

6 Fisheries Impact

6.1 Introduction

6.1.1 This Section provides an evaluation of the potential fisheries impacts arising from the construction and operation of the proposed Project. Appropriate mitigation measures have been recommended, where necessary, in order to mitigate the impacts.

6.2 Environmental Legislation, Standards and Criteria

6.2.1 The relevant local legislation, standards and guidelines applicable to the assessment of fisheries impact include:

- Annex 9 of the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) - provides the criteria for evaluating the fisheries impacts of this Project.
- Annex 17 of the EIAO-TM – sets out the methodology for assessment of fisheries impacts, in order to provide objective identification, prediction and evaluation of potential fisheries impacts arising from the Project.
- Fisheries Protection Ordinance (Cap. 171) – promotes the conservation of fish and other forms of aquatic life within Hong Kong waters by regulating fishing practices to prevent detrimental activities to the fisheries industry. The authority may also make rules for the management and control of fishing in any fisheries protection area, including but not limited to the specification of any zone within any fisheries protection area and the prohibition of any fishing in the specified zone.
- Marine Fish Culture Ordinance (Cap. 353) – regulates and protects marine fish cultured by designating areas of fish culture zone, granting licenses, prohibiting unauthorised vessels and any deposition of chemicals or other substances which are likely to cause injury to fish in a fish culture zone.
- Water Pollution Control Ordinance (Cap. 358) – aims to control water pollution in waters of Hong Kong. Water Control Zones (WCZs) are designated with individual water quality objectives to promote the conservation and best use of those waters in the public interest.

6.3 Effluent Disposal Arrangement

6.3.1 This Project will upgrade the design capacity of Tai Po Sewage Treatment Works (TPSTW) from 120,000 m³ per day to 160,000 m³ per day in Average Dry weather Flow (ADWF). Only land-based construction activities will be carried out at the Project site in Tai Po industrial Estate (TPIE). No marine works will be required for the Project.

6.3.2 Currently, disinfected secondary effluent from the existing TPSTW is conveyed to Kai Tak River (KTR) in Victoria Harbour via the Tolo Harbour Effluent Export Scheme (THEES). The THEES effluent will then run through the Kai Tak Approach Channel (KTAC) and Kwun Tong Typhoon Shelter (KTTS) and eventually discharge into the main open channel of the Victoria Harbour. During the THEES maintenance period, treated effluent from the existing TPSTW would be discharged via the existing emergency outfall of TPSTW. The existing Sha Tin Sewage Treatment Works (STSTW) will be relocated to caverns under the Sha Tin Cavern Sewage Treatment Works (CSTW) project. The CSTW is being constructed and will be operated before commissioning of this Project. During the THEES maintenance period, treated effluent from the CSTW will also be discharged to Tolo Harbour via the existing emergency outfall of STSTW. Under the emergency situation, primarily treated effluent from the existing TPSTW would be discharged to Tolo Harbour via the existing emergency outfall of TPSTW. Locations of the existing emergency outfalls of TPSTW and STSTW are shown in **Figure 6.1**.

- 6.3.3 This Project will follow the same effluent disposal arrangement of the existing TPSTW during both construction and operational phases.

6.4 Assessment Area

- 6.4.1 The assessment areas of this fisheries impact assessment are the same as the water quality impact assessment areas including the entire Tolo Harbour and Channel Water Control Zone (WCZ) and the central portion of Victoria Harbour WCZ as presented in **Figure 4.3** and **Figure 4.4** and also discussed in Section 4.3.6. Special attention has been given to the indirect water quality changes in aquaculture sites, fishing ground, fisheries habitat and nursery area in the Tolo Harbour and Channel WCZ due to the THEES maintenance discharge or under emergency situation.

6.5 Assessment Methodology

- 6.5.1 Fisheries baseline information including the data from the latest Agriculture, fisheries and Conservation Department (AFCD) Port Survey 2016/2017, AFCD Annual Reports as well as other relevant information available in other Environmental impact Assessment (EIA) reports and publications was reviewed.
- 6.5.2 This fisheries impact assessment was prepared in accordance with the criteria and guidelines in Annexes 9 and 17 of the EIAO-TM as well as Clause 3.4.7 and Appendix E of the EIA Study Brief. The extent and severity of indirect impacts from the Project were assessed with reference to the water quality modelling results. Mitigation measures were proposed, if required.

