



## **9. FISHERIES**

### **9.1 Introduction**

9.1.1 The Fisheries Impact Assessment comprises three major parts: establishment of baseline conditions, evaluation and assessment of fisheries impact following the criteria and guidelines of Annexes 9 and 17 of the EIAO-TM, and recommendations of mitigation measures where necessary.

9.1.2 Key issues of the Fisheries Impact Assessment, as stipulated in Section 3.4.7.2 of the EIA Study Brief No. ESB-211/2009, include but not be limited to the following:

- Fishing activities;
- Fish spawning and nursery grounds within the assessment area; and
- any nearby fish culture zones.

9.1.3 The assessment covers any potential short and long-term impacts on both capture and culture fisheries, during the construction and operation phases of the Project.

9.1.4 The Fisheries Impact Assessment includes the following according to the Study Brief:

- description of the physical environmental background;
- description and quantification of existing capture and culture fisheries activities;
- description and quantification of existing fisheries resources (e.g. major fisheries products and stocks);
- identification of parameters (e.g. water quality parameters) and areas that will be affected;
- identification and evaluation of any direct and indirect, onsite and offsite impacts on capture fisheries such as loss or disturbance of fishing grounds, spawning and nursery grounds and disruption of fishing activities;
- identification and evaluation of any direct and indirect, onsite and offsite impacts on cultures fisheries such as water quality deterioration in fish culture zone;
- recommendations on any environmental mitigation measures with justification, description of scope and programme, feasibility as well as staff and financial implications including those related to subsequent management and maintenance requirements of such recommendations; and
- review of the need for monitoring and, if necessary, recommendation of monitoring and auditing programme.

### **9.2 Environmental Legislation, Standards & Guidelines**

9.2.1 HKSAR Ordinances and Regulations which are relevant to this study 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 its subsidiary legislation; and
- Water Pollution Control Ordinance (Cap. 358) and its subsidiary regulations and statements.



### 9.3 Methodology for Baseline Establishment

- 9.3.1 In accordance with the EIA Study Brief, the Assessment Area generally covers the North Western Water Control Zone (WCZ) and other areas likely to be impacted by the Project. Special attention has been given to the fishing activities and fishing spawning and nursery grounds within the assessment area.
- 9.3.2 Existing information available from relevant studies/surveys regarding 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;
  - Latest AFCD Departmental Annual Report (for 2013 – 2014) and departmental website; and
  - Other relevant reports from private sectors or Government.
- 9.3.3 Port Survey is the most comprehensive territorial-wise fisheries study survey routinely conducted by AFCD every 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.
- 9.3.4 AFCD’s latest Departmental Annual Report (for 2013 - 2014) and departmental website provide the most updated information on the development and trend in Hong Kong fisheries. The latest annual fisheries production is also provided.
- 9.3.5 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).
- 9.3.6 The validity of the information compiled during the literature review has been assessed before it is adopted into the present FIA study.
- 9.3.7 Impacts are assessed in the absence of mitigation. The construction and operational phases impact of present project on fisheries resources have been assessed individually in the absent of other concurrent projects, and then assessed cumulatively, in combination with other existing, committed and proposed developments.

### 9.4 Assessment Methodology

- 9.4.1 The Assessment Area for the fisheries impact assessment generally covers the North Western Water Control Zone (WCZ) (**Figure 9.1**) and other areas likely to be impacted by the Project. Special attention has been given to the fishing activities and fishing spawning and nursery grounds within the assessment area (**Figure 9.1**). It also includes all areas within 500m from the boundary of the works area, i.e. Po Chue Tam, Kat Hing Back Street, Shek Tsai Po, Tai O Tai Ping



Street, Lung Tin Estate, Wang Hang Village, Leung Uk Tsuen, San Tsuen, Nam Chung Tsuen and Fan Kwai Tong.

### **Criteria to Evaluate Impacts**

- 9.4.2 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.
- 9.4.3 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 loss of fishing ground (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.
- 9.4.4 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.
- 9.4.5 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.
- 9.4.6 Finally, the FIA would conclude whether the mitigation measures could bring the negative impacts caused by the Project and its components within acceptable bounds.

### **Development of Mitigation Measures**

- 9.4.7 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.

