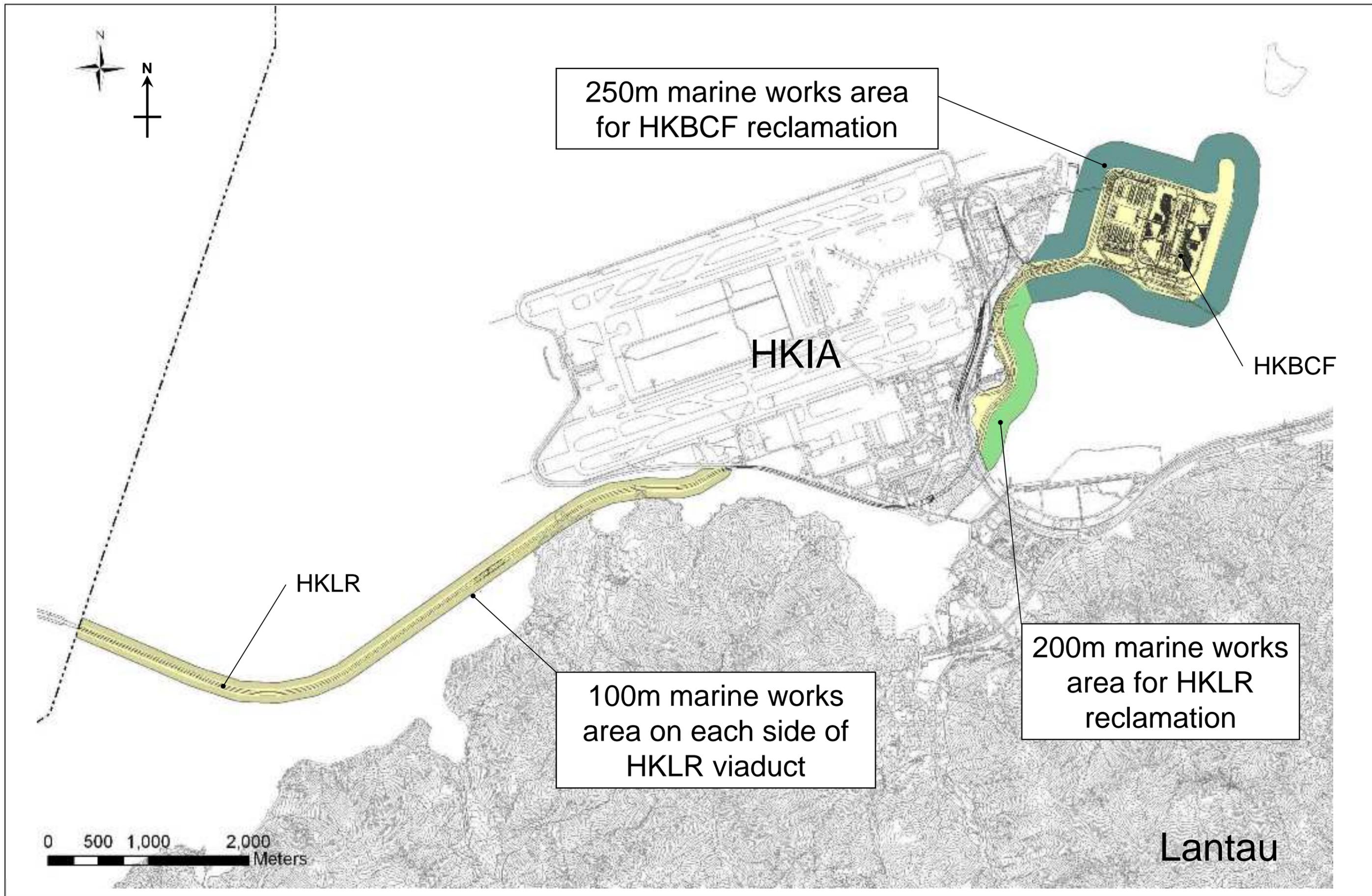


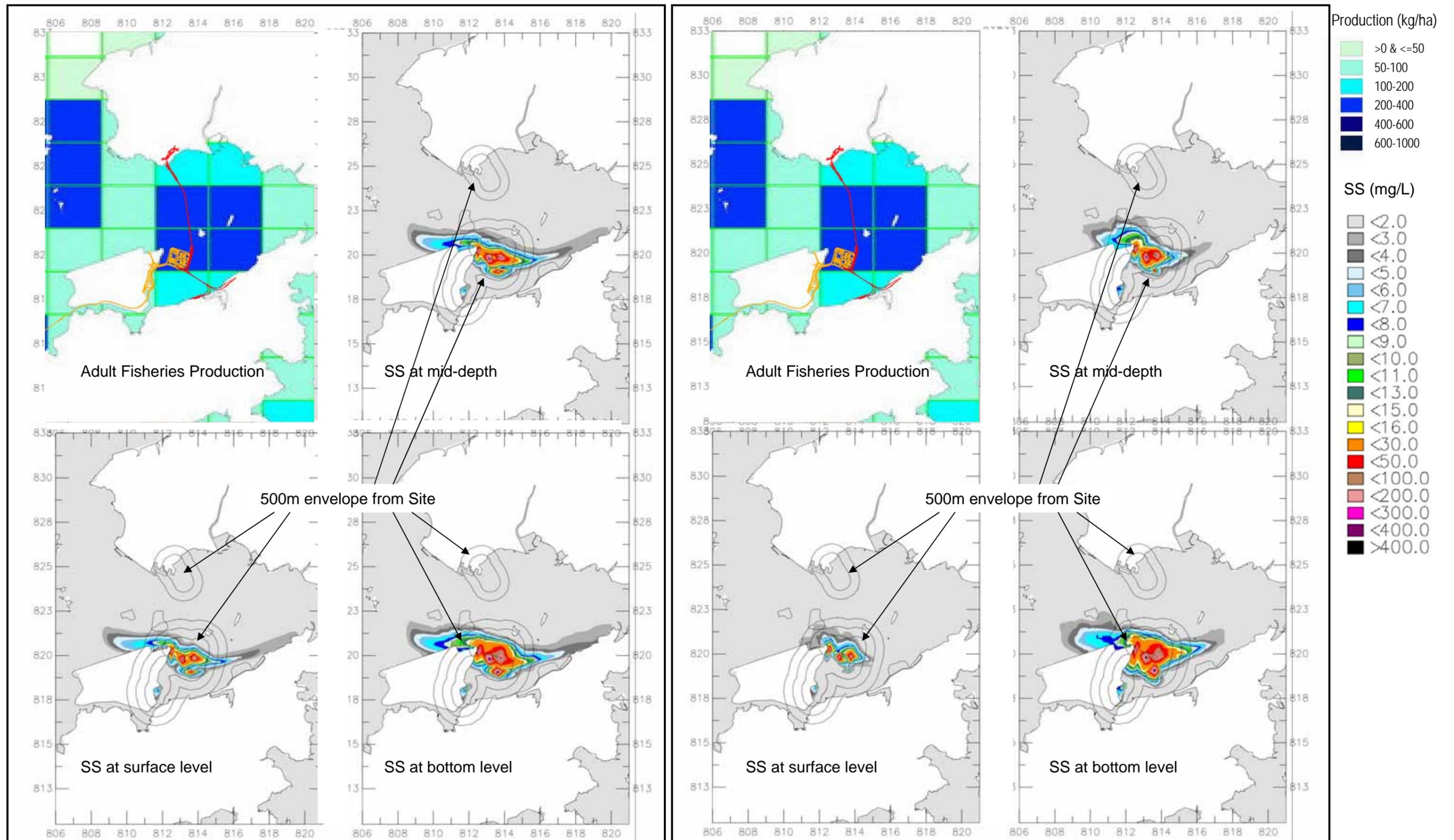








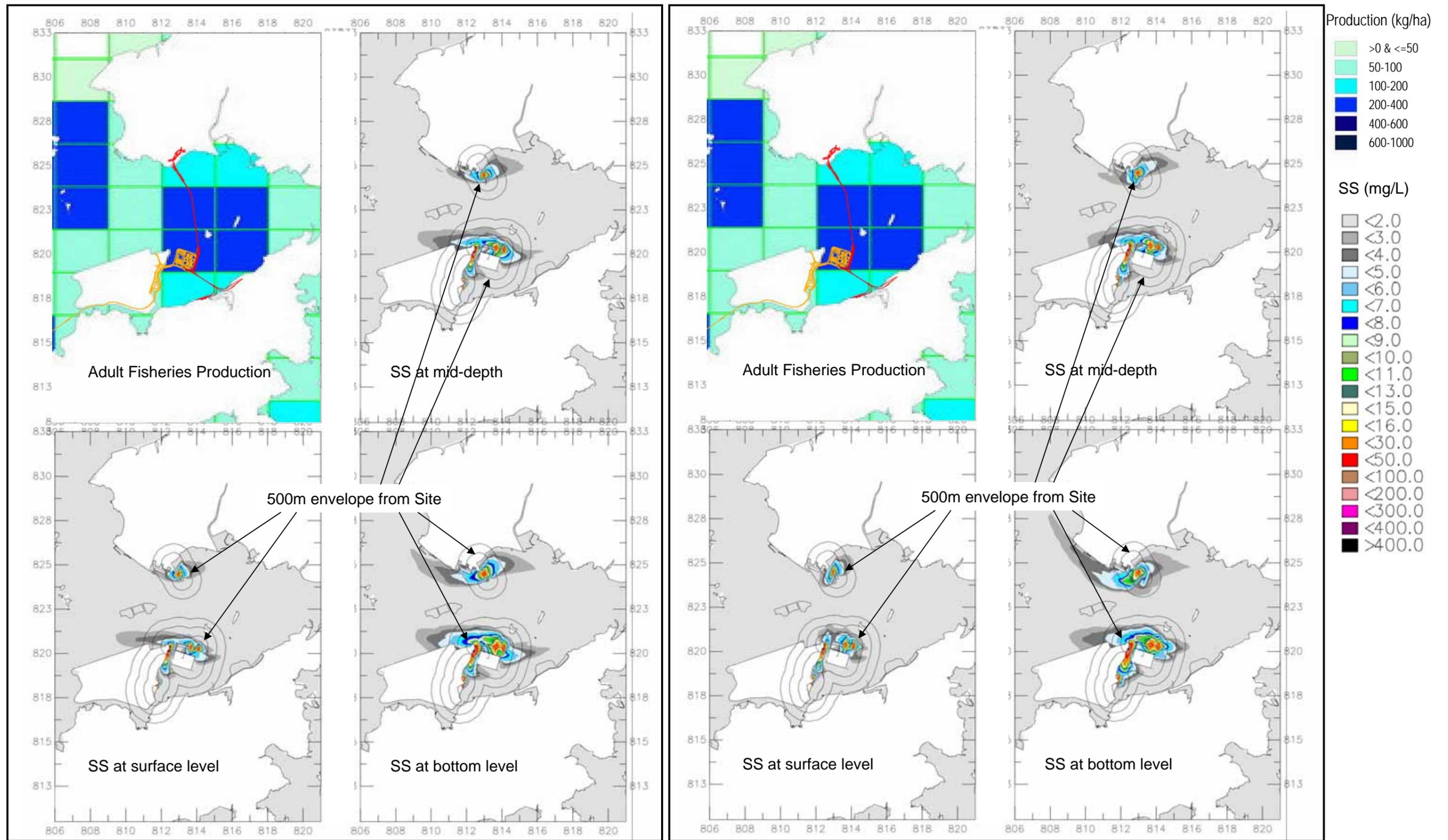




A) Dry Season, After mitigation with (1+1) silt curtain system