6.6 Description of the Environment

Sites of Fisheries Importance

Tolo Harbour and Channel WCZ

- 6.6.1 Based on the report of Fisheries Resources and Fishing Operations in Hong Kong (AFCD, 1998), important nursery area of commercial fisheries resources including Three Fathoms Cove is over 5 km away from the Project discharge point (i.e. the existing emergency outfall of TPSTW at TPIE waterfront, see **Figure 6.1**). There are four existing marine culture areas identified in Tolo Harbour and Channel WCZ, namely Yim Tin Tsai Fish Culture Zone (FCZ), Yim Tin Tsai East FCZ, Yung Shue Au FCZ and Lo Fu Wat FCZ. Yim Tin Tsai FCZ and Yim Tin Tsai (East) FCZ are located about 2 km and 3.5 km away from the Project discharge location. Yung Shue Au FCZ and Lo Fu Wat FCZ are both over 9 km away from the Project discharge point. Locations of key fisheries resources are shown in **Figure 6.1**.

Victoria Harbour WCZ

- 6.6.2 No site of fisheries importance is identified within the assessment area of Victoria Harbour WCZ.

Capture Fisheries

- 6.6.3 In 2020, the capture fishing industry produced approximately 116,000 tonnes of fisheries product valued at \$2.7 billion (AFCD, 2021a). The industry consists of about 5,040 fishing vessels and 10,150 local fishermen. Fishing activities are mainly conducted in the waters of the continental shelf in South China Sea. The majority of the fishing vessels are manned by family members with the assistance of hired Mainland crew. The recent data on local capture fisheries industry are summarized in **Table 6.1**.

Table 6.1 Recent Figures of Hong Kong Capture Fisheries Industry

Parameter	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
Fishing fleet size (No. of vessels)	5,040	5030	5050	5150	5160	4,150	4,500	4,000	4,000	4,000
Local fishermen engaged in capture fisheries	10,150	10100	10200	10600	10800	9,170	9,400	8,800	8,800	8,500
Production (thousand tonnes)	116.0	123.0	124.0	127.6	142.8	162.0	160.8	170.7	155.2	170.7
Value of produce (HK\$ million)	2,700	2800	2800	2600	2565	1,600	2,530	2,338	2,317	2,358

Source: AFCD website (2012 – 2021)

- 6.6.4 The Government has implemented in recent years a series of fisheries management measures (including a statutory ban on trawling in Hong Kong waters implemented on 31 December 2012) for conservation of marine resources and promotion of sustainable development of the fishing industry. Fishing activities in the waters of Hong Kong are mainly conducted by sampans using multiple fishing gears as well as other smaller non-trawler vessels (such as gill netters, long liners, purse seiners, etc.). On the other hand, trawlers and other larger non-trawlers are generally operating in the adjacent waters of the South China Sea.
- 6.6.5 The latest AFCD Port Survey 2016/2017 (AFCD, 2018) provides the most updated information on capture fisheries in Hong Kong waters. The highest fisheries yields in Hong Kong of over 300 kg/hectare (ha) were obtained in southern waters (around Cheung Chau, Soko Islands, Shek Kwu Chau and Po Toi), outside the assessment area.
- 6.6.6 Within the assessment area of Tolo Harbour and Channel WCZ, the overall fisheries production yields were no more than 300 kg/ha. Low fisheries production of > 50 – 100 kg/ha was recorded at the inner Tolo Harbour where the Project discharge point is located. The outer Tolo Harbour had a relatively higher fisheries production yields of >100 – 200 kg/ha. Highest fisheries production yields within assessment area (>200 – 300 kg/ha) were obtained at or near the Tolo Channel far away from the Project discharge point.
- 6.6.7 Within the assessment area of Victoria Harbour WCZ, low fisheries production yields of > 50 – 100 kg/ha was recorded except for the eastern edge of the assessment area (i.e. the waters near or to the east of Yau Tong) where the fisheries production was >100 – 200 kg/ha.
- 6.6.8 Sampans were the dominant fishing vessels but other vessels such as gill netters, long liners and purse seiner were also operated within the assessment area. The number of operating fishing vessels near the Project discharge point at inner Tolo Harbour was >100 – 200. The outer Tolo Harbour and the Tolo Channel had a relatively higher number of operating fishing vessels, which ranged from >200 – 600. The number of operating fishing vessels at the eastern edge of the assessment area in Victoria Harbour was >200 – 400. The remaining assessment area in Victoria Harbour including the area closest to the Project discharge point has a lower number of operating fishing vessels of >100 – 200.
- 6.6.9 The top ten fish families / groups of fish catch in Hong Kong waters are shown in **Table 6.2**.

Table 6.2 Top Ten Families / Groups of Fish Catch in Hong Kong Waters *

Rank #	Family / Group	Common Name of Fish Catch
1	Mugilidae	Mullet
2	Clupeidae	Sardine, Shad
3	Carangidae	Scad, Jack
4	Sparidae	Seabream
5	Sciaenidae	Croaker
6	Mixed squid	Squid

Rank #	Family / Group	Common Name of Fish Catch
7	Mixed crab	Crab
8	Siganidae	Rabbitfish
9	Mixed shrimp	Shrimp
10	Platycephalidae	Flathead

Source: AFCD Port Survey 2016/2017 (AFCD, 2018)

■ Other families / groups of common fish catch include Muraenesocidae (conger-pike eel), Scombridae (mackerel), Polynemidae (threadfin), Scorpaenidae (common rock fish) and Cynoglossidae (tongue sole), etc.