## **9.5 Baseline Conditions**

### **Marine Environments**

- 9.5.1 The assessment area for fisheries impact assessment is the same as the assessment area for marine water quality. 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

- 9.5.2 Fishing grounds cover most of the open waters in north Lantau waters, except for shipping fairways and marine exclusion areas. The Project includes both land-based element and marine-based element (which involves dredging and reclamation) (see **Figure 9.2**), and would cause loss of fishing grounds in North Lantau waters.
- 9.5.3 Besides the fishing grounds, the following fisheries resources are located in North Lantau waters:
- Artificial reefs deployed within Sha Chau and Lung Kwu Chau Marine Park; and those to be deployed within the proposed Marine Park at the Brothers; and
  - Important spawning grounds for commercial fisheries resources in North Lantau waters.

### Capture Fisheries

- 9.5.4 The local fishing industry makes an important contribution to Hong Kong marine fish supply. In 2014, it produced an estimated 160,789 tonnes of fisheries production valued at about \$2,530 million. The industry now consists of some 4500 fishing vessels and 9400 local 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 (AFCD 2015a).
- 9.5.5 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 territorial-wise fisheries study survey routinely conducted by AFCD every 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, hand 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.
- 9.5.6 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.
- 9.5.7 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.
- 9.5.8 Within HKSAR waters, the highest yields for local fisheries were mainly derived from the eastern and southern coasts (e.g. the majority of the waters from south Lantau to Po Toi ) as indicated in the distribution of overall fisheries production on adult fish (see **Figure 9.3**), while the western buffer waters were comparatively less productive.
- 9.5.9 Within the North Lantau waters, there are some areas of higher production, including the waters around the brothers and around Sha Chau and Lung Kwu



Chau, But all these areas are far away from the Project Area and unlikely to be influenced by the Project given the small scale of reclamation involved.

- 9.5.10 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). The waters near Tai O also has higher fish production which is more relevant to the Project.
- 9.5.11 In Port Survey, grid cells are categorised into one of the 6 classes, i.e. > 0-50kg/ha; 50-100kg/ha; 100-200kg/ha; 200-400kg/ha; 400-600kg/ha; and 600-1000kg/ha, in accordance with their overall adult fish production. For present study, as reported in the Port Survey 2006, the catches from the reclamation area is ranked as high in Hong Kong waters (400-600kg/ha).
- 9.5.12 Fish fry production was only 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 9.4**). However, the results of Port Survey 2006 indicated that fry collection has become very limited and localized throughout Hong Kong waters. No fish fry production was recorded in the entire North Lantau waters including the Assessment Area.
- 9.5.13 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 100-400 fishing vessels operated near the Assessment Area (**Figure 9.5**). The fishing operation within the Assessment Area was mainly supported by vessels less than 15m in length. Sampan was the dominant fishing vessel, followed by Shrimp Trawler and Hang Trawler.
- 9.5.14 In Tai O waters, the most common capture fish around the Tai O waters is shrimp with a high production of 40 – 60kg/ha. Other common catches in this area include Scad (Carangidae), Rabbit Fish (Siganidae), Croaker (Sciaenidae) and Mullet (Mugilidae) with a medium production of 20 – 40kg/ha. The values of fish production is ranked as high (HK\$5,000 – 10,000 per ha annually), as compared with other fishing grounds in Hong Kong (**Figure 9.6**).
- 9.5.15 No important seasonal spawning area has been identified within the Project Site. Within the North Western WCZ, there is an important spawning area for commercial fisheries resources located approximately 8 km to the northeast of Tai O (the North Lantau waters between the Brothers Islands and Lung Kwu Chau) (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*.

### Culture Fisheries

- 9.5.16 In Hong Kong, aquaculture includes marine fish culture, pond fish culture and oyster culture. In 2014 production from the aquaculture sector was 3,377 tonnes value at \$169 million which was 2% in weight and 6% in value of the total fisheries production (AFCD 2015b).
- 9.5.17 Though there were some ponds in Tai O area as indicated in the habitat maps for ecology chapter, there were no sign of pond fish culture observed in those ponds. Even these ponds would have been used for fish culture, they should be abandoned for a prolonged period. And the land-based element for the Project is of very small scale and mainly conducted in urbanised area, it is thus considered



that pond fish culture is not an issue for the present FIA. As the oyster farming sites are far away (in Deep Bay area), the culture fisheries would only focus on marine fish culture. Marine fish culture In Hong Kong 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, goldlined seabream, star snapper and red drum (AFCD 2013b).