B) Wet Season, After mitigation with (1+1) silt curtain system

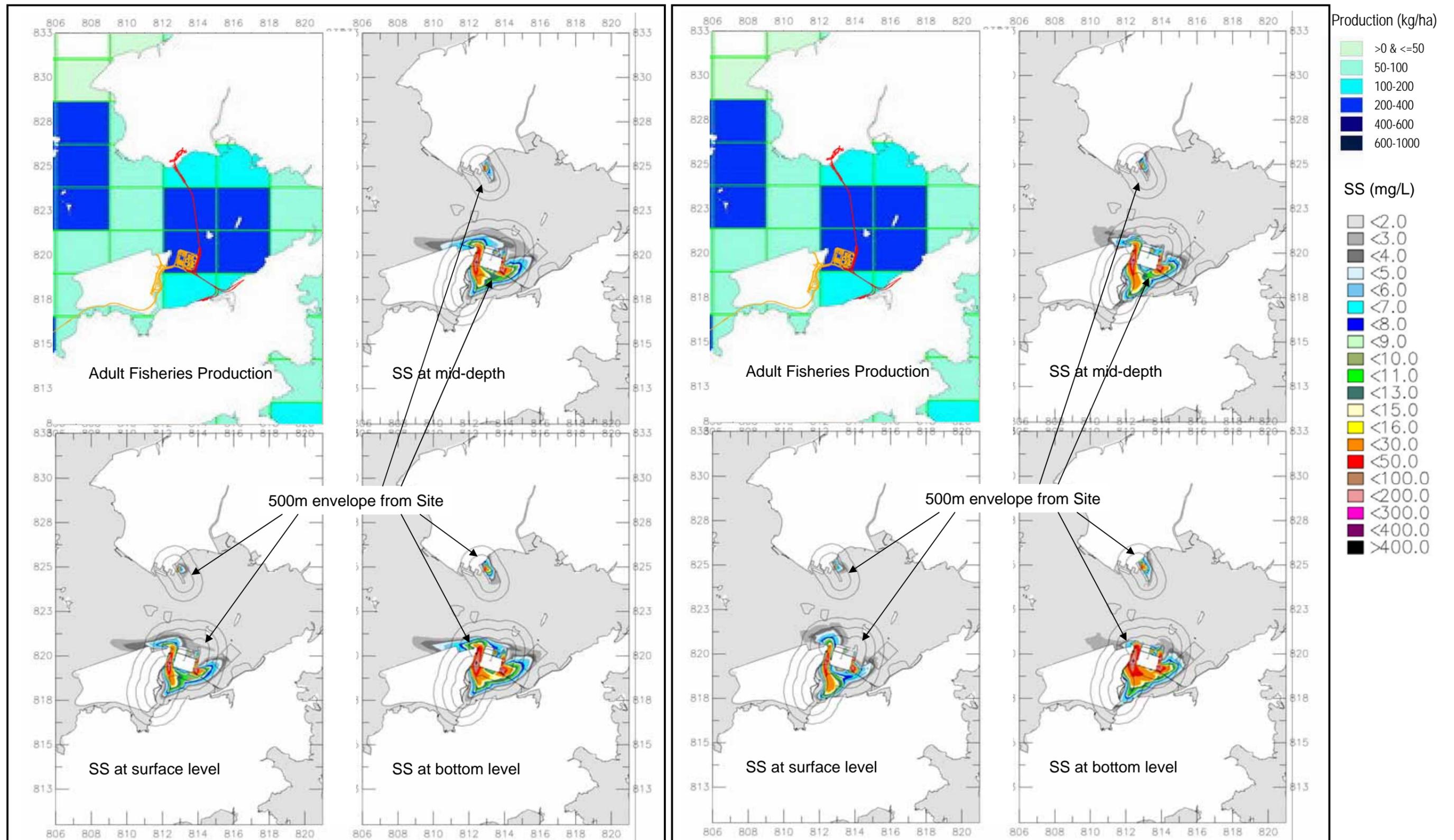
Note: The contour shows the predicted highest SS concentration over the whole simulation period and such a level may only be predicted for a very short period of time.



A) Dry Season, After mitigation with (1+1) silt curtain system

B) Wet Season, After mitigation with (1+1) silt curtain system

Note: The contour shows the predicted highest SS concentration over the whole simulation period and such a level may only be predicted for a very short period of time.