Ranking is based on the estimated weight of production of each family / group of fish catch.

6.6.10 The main commercial families of fisheries resources recorded in the North-Eastern (NE) water (covering Tolo Harbour and Tolo Channel) and South-Eastern (SE) water (closest to the assessment area in Victoria Harbour) from the Report on Survey of Fisheries Resources in Hong Kong (2010-2015) (AFCD, 2017) are presented in the following table.

Table 6.3 Main Commercial Families in North-Eastern (NE) and South-Eastern (SE) Waters of Hong Kong

Rank#	NE	SE
From Shrimp Trawl Surveys		
1	Leiognathidae	Leiognathidae
2	Platycephalidae	Platycephalidae
3	Portunidae	Sparidae
4	Clupeidae	Portunidae
5	Sparidae	Sciaenidae
6	Gerreidae	Polynemidae
7	Synodontidae	Cynoglossidae
8	Squillidae	Penaeidae
9	Sciaenidae	Terapontidae
10	Soleidae	Synodontidae
From Stern Trawl Surveys		
1	Leiognathidae	Leiognathidae
2	Clupeidae	Sparidae
3	Sparidae	Carangidae
4	Carangidae	Clupeidae
5	Polynemidae	Engraulidae
6	Trichiuridae	Sciaenidae
7	Siganidae	Trichiuridae
8	Synodontidae	Stromateidae
9	Sciaenidae	Nemipteridae
10	Nemipteridae	Synodontidae
From Purse-Seine Surveys		
1	Clupeidae	NA
2	Carangidae	NA

Rank#	NE	SE
3	Engraulidae	NA
4	Scombridae	NA
5	Sphyraenidae	NA

Consolidated ranking based on the biomass of each family collected in the surveys

NA - Information not available

Culture Fisheries

- 6.6.11 Culture fisheries include marine culture, pond culture and oyster culture. No pond culture and oyster culture are located within the assessment areas. No culture fisheries is located in the assessment area of Victoria Harbour.
- 6.6.12 Currently, marine culture areas for marine fish include 26 Fish Culture Zones (FCZs) located in various sheltered coastal areas throughout Hong Kong's marine water and occupied about 209 ha of marine areas with about 925 licensed operator in 2020 (AFCD, 2021b).
- 6.6.13 There are four existing FCZs present in the assessment area of Tolo Harbour and Channel WCZ, namely Yim Tin Tsai, Yim Tin Tsai (East), Lo Fu Wat, and Yung Shue Au FCZs (see **Figure 6.1**).
- 6.6.14 No figures are available on the individual production of these FCZs. It was estimated that culture fisheries of marine fish production in Hong Kong in 2020 was about 687 tonnes valued at \$52 million, which catered about 5% of local demand for live marine fish (AFCD, 2021b). Recent figures on marine fish culture fisheries are presented in **Table 6.4**.

Table 6.4 Recent Figures of Hong Kong Marine Fish Culture Industry

Parameter	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
Licensed operator	925	923	931	938	949	969	968	987	1,008	1,015
Production (tonnes)	687	889	850	1,004	1,031	1,219	1,255	1,005	1,299	1,185
Value (HK\$ million)	52	72	71	78	86	105	115	94	117	94

Source: AFCD website (2012 – 2021)

- 6.6.15 The species cultured in FCZs changed gradually in recent years depending on the availability of imported fry. Common species include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, red snapper, star snapper, and pompano (AFCD, 2021b).

Artificial Reefs

- 6.6.16 Artificial reefs (ARs) are effective in promoting the growth and development of various marine organisms which in turn provide food, protection and shelter for fish. Since 1996, AFCD has been implementing an ARs project and some 179,200 cubic metres of ARs have been deployed at suitable locations including marine parks, and important fish spawning and nursery grounds in Port Shelter and Long Harbour (AFCD, 2020). The closest marine park, where the ARs are located, is Hoi Ha Wan Marine park located near the mouth of Tolo Channel over 14 km away from the Project discharge point. Port Shelter and Long Harbour are located outside the assessment area.
- 6.6.17 Over 220 species of fish, including many high-value ones such as grouper, bream, snapper and sweetlip, have been found using the reefs for feeding and shelter, as well as spawning and nursery. To improve the water quality and seabed condition of fish culture zones, artificial reefs used as biofilters were deployed in the Kau Sai, Sham Wan, Lo Tik Wan and Yim Tin Tsai East FCZs (AFCD, 2020). Yim Tin Tsai East FCZ is located about 3.5 km away from the Project discharge location as shown in **Figure 6.1**. Kau Sai, Sham Wan and Lo Tik Wan FCZs are located outside the assessment area.