- 9.5.18 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 (**Figure 9.7**) occupying a total sea area of 209 ha with some 968 licensed operators. In 2014, the production from local marine fish culture was 1,255 tonnes (of value HK\$115 million), constituting 6% of the local demand for live marine fish (AFCD 2014b).
- 9.5.19 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 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 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.
- 9.5.20 There are no Fish Culture Zones (FCZs) within the footprint for the Project or in the vicinity. Of the 26 gazetted FCZs zones in Hong Kong, none occur within the fisheries assessment area (North Western WCZ). The nearest FCZ is the Cheung Sha Wan Fish Culture Zone, which is approximately 16 km to the southeast of the Project Site and sheltered from the Project Site by the landmass of Lantau Island. Ma Wan Fish Culture Zone is relatively closer to the North Western WCZ and is located about 22 km to the east of the Project Site.

### **Artificial Reefs**

- 9.5.21 Artificial reefs (AR), 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. The ARs at Airport Island is about 9 km from the Project Site, while the ARs in the Marine Park are about 11 km from the Project Site. The ARs in Marine Exclusion Zone 3 are indeed close to the on-going HKBCF construction site and are anticipated to be impacted by the HKBCF construction work, as such replacement ARs are proposed to be deployed as mitigation in the HKBCF EIA (ARUP 2009). Therefore, the ARs in Marine Exclusion Zone 3 are not considered as sites of fisheries importance in the present FIA.
- 9.5.22 Besides the above existing ARs, new ARs are also proposed in the Proposed Marine Park at the Brothers which is a mitigation measure for marine habitat loss due to the HKBCF reclamation. The authority made a firm commitment to seek the designation of a marine park at the Brothers, to mitigate the habitat loss of



Chinese White Dolphins. As it was predicted in the HZMB EIA that impacts on the ARs were expected, replacement ARs will be deployed as a mitigation measure, probably at the proposed The Brothers Marine Park, and will still be more than 10 km away from the Project Site. The detailed study for the proposed Marine Park and the new ARs are still ongoing, but the preliminary boundary of the proposed Marine Park has been proposed. In accordance with the HKBCF EIA, the new ARs would be at least three times the volume of the existing ARs inside the Marine Exclusion Zone, and thus should be over 3,600m<sup>3</sup>.

### **Fisheries Sensitive Receivers**

9.5.23 Identified fisheries sensitive receivers include the following:

- Fishing ground around Tai O waters;
- Nursery ground for commercial fisheries resources in South Lantau;
- Artificial reefs deployed within Sha Chau and Lung Kwu Chau Marine Park; and those to be deployed within the proposed Marine Park at the Brothers; and
- Important spawning grounds for commercial fisheries resources in North Lantau waters.

### **Identification of Data Gap**

9.5.24 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 and fishing operations have provided information sufficient for fisheries impact assessments 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.

## **9.6 Impact Identification and Evaluation**

### **General Environmental Impacts**

- 9.6.1 The assessment and sensitive receivers largely focused in the North Lantau waters where the Project is located. For the fisheries resources, the water quality assessment results would be able to demonstrate whether they are subject to indirect impacts from the Project.
- 9.6.2 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 submarine outfall.
- 9.6.3 Fully-dredge with the use of closed grab dredgers is a traditional way to construct submarine outfall. The seabed is dredged to the required depth for placing the outfall pipes and the pipes protection materials. Under this option, the outfall could be designed to its shortest length of 130m in order to minimize the associated environmental impacts during both the construction and operation stage. Proper protections on outfall pipes with armoured rock could be provided to enhance the durability of pipelines. Measures such as silt curtains could be provided around the seabed excavation for the outfall construction so as to contain marine sediment and minimise water quality impact.



9.6.4 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 construction run-off, dredging and filling, and associated impacts on fisheries resources.

9.6.5 Potential sources of impact during the operation phase include:

- Changes in water quality caused by normal discharge of treated sewage from outfall and emergency discharge of untreated sewage from STW and/or the two proposed SPSs;
- 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**

9.6.6 Reclamation comprising a seawall and stone fill reclamation, adjacent to, and at the west of the existing STW site. It would cause a net loss of 0.26 ha of seabed and water column, and thus a permanent loss of fishing ground. The works areas for both the reclamation and the outfall construction would also constitute a temporary fishing ground loss of 1.1 ha as the works areas would not be available for fishing operations during the construction phase.

9.6.7 When compared with the 1,651km<sup>2</sup> of Hong Kong's total marine waters (EPD 2005) which is mostly available for fishing, the permanent (0.26 ha) loss of fishing ground and temporary fishing ground loss (1.1 ha) caused by the Project is considered to be of insignificant proportion. Moreover, the proposed reclamation area is located near the seashore, fishing activities are unlikely to occur at the loss area.