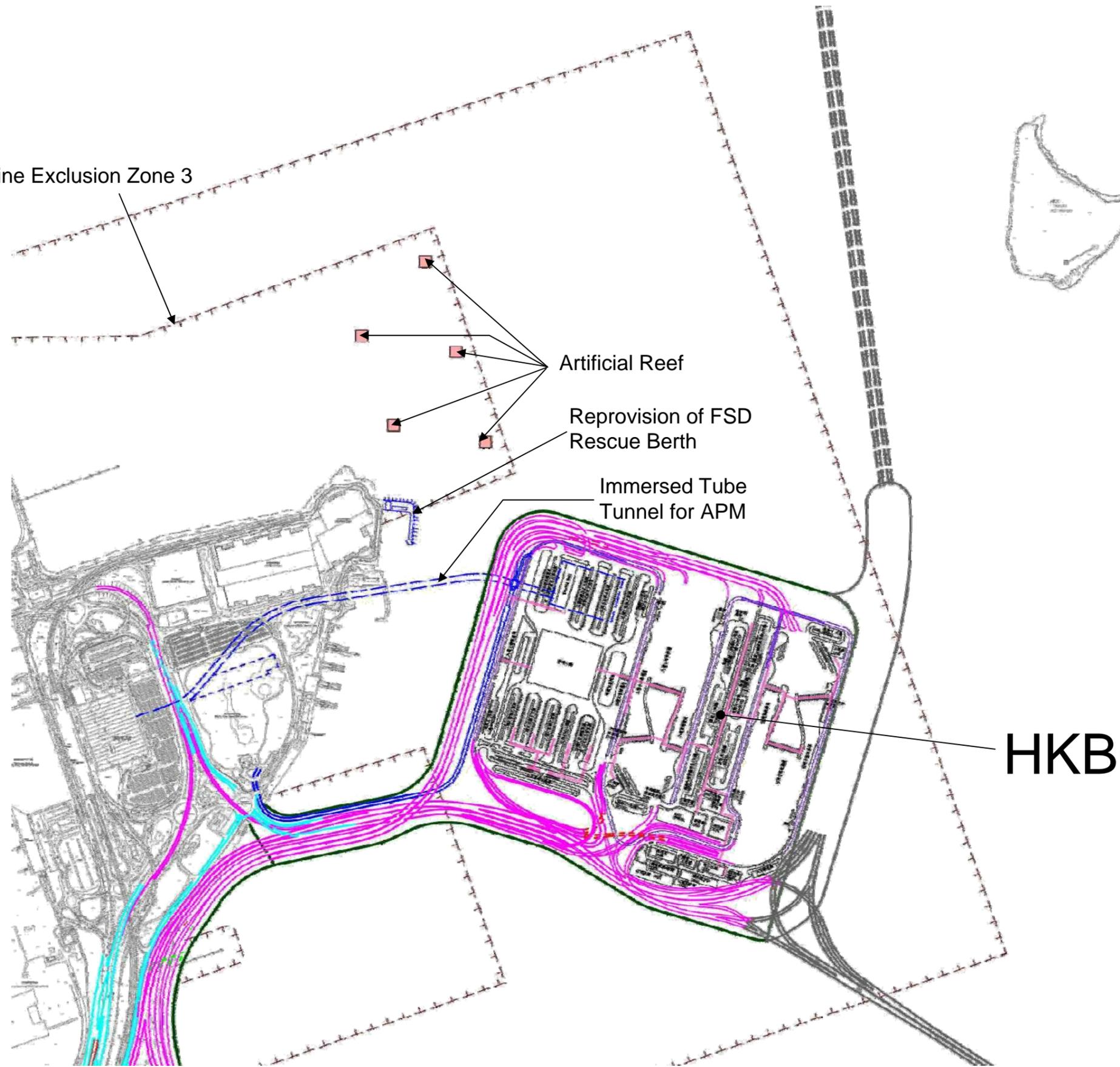
A) Dry Season, After mitigation with (1+1) silt curtain system

B) Wet Season, After mitigation with (1+1) silt curtain system

Note: The contour shows the predicted highest SS concentration over the whole simulation period and such a level may only be predicted for a very short period of time.



Marine Exclusion Zone 3



Artificial Reef

Reprovision of FSD
Rescue Berth

Immersed Tube
Tunnel for APM

HKBCF