6.6.18 No AR is identified in the assessment area of Victoria Harbour.

6.7 Identification and Evaluation of Potential Impacts

Construction Phase (Tolo Harbour and Tolo Channel)

Direct Impact

6.7.1 The Project will only involve land-based construction works in TPIE. No direct fisheries impact nor loss of fishing grounds would be resulted from this Project.

Indirect impact

Water Quality Changes from Land-based Construction

6.7.2 Discharge from land-based construction works of the Project (including wastewater generated from construction activities, construction site run-off, accidental chemical spillage, sewage effluent from construction workforce, etc.) may cause a temporary increase in water pollution level, if uncontrolled. With the implementation of appropriate measures to control run-off and wastewater from the construction site, as well as the adoption of the relevant guidelines and good site practices for handling and disposal of construction discharges (recommended under the water quality impact assessment in Section 4.11), unacceptable impacts on water quality and fisheries due to water quality deterioration by land-based construction works would not arise.

Overall Impact

6.7.3 The evaluation of construction phase fisheries impacts in Tolo Harbour and Tolo Channel is summarized in **Table 6.5**. The overall fisheries impact during the construction phase is considered **Minor**.

Table 6.5 Potential Fisheries Impact during Construction Phase (Tolo Harbour and Tolo Channel)

Criteria	Construction Phase Impact
Nature of Impact	<p><u>Direct Impact</u> The Project will only involve land-based construction works. No marine works are proposed. There will be no disturbance to marine or riverbed sediments. No loss of fishing ground is anticipated.</p> <p><u>Indirect Impact</u> Temporary increase in water pollution due to the discharge from land-based construction works.</p>
Size of Affected Area	<p><u>Direct Impact</u> There will be no disturbance to marine or riverbed sediments. No loss of fishing ground is anticipated.</p> <p><u>Indirect Impact</u> Tolo Harbour</p>
Loss of Fisheries Resources / Production	<p>There will be no disturbance to marine or riverbed sediments.</p> <p>With the implementation of mitigation measures and the adoption of guidelines and good site practices, loss of fisheries resources / production due to water quality deterioration by land-based construction works is considered insignificant.</p>

Criteria	Construction Phase Impact
Destruction and Disturbance of Nursery and Spawning Grounds	There will be no direct loss of important nursery and spawning grounds for commercial fisheries species. With the implementation of mitigation measures and the adoption of guidelines and good site practices, the degree of destruction and disturbance of nursery and spawning grounds due to water quality deterioration by land-based construction works is considered insignificant.
Impact on Fishing Activity	There will be no disturbance to marine or riverbed sediments. No impact on fishing activity is anticipated.
Impact on Aquaculture Activity	Minor
Overall Fisheries Impact	Minor

Construction Phase (Victoria Harbour)

- 6.7.4 No construction work will be carried out in Victoria Harbour WCZ. No fisheries impact in Victoria Harbour is identified during the construction phase. Evaluation of fisheries impact for construction phase is not required for Victoria Harbour WCZ.

Operational Phase (Tolo Harbour and Tolo Channel)

Indirect impact

Normal Plant Operation

- 6.7.5 Under normal plant operation, this Project would not cause any increase in the pollution loading to the Tolo Harbour and Tolo Channel as compared to the baseline or existing condition. No unacceptable water quality would arise from normal operation of the Project.

THEES Maintenance Period

- 6.7.6 During the THEES maintenance period, disinfected secondary effluent would be discharged from both the Sha Tin Cavern Sewage Treatment Works (CSTW) and TPSTW into the Tolo Harbour to allow inspection of the THEES tunnel. Water quality modelling was conducted under this EIA to simulate a possible worst case where the THEES maintenance event would last for a continuous period of four weeks in June / July (outside the algae blooming season). The water quality modelling results for THEES maintenance discharge to Tolo Harbour (namely Scenario 4) are compared with the baseline condition with no THEES maintenance (namely Scenario 3) to identify the water quality changes due to the THEES maintenance.

Suspended Solids

- 6.7.7 The THEES maintenance discharge may temporarily elevate the Suspended Solids (SS) level in Tolo Harbour. Possible high SS levels may clog the gill structure of fish and cause physical damage and reduce survival, reproduction and growth rates. These effects could be lethal or sub-lethal. Fish egg, larval fish (fry) and culture fisheries resources are more susceptible to impacts from SS elevation. Adult fish (living outside the FCZs) are more likely to move away when they detect increase in SS level and therefore less sensitive to the effects from SS elevation.
- 6.7.8 There is no statutory Water Quality Objective (WQO) for SS available in Tolo Harbour and Tolo Channel under the Water Pollution Control Ordinance (WPCO). Lethal response had not been observed in adult fish at SS level less than 125 mg/L (Çınar 2017; DSD 2004 and 2016), and sublethal effects were only reported at levels exceeded 90 mg/L (Alabaster, 1984; DSD, 2004

and 2016). However, the recommended SS value based on international marine water quality objective guidelines for the ecosystem protection was 50 mg/L (AFCD, 2001).