9.6.8 Although the sea areas of the temporary and permanent losses are of high production output, the magnitude of the impact would be very low due to the very small sizes of reclamation and works areas. For the present project, the reclamation area is very small, if based upon the production of Tai O waters (production of the grid cell is 400 – 600kg/ha), the maximum loss from the 0.26 ha would be only 156kg per year. This impact is therefore considered **Insignificant** and hence mitigation is not required.

**Construction Phase – Indirect Impacts (Water quality impact)**

9.6.9 The major potential activities that could cause water quality impacts during the construction phase of the Project include:

- Marine traffic (e.g. working barges);
- Dredging;
- Seawall construction;
- Reclamation filling behind seawall;
- Construction site runoff; and
- Wastewater from construction activities.

9.6.10 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. This impact is therefore considered **Insignificant** and hence mitigation is not required.

- 9.6.11 During construction phase, dredging works are required to remove the soft marine deposit underneath the foundation of seawall and reclamation area. The proposed seawall shall comprise pre-casted seawall blocks and suitable back filling material at the boundary of reclamation area. In fact, dredging and filling works for the reclamation and submarine outfall are both potential sources of suspended solids and the associated water quality deteriorations such as reduction in dissolved oxygen. In accordance with the water quality assessment results, the allowable SS increase would be exceeded the allowable limit (i.e. less than 30% of the ambient concentration at all times referring to the WQO standard of SS, or 4.3 mg/L in this case) within 550m from the dredging site if no mitigation measures are taken during the dredging activity. The potential impact is ranked as **minor** and appropriate mitigation measures to the dredging activities will be implemented to minimise the potential impact.
- 9.6.12 A dredging rate of 62.5m<sup>3</sup>/hour is recommended. Reduction in dredging rate will decrease the dispersion of suspended solids which in turn would prolong the dredging duration. It is estimated that the dredging duration would be less than 2 months with the dredging rate of 62.5m<sup>3</sup>/hour. Subsequently, the sediment release rate will be decreased to around 0.313 kg/s. Cage type silt curtains will also be provided during the dredging. Suspended solids will be reduced by 75% with the incorporation of silt curtain.
- 9.6.13 With the implementation of mitigation measures including using closed grab dredges, reducing the dredging rate and installing silt curtains, the elevation of suspended solids concentration will greatly decrease compared to those without mitigation measure (see Table 5.14 in water quality chapter), and the SS only fails the compliance of the WQO standard (i.e. 4.3mg/L) within 150m area, which is considered acceptable.
- 9.6.14 Western Hong Kong waters are in estuarine conditions and characterized by high background levels of suspended solids due to the proximity to the Pearl River estuary. Marine fauna including fisheries species in western waters are inhabiting an environment subject to estuarine influences, and thus should be able to adapt to a high SS environment, and the fish has developed some adaptation behaviour (e.g. clearing of gills, swimming to clear areas) to tolerate such environment. Therefore, they are not expected to be impacted by the small-scale SS increase caused by the Project.
- 9.6.15 The dredged marine sediment may contain organics materials and lead to a decrease in dissolved oxygen. The water quality results indicated that the DO is still in compliance with the WQO standard (4mg/L) even without mitigation. With the implementation of above-mentioned mitigation measures to the dredging activities, the DO depletion will be further reduced. Thus, no significant adverse impact on DO is anticipated.
- 9.6.16 Resuspension of seabed sediment might potentially incur the release of contaminants, if any, into the seawater. If contaminants are present in the seawater, they 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 5.6.18**). Results indicate that the impacts would comply with statutory requirements.



- 9.6.17 The potential water quality impacts due to land works including 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 5.6.1 – 5.6.7**).
- 9.6.18 There is also 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.
- 9.6.19 The impact from water quality deterioration on fisheries resources and fisheries sensitive receivers is thus ranked as **Minor** and specific mitigation is not required other than the water quality measures.

#### **Construction Phase – Indirect Impacts (Disturbance on Fishing Operation)**

- 9.6.20 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, these small vessels would have higher flexibility in their operations and less sensitive to disturbance from marine traffic. Given the small size reclamation area, this temporary impact would be **Minor**. No mitigation is required.

#### **Operational Phase – Direct Impacts**

- 9.6.21 No direct impact is expected to arise during operational phase under the normal operation of the proposed sewerage works.

#### **Operational Phase – Indirect Impacts**

- 9.6.22 The operation of SPS with associated gravity sewers will connect unsewered areas to sewer mains. The sewer mains will lead untreated or partially treated sewage to Tai O STW, and that treated effluent will then be discharged into the North Western WCZ. In other words, the total pollutant load to the North Western WCZ is expected to decrease through the decrease in untreated sewage discharge. Potential improvements to water quality would therefore be achieved and that fisheries resources would receive beneficial impact. The near-field modelling water quality results in Section 5.6 indicated that during the operation phase, the water quality parameters at a distance of 10 ~ 11m from the outfall (i.e. the edge of the initial mixing zone) would generally meet the WQO standard, with a marginal (i.e. 0.01 mg/L) non-compliance at TIN in wet season. However, the background TIN value is relatively high (0.44mg/L) compared to WQO standard (0.5mg/L), and this exceedance only occurs under one extreme condition. The compliance of the TIN WQO was achieved in all other scenarios. Therefore, no adverse impact from TIN increment is anticipated. For the fisheries resources near Tai O, as compliance of WQO on the concentrations of concerned pollutants were observed at the edge of initial mixing zone, no adverse water quality impact is anticipated, especially outside of the initial mixing zone. The initial mixing zone was also predicted to be localized in a small scale. Thus, it is expected that the no significant adverse impact would occur to the fisheries resources in the vicinity of Tai O.
- 9.6.23 According to the Water Quality Chapter, a time-series comparison of the magnitude and direction of tidal flow currents near the project area for the pre-



and post- reclamation scenarios was conducted. The comparison shows that the hydrodynamic change due to the reclamation is not significant.

- 9.6.24 In case of the failure of the duty and standby submarine outfalls, treated effluent would be diverted to the emergency outfall for discharge. Furthermore, raw sewage may be diverted to the submarine outfall or the emergency outfall for discharge in the case of temporary failure of treatment units. Though these emergency events would be rare, the worst case of discharge via emergency outfall was evaluated in the water quality assessment and presented in Section 5.6. For most of the water quality parameters, they could meet the WQO standard after 100m distance from the release point. The exceptions are TIN and UIA which require longer distances from 1000m to 1500m. There will also be potential adverse impact on water quality associated with sewage overflow from the SPS during pump failure, power supply failure, and damage to pressure main or flooding. Nevertheless, with the precautionary measures discussed in the Water Quality section, such as provision of standby power to secure electricity supply, and provision of standby pumps etc., the possibility of sewage overflow would be extremely remote. Therefore, potential adverse impacts on fisheries due to sewage overflow are considered to be **Insignificant**.



**Table 9.1 : 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		
<b>Construction phase</b>										
Loss of fishing grounds	Reclamation for Tai O STW	Tai O waters	Permanent	0.26 ha	Yes	Do not encroach on important spawning and nursery ground.	Reduction of fishing area and the fishing activities will be affected by increasing marine traffic	No	Insignificant	No
	Works areas for reclamation and Submarine outfall construction	Tai O waters	Temporary	1.1 ha	Yes	Do not encroach on important spawning and nursery ground.	Reduction of fishing area and the fishing activities will be affected by increasing marine traffic	No	Insignificant	No
Marine water quality deterioration	Dredging and filling Reclamation	Fisheries resources and fisheries sensitive receivers	Temporary	Tai O waters	No	Potentially disturbed spawning and nursery ground in the Brothers and Lung Kwu Chau, but the areas are too far from the Project Site (~8km), the effect will be insignificant.	No	No	Minor	Only water quality mitigation measures and monitoring
Disturbance on fishing operations	Marine traffic from construction	Fishing vessels	Temporary	Near the works area	No	No	Yes	No	Minor	No



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		
<b>Operation phase</b>										
Change of hydrodynamic regime	Marine structures (Reclamation)	Fisheries resources and fisheries sensitive receivers	Permanent	Tai O waters	No	No	No	No	Insignificant	No. Only water quality monitoring
Marine water quality deterioration	Treated effluent from submarine outfall	Fisheries resources and fisheries sensitive receivers	Permanent	Tai O waters	No	No	No	No	Insignificant	No
	Emergency events	Fisheries resources and fisheries sensitive receivers	Occasional incidents	Tai O waters	Yes	No	No	No	Insignificant	Emergency plans stated in water assessment chapter



9.6.25 Construction and Operational phase impacts on fisheries are summarised in **Table 9.1** 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**

9.6.26 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.