- 6.7.9 The predicted mean SS levels under the THEES maintenance scenario (Scenario 4) at the four existing FCZs and the important nursery area for commercial fisheries resources are no more than 3 mg/L (see **Appendix 4.5**). The THEES maintenance would increase the mean SS level at Yim Tin Tsai FCZ (the closest site of fisheries importance to the Project discharge point) by no more than 0.1 mg/L (or about 4%) under Scenario 4 as compared to the baseline condition with no THEES maintenance (Scenario 3).
- 6.7.10 Referring to the time series plots (in Figure 14 of **Appendix 4.6**), the maximum SS level at the closest site of fisheries importance (Yim Tin Tsai FCZ) would be no more than 15 mg/L during the THEES maintenance period. The time series plots also showed that the SS trend at the FCZ during the THEES maintenance period (Scenario 4) would be similar to that of the baseline condition (Scenario 3). The maximum differences between the two scenarios would be 2.1 mg/L. The maximum increase from the baseline scenario caused by the maintenance discharge is predicted to be 18.6%. As shown in the time series plots, the SS elevations at other sites further away from the discharge point would be much smaller.
- 6.7.11 In summary, the predicted SS levels under the THEES maintenance event are in similar trend to that under the baseline or normal condition. The maximum absolute SS level under the THEES maintenance event was well below the recommended guideline value for ecosystem protection of 50 mg/L. No unacceptable SS impact upon the fisheries is predicted.

Dissolved Oxygen

- 6.7.12 Increase in SS in water column combined with a number of other physical or biotic factors would reduce Dissolved Oxygen (DO) in water column. Elevated SS would reduce light penetration, lower the photosynthetic rate of phytoplankton and thus lower the rate of oxygen production in the water column. Also the release of inorganic substances into the marine water may cause eutrophication and algal bloom. Oxidation of dead algae may use up some of the oxygen in the water. If oxygen levels are depleted to low levels, fish, especially those in early life stages may be unable to tolerate such conditions and suffer hypoxia-induced mortality and / or stress including reduced feeding and growth rate.
- 6.7.13 According to the water quality model results, full compliance with the WQO for DO is predicted at all the sites of fisheries importance under the THEES maintenance event (Scenario 4). The predicted minimum DO levels at the four FCZs ranged from 5.1 mg/L to 5.9 mg/L (see **Appendix 4.5**). No adverse fisheries impacts due to oxygen depletion would be expected.

Nutrients

- 6.7.14 High nutrient levels in marine water may trigger rapid increase in phytoplankton, resulting in algal bloom. When a large number of algae die, degradation of dead algae would cause sudden drop in DO which leads to suffocation of fish and other organisms. The phytoplankton may also produce biotoxins which could be lethal to fish. No WQO for nutrients is available in the marine water of Tolo Harbour and Channel WCZ. According to the water quality modelling results (**Appendix 4.5** and Figure 11 of **Appendix 4.6**), the THEES maintenance event would only temporarily increase in the Total Inorganic Nitrogen (TIN) levels in Yim Tin Tsai FCZ (FC1) as compared to the baseline situation. No obvious TIN increase is predicted in the remaining FCZs (FC2 – FC4). The predicted mean TIN levels at the four FCZs are similar between Scenario 3 (baseline condition) and Scenario 4 (with THEES maintenance discharge) (see **Appendix 4.5**). Therefore, unacceptable fisheries impacts due to release of nutrients are not expected.

Chlorophyll-a

- 6.7.15 Tolo Harbour and Tolo Channel WCZ is a shallow landlocked water body with low water

exchange rate and poor flushing capacity, which is susceptible to algal formation and accumulation of algae. Chlorophyll-*a* is a pigment in plant. The chlorophyll-*a* level would provide an indication of algae concentrations in water. The maximum 5-day running mean chlorophyll-*a* levels at the four FCZs ranged from 12– 49 µg/L under the THEES maintenance (Scenario 4) as compared to the baseline situation (Scenario 3) of 11 – 18 µg/L (see **Appendix 4.5**). It should be noted that the chlorophyll-*a* levels mentioned above represent the maximum 5-day running means over the entire 1-year simulation period. The mean chlorophyll-*a* levels predicted under the THEES maintenance (Scenario 4) are much lower as shown in the contour plot (Figure 10 of **Appendix 4.4**). The predicted mean chlorophyll-*a* levels are <15 µg/L in Yim Tin Tsai FCZ (FC1), < 10 µg/L in Yim Tin Tsai East FCZ (FC2) and Yung Shue Au FCZ (FC4) as well as <6 µg/L in Lo Fu Wat FCZ (FC3).

- 6.7.16 As indicated in the time series plots (Figures 02, 05 and 08 of **Appendix 4.6**), the chlorophyll-*a* elevation caused by the THEES maintenance discharge is more significant at FC1 (closest to the THEES effluent discharge). The predicted magnitude of elevation is significantly reduced in the remaining FCZs further away from the effluent discharge points. The temporary chlorophyll-*a* elevations are predicted to be reversible. The chlorophyll-*a* levels can return to the condition similar to the baseline levels within about 2 weeks after termination of the maintenance discharge.
- 6.7.17 The THEES is aimed to protect the fisheries resources in Tolo Harbour and Tolo Channel by diverting the treated sewage effluent loading away for discharge into the Victoria Harbour. Regular inspection and maintenance of the THEES system are inevitable under the existing practice and during the Project operation. The short-term THEES closure is essential to safeguard the proper functioning and integrity of the THEES, and thus to protect the coastal water and fisheries resources against pollution in the long run.
- 6.7.18 Red tides are natural phenomena which occur seasonally in both polluted and unpolluted waters. It is believed that the formation of red tide is a complicated process. It would depend on a combination of different factors such as the flow and weather conditions, light penetration, salinity distribution, nutrient concentrations, nutrient ratios and species competition, etc. The short-term THEES maintenance discharge may not be a critical factor for triggering red tide in Tolo Harbour and Tolo Channel. The THEES maintenance event would be arranged outside the peak algae blooming seasons (December to April/May) to minimize the chance of algal bloom in Tolo Harbour and Tolo Channel. The scheduling of the maintenance discharge would also take into account any ongoing blooming event in the area, which may occur outside the blooming season. The occurrence of the THEES maintenance would be remote (no more than once in every 5 years). From past record over the last 15 years, the duration of THEES maintenance is no more than 3 days. The overall fisheries impact due to the short-term THEES maintenance would be minor.
- 6.7.19 Appropriate mitigation measures and water quality monitoring programme as described in Sections 6.8 and 6.10 should be implemented to minimise the impact to the mariculture activities in the nearby fish culture zones. With implementation of the mitigation measures and monitoring programme recommended in this EIA, no unacceptable fisheries impacts would arise from the THEES maintenance. For information, any potential impacts from red tide or Harmful Algal Blooms (HABs) that may arise in the Tolo Harbour and Tolo Channel is currently managed and responded under the routine red tide monitoring and management protocol and response plan adopted by the Hong Kong government. AFCD is acting as the coordinator of the Red Tide Reporting Network, to receive reports of red tide, conduct investigation and provide warning of the risk associated and appropriate mitigation measures. The objectives of this red tide monitoring programme are to provide coordination of monitoring and response to red tides/HABs and fish kills and to compile and synthesize data necessary to effectively manage fisheries resources, protect human health and the marine ecosystems. The existing red tide monitoring and management plan are described in the AFCD website

(<https://www.afcd.gov.hk/english/fisheries/hkredtide/management/management.html>).

Emergency Discharge from TPSTW

6.7.20 During the operational phase, it is assumed that an emergency discharge of primarily treated sewage from the TPSTW would occur for a period of only 3 hours in case of power or plant failure. According to the water quality modelling results, the short-term discharge under this emergency situation (Scenario 5) would not cause obvious impact upon the predicted mean SS, DO, TIN and chlorophyll-a levels at the fisheries resources as compared to the normal plant operation under Scenario 3 (**Appendix 4.5** and **Appendix 4.8**). Therefore, unacceptable fisheries impacts would not rise from the emergency discharge.

Treated Effluent Reuse

6.7.21 Reuse of treated effluent is proposed under the Project and will be limited to non-potable use. Any spent effluent would be treated again for discharge and would not contribute to additional pollution load. Thus, no additional impact on the water environment, and hence, no additional fisheries impact will be induced by the proposed treated effluent reuse.

Overall Impact

6.7.22 The evaluation of operational phase fisheries impacts in Tolo Harbour and Tolo Channel is summarized in **Table 6.6**. The overall fisheries impact during the operational phase is considered **Minor**.

Table 6.6 Potential Fisheries Impact during Operational Phase (Tolo Harbour and Tolo Channel)