9.6.27 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 present project, thereby resulting in cumulative impacts whose effects would exceed in severity those of the various projects taken individually. Nearby projects that would have potential cumulative fisheries impacts (water quality) are shown in **Table 9.2**.

9.6.28 The projects are all land-based construction, potential indirect impact may affect water quality and subsequent fishery resources. However, no accumulation effect is expected if proper mitigation measures such as good site practice are employed by those projects.



**Table 9.2 : Concurrent Projects with Implications on Fisheries**

Proposed Development	Nature of the projects	Impacts to be Considered		Seabed loss	Schedule
		Construction	Operation		
Natural Terrain Hazard Mitigation Works” undertaken by CEDD/GEO	Natural terrain hazard mitigation works	✓		No	Commence in June 2015, for completion in December 2017
Water Supply from Tung Chung to Tai O	Construction of water mains	✓		No	The design and construction of this project is suspended at the current stage
Replacement and Rehabilitation of Water Mains Stage 3, Mains On Hong Kong and Islands – Investigation, Design and Construction	Construction of water mains	✓		No	Mid 2012
Replacement and Rehabilitation of Water Mains Stage 4, Mains On Hong Kong and Islands – Investigation, Design and Construction	Construction of water mains	✓		No	Mid 2012 – Mid 2016

## 9.7 Mitigation of Impacts

9.7.1 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

9.7.2 There would be permanent loss of fishing ground due to the reclamation, but the impact is considered Insignificant. Mitigation is thus not required. On the other hand, adoption of sloping rip-rap seawalls to provide more microhabitats for fish fry can be considered. Artificial seawalls in the form as inclined rubble-mount are considered of some fisheries value due to the artificial reef like function in some approved EIA studies such as HZMB-HKBCF (ARUP 2009).

### Construction phase – Indirect Impacts

9.7.3 Mitigation measures for water quality would be required. Any significant changes in water quality or turbidity (re-suspension of sediments) should be avoided. This could be mitigated through construction methods. This includes measures such as using closed-grab dredging, and using cage type 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.

- 9.7.4 Good Site Practices: – The integrity and effectiveness of all cage type 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.
- 9.7.5 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.
- 9.7.6 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 ecological resources. Given these measures, the marine ecosystem as well as fisheries resources in the area would be protected.

### Operational phase

- 9.7.7 No fisheries specific mitigation measure is required for the operation phase of the Project.
- 9.7.8 Mitigation measures for the construction and operational impacts are summarised in **Table 9.3** below:

**Table 9.3 : Mitigation Measures for Construction Phase**

Impacts	Mitigation Measures and Effects
Water quality	Cage type 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

- 9.7.9 The implementation arrangement, resources requirement, subsequent management and maintenance of the above proposed mitigation measures will be detailed in separated contracts and covered by the EMIS.

### 9.8 Residual Impacts

- 9.8.1 The Project will result in loss of fishing ground. However, the loss of fishing ground is relatively small. The loss will result in an estimated reduction in total adult fish production of 156 kg per year in maximum. Moreover, the proposed reclamation area is located near the seashore, fishing activities are unlikely to occur at the loss area.





Therefore the loss of fishing ground is not expected to have a significant negative impact on capture fisheries. Residual impacts of loss of fishing ground are acceptable.

- 9.8.2 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.

## 9.9 Environmental Monitoring and Audit

- 9.9.1 There will be monitoring and auditing for marine water quality during construction of the Project. A monitoring and audit programme aims to ensure that the released SS concentrations from the dredging activities would not adversely affect the sensitive receivers. This monitoring programme would be used to assess the effectiveness of mitigation measures during construction. No specific fisheries EM&A programme would thus be required during the construction and operation phases of the project.

## 9.10 Conclusion

- 9.10.1 The reclamation would cause a net loss of 0.26 ha in sea area (seabed and water column) in North Lantau waters. When compared with the 1,651 km<sup>2</sup> of Hong Kong's total marine waters which is mostly available for fishing, the fishing ground loss caused by the Project is considered to be very small. This loss would therefore be Insignificant. Besides the permanent loss, the project aims to improve the coastal water quality to the northwest of Tai O by provision and upgrading the sewage treatment facilities, which may have potential benefits for fishery resources in the long term. Besides the water quality mitigation measures, no other mitigation measures for fisheries are required.

## 9.11 References

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