Criteria	Operational Phase Impact
Nature of Impact	<p><u>Indirect Impact</u></p> <p>Normal operation of this Project will not cause an increase in pollution loading into the Tolo Harbour and Tolo Channel. Both the THEES maintenance and emergency discharge are short-term and reversible.</p> <p>This Project would optimize the THEES maintenance in the period outside the algae blooming season and minimize the red tide occurrence and potential impact upon the fisheries resources. The scheduling of the maintenance discharge would also take into account any ongoing blooming event in the area, which may occur outside the blooming season. In addition, any increase in algae or chlorophyll-a levels can return to the condition similar to the baseline levels within about 2 weeks after termination of the effluent bypass. The occurrence of THEES maintenance would be remote (i.e. no more than once in every 5 years according to Section 6.7.18) .</p> <p>The short-term emergency discharge would not cause obvious changes in the predicted water quality at the fisheries resources as compared to the baseline conditions.</p> <p>With the implementation of specific water quality monitoring programme and mitigation measures, no unacceptable water quality and fisheries impacts are expected.</p>
Size of Affected Area	<p><u>Indirect Impact</u></p> <p>Tolo Harbour</p>
Loss of Fisheries Resources / Production	<p>There will be no disturbance to marine or riverbed sediments.</p> <p>The indirect water quality deterioration in Tolo Harbour due to the THEES maintenance and emergency discharge are short-term and reversible. Loss of fisheries resources / production due to indirect water quality deterioration is predicted to be insignificant.</p>
Destruction and Disturbance of Nursery and Spawning Grounds	<p>There will be no direct loss of important nursery and spawning grounds for commercial fisheries species.</p> <p>With the implementation of specific water quality monitoring programme and mitigation measures, the degree of destruction and disturbance of nursery and spawning grounds for commercial fisheries due to changes in water quality is considered insignificant.</p>

Criteria	Operational Phase Impact
Impact on Fishing Activity	There will be no disturbance to marine or riverbed sediments. No impact on fishing activity is anticipated.
Impact on Aquaculture Activity	Minor. Normal operation of this Project will not cause any additional pollution loading to Tolo Harbour and Tolo Channel and will not induce any water quality and fisheries impact upon the Tolo Harbour and Tolo Channel. Changes in water quality in Tolo Harbour are expected due to the THEES maintenance discharge from TPSTW and CSTW. No significant changes in water quality parameters are predicted at the sites of fisheries importance except for the temporary chlorophyll-a elevations at Yim Tin Tsai FCZ. This Project would optimize the THEES maintenance operation and minimize the chlorophyll-a impacts at the fisheries resources. In addition, the potential chlorophyll-a impacts are reversible. The chlorophyll-a levels can return to the condition similar to the baseline levels within about 2 weeks after termination of the effluent bypass. . The short-term emergency discharge would not cause significant impact upon the predicted mean SS, DO, TIN and chlorophyll-a levels at the fisheries resources as compared to the normal plant operation.
Overall Fisheries Impact	Minor

6.7.23 In summary, there will be no loss of fishing ground. Based on the water quality modelling, no unacceptable water quality impacts are expected during the construction and operational phase. Any indirect water quality impacts would be temporary and reversible. The overall fisheries impact is expected to be minor during the construction and operational phase.

Operational Phase (Victoria Harbour)

6.7.24 Only treated and disinfected secondary effluent from the Project will be allowed to be discharged into Victoria Harbour. Based on the water quality modelling results as illustrated in **Appendix 4.3**, the overall water quality conditions in the open channel of Victoria Harbour are similar with or without this Project for all water quality parameters of concern. This Project would not change the overall degree of water quality levels in Victoria Harbour as compared to the baseline conditions. No unacceptable impact upon the fishing ground in Victoria Harbour is expected.

6.7.25 The evaluation of operational phase fisheries impacts is summarized in **Table 6.7**. No site of fisheries importance is located in the assessment area of Victoria Harbour. The overall fisheries impact during the operational phase is considered **Negligible**.

Table 6.7 Potential Fisheries Impact during Operational Phase (Victoria Harbour)

Criteria	Operational Phase Impact
Nature of Impact	<u>Indirect Impact</u> Only treated and disinfected secondary effluent from the Project will be allowed to be discharged into Victoria Harbour. The predicted water quality conditions in the open channel of Victoria Harbour are similar with or without this Project. This Project would not change the overall water quality levels in Victoria Harbour as compared to the baseline conditions. No unacceptable impact upon the fishing ground is expected.
Size of Affected Area	<u>Indirect Impact</u> Central Victoria Harbour
Loss of Fisheries Resources / Production	There will be no disturbance to marine or riverbed sediments. Negligible loss of fisheries resources / production due to indirect water quality changes is anticipated.

Criteria	Operational Phase Impact
Destruction and Disturbance of Nursery and Spawning Grounds	No important nursery and spawning grounds for commercial fisheries species is identified.
Impact on Fishing Activity	There will be no disturbance to marine or riverbed sediments. No impact on fishing activity is anticipated.
Impact on Aquaculture Activity	No aquaculture activity is identified in the assessment area
Overall Fisheries Impact	Negligible

6.8 Mitigation Measures

6.8.1 According to the guidelines in Annex 17 of EIAO-TM, the general policy for alleviating fisheries impacts in order of priority are avoidance, minimization and compensation.

Avoidance

6.8.2 Potential impacts on fisheries resources and fishing operations arising from the Project have been avoided and minimized by using the existing emergency outfall for the Project with the least water quality impact. This would avoid marine construction works for new outfall and the potential loss of fishing grounds. In addition, the THEES maintenance event would be scheduled outside the blooming season of algae (i.e. December to April/May) to minimize the potential fisheries impacts. The number of red tide incidents was found lowest from July to November according to the data from 1975 to 2020. It is recommended that any THEES maintenance period should be arranged within July to November and should be shortened as far as possible. The scheduling of the maintenance discharge should also take into account any ongoing blooming event in the area, which may occur outside the blooming season. In planning of the maintenance work and before the maintenance discharge, AFCD should be consulted to seek advice on the potential for red tide occurrence in the receiving water. The maintenance discharge should be rescheduled or postponed based on AFCD's advice, as necessary.

Minimisation

6.8.3 Mitigation measures recommended in the water quality impact assessment for controlling water quality impact will also serve to protect fisheries from indirect impacts and ensure no unacceptable impact on fisheries resources and operations. The recommended water quality mitigation measures are presented in Sections 4.11 and 4.12.

6.8.4 Relevant government departments including EPD, WSD and AFCD as well as key stakeholders for mariculture and fisheries in Tolo Harbour and Tolo Channel should be informed prior to the THEES maintenance / emergency discharge events.

6.9 Evaluation of Cumulative Impacts and Residual Impacts

6.9.1 There will be no loss of fishing ground arising from the Project. The residual impacts would be the indirect water quality changes at the nearby fisheries resources associated with the THEES maintenance and emergency discharge. Assessment of the indirect water quality changes has been based on the water quality modelling results, which have taken into account the cumulative impacts from all potential concurrent projects in the assessment areas. The potential water quality changes are predicted to be localized, short-term and reversible. No unacceptable cumulative and residual fisheries impact is expected from these temporary discharges provided

that all the recommended mitigation measures and monitoring programme are properly implemented.

6.10 Environmental Monitoring and Audit (EM&A) Requirements

- 6.10.1 No unacceptable residual fisheries impact is expected from the Project. No monitoring program specific for fisheries is required. However, monitoring of water quality parameters would be required to ensure the effectiveness of the mitigation measures. A summary of the water quality monitoring programme is presented in Section 4.15. Details of the EM&A programme are presented in the standalone EM&A Manual.
- 6.10.2 Any potential impacts from red tide or HABs that may arise in the Tolo Harbour should also be managed and responded under the existing routine red tide monitoring and management protocol and response plan adopted by the government in Hong Kong. Details of the existing red tide monitoring and management plan are provided in the AFCD website (<https://www.afcd.gov.hk/english/fisheries/hkredtide/management/management.html>).

6.11 Conclusion

- 6.11.1 A study based on existing information on commercial fisheries resources and fishing operations within the waters of the assessment area has been undertaken, following the criteria and guidelines for evaluating and assessing fisheries impact as stated in Annexes 9 and 17 of the EIAO-TM. Sites of fisheries importance have been identified.
- 6.11.2 The Project will only involve land-based construction works in Tai Po Industrial Estate. There will be no disturbance to marine bed or riverbed sediments. No loss of fishing ground would arise.
- 6.11.3 Indirect fisheries impacts due to water quality changes under the THEES maintenance and emergency discharge during the operational phase were assessed to be short term and reversible. The frequency of such occurrence would be remote. No unacceptable fisheries impacts are expected from the Project.

6.12 References

AFCD (1998). Fisheries Resources and Fishing Operations in Hong Kong Waters.

AFCD (2001). Final Report. Consultancy Study on Fisheries and Marine Ecological Criteria for Impact Assessment. Prepared by Centre for Coastal Pollution and Conservation, City U Professional Services Limited for Agriculture, Fisheries and Conservation Department, The Government of the Hong Kong Special Administrative Region.

Drainage Services Department (DSD) (2004). TPSTW – Stage V EIA (EIAO Register No.: AEIAR-081/2004).

AFCD (2009). Environmental Management of Mariculture. Agriculture, Fisheries and Conservation Department, the Government of the Hong Kong Special Administrative Region.

AFCD (2017). Report on Survey of Fisheries Resources in Hong Kong (2010-2015)

AFCD (2018). Port Survey 2016/17.

AFCD (2020). Department Annual Report 2018-2019.

AFCD. (2021a) Fisheries: Capture Fisheries.

http://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap_latest/fish_cap_latest.html

AFCD (2021b). Fisheries: Aquaculture.

http://www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html

Alabaster JS & Lloyd R (1984) Water Quality Criteria for Freshwater Fisheries. Butterworths, London.

DSD (2016). Sha Tin Cavern Sewage Treatment Works EIA (EIAO Register No.: AEIAR-202/2016)

Çınar Mühendislik Müşavirlik (2017), TANAP Project Offshore Fisheries Livelihood Restoration Plan (Final).