8a. FISHERIES IMPACT (TTAL SITE)

8a.1 Introduction

8a.1.1.1 This section identifies and evaluates the potential impacts on capture and culture fisheries in the assessment area resulting from the construction and operation activities of the IWMF at the TTAL site.

8a.1.1.2 This assessment is based on a desktop review of the latest relevant literatures describing baseline conditions, identifying and evaluating potential, direct, indirect, residual and cumulative impacts on fisheries resources during construction and operation phase of the IWMF. Where necessary, mitigation measures and monitoring programme are recommended.

8a.2 Environmental Legislation, Policies, Plans, Standards and Guidelines

8a.2.1.1 This fisheries impact assessment is conducted in accordance with criteria and guidelines as set out in the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) Annex 9 and Annex 17 which aims to provide a complete and objective identification, prediction and evaluation of potential fisheries impacts arising from the proposed Project. EIAO-TM Annex 17 sets out the methodology for assessment of fisheries impacts while Annex 9 provides the evaluation criteria.

8a.2.1.2 Other local legislations that are applicable to fisheries impact and are relevant to this assessment include the following:

- Fisheries Protection Ordinance (Cap. 171) – aims to promote the conservation of fish and other forms of aquatic life within the Hong Kong waters by regulating fishing practices to prevent detrimental activities to the fisheries industry. The Ordinance came into effect on 30 June 1997.
- Marine Fish Culture Ordinance (Cap. 353) – regulates and protects marine fish culture by allocating areas of fish culture zone, granting license, prohibiting unauthorized vessels and any deposition of chemicals or other substance which are likely to cause injury to fish in a fish culture zone. The list of designated fish culture zones was last revised in January 2000.
- The Water Pollution Control Ordinance (Cap.358) – aims to control water pollution in the waters of Hong Kong. Water control zones are designated with individual water quality objectives to promote the conservation and best use of those waters in the public interest. The most updated water quality objectives for the North Western and Deep Bay Water Control Zones were last revised in June 1997.

8a.3 Study Area

8a.3.1.1 The study area for the fisheries impact assessment covers the North Western and Deep Bay Water Control Zones as specified under the Water Pollution Control Ordinance (Cap. 358, WPCO).

8a.4 Assessment Methodology

8a.4.1.1 Baseline information on fisheries resources in the assessment area was acquired via a desktop review of available literatures. This review also covered relevant fisheries baseline data as presented in Port Survey 2006 (AFCD, 2010a) and relevant information available in other reports and publications. Based on the desktop review, data collected

are considered sufficient for further analysis with no significant gaps identified, as such, no field surveys were deemed necessary.

8a.4.1.2 The impact assessment followed the criteria and guidelines as stated in Annex 9 and Annex 17 of the EIAO-TM for evaluating and assessing fisheries impacts.

8a.5 Description of the Environment

8a.5.1 Sites of Fisheries Importance

8a.5.1.1 The sites of fisheries importance identified in the assessment area include:

- Spawning and nursery grounds for fish and shrimp (approx. 5 km away from the IWMF);
- Oyster culture area in Deep Bay (approx. 3 km away from the IWMF); and
- Artificial reefs at Sha Chau and Lung Kwu Chau Marine Park (approx. 5 km away from the IWMF) and Chek Lap Kok Marine Exclusion Zone 3, at the north-east corner of the airport island (approx. 6 km away from the IWMF).

8a.5.1.2 All the above locations of fisheries resources are depicted in **Figure 8a.1**. Further details of these resources are discussed in the following sections.

8a.5.2 Capture Fisheries

8a.5.2.1 In 2009, the capture fishing industry landed approximately 159,000 tonnes of fisheries product valued at $2,000 million (AFCD, 2010a). The industry consists of about 3,700 fishing vessels and 7,600 fishermen. Fishing activities are mainly conducted in the waters of the continental shelf in South China Sea. Majority of the fishing vessels are manned by family members with the assistance of a hired crew. Main fishing methods being used include trawling, long-lining, gill-netting and purse-seining, with significant portion of the total catch obtained through trawling. Some recent data on local capture fisheries industry are summarized in **Table 8a.1**.

Table 8a.1 Recent Hong Kong Capture Fisheries Industry Figures

Parameter	2009	2008	2007	2006	2005	2004	2003	2002	2001
Fishing fleet size (No. of vessels)	3,700	3,800	4,000	3,950	4,150	4,300	4,600	4,470	5,100
Local fishermen engaged in capture fisheries	7,600	7,900	8,500	8,500	9,170	9,700	10,100	10,860	11,560
Production (thousand tonnes)	159	158	154	155	162	167.5	157.4	169.8	174
Value of produce (HK$ million)	2,000	1,780	1,530	1,600	1,600	1,600	1,500	1,600	1,700

Source: AFCD 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009a and 2010a

8a.5.2.2 The latest AFCD Port Survey 2006 (AFCD 2010a) provides the most updated information on capture fisheries in Hong Kong waters, including both fishing operation and fisheries production (adult fish and fry). In general, the highest fish yields in Hong Kong were obtained in the eastern waters (e.g. Tolo Harbour, Crooked Haven, Port Shelter, and Po Toi) and the southwestern waters (e.g. Lamma Island, Cheung Chau and Soko Islands).

8a.5.2.3 The fishing operation within the assessment area was supported by vessels of varying length. Majority of vessels operating around the Sha Chau-Lung Kwu Chau, the Brothers Islands and Tai O area were less than 15 m in length. Shrimp trawlers and hang trawlers

were considered as the dominant fishing vessels, but other vessels such as stern trawler, gill netters, long liners, purse seiner, sampan and miscellaneous crafts were also seen operating within the assessment area.

8a.5.2.4 The number of fishing vessels in operation was generally low (less than 100 vessels) in the North Western WCZ and within the Deep Bay WCZ where the IWMF would be located. Relatively higher number of fishing vessels has been recorded around Sha Chau-Lung Kwu Chau, the Brothers Islands and Tai O (50–400 vessels).

8a.5.2.5 In terms of weight, adult fish production was low (less than 50 kg/ha) within the Deep Bay WCZ. Higher production was found within North Western WCZ, ranging from 50 – 100 kg/ha) at the coastal areas to 200 – 600 kg/ha around Sha Chau-Lung Kwu Chau, the Brothers Islands and Tai O. No fish fry production has been recorded within the study area.

8a.5.2.6 The overall catch value was less than HK$1,000 per hectare annually within the Deep Bay WCZ and ranged from HK$1,000 to HK$10,000 per hectare annually within the North Western WCZ. Similarly, the highest overall catch value was recorded around Tai O and waters south of Sha Chau-Lung Kwu Chau.

8a.5.2.7 Capture fish common in Hong Kong could all be found in the Deep Bay WCZ but the production was very low (less than 50 kg/ha). Within the North Western WCZ, the most common capture fish was Croaker (Sciaenidae); other common capture fisheries included Scad (Carangidae) and shrimp.

8a.5.2.8 Fry collection in Hong Kong has been much reduced in scale in recent years. The latest interview studies reported that fry collection only occurs in a few areas (AFCD, 2009a). The highest fry collection was mainly found in the northeast inshore waters at Three Fathoms Cove, Crooked Harbour, Double Haven and Long Harbour which are all outside the assessment area.

8a.5.2.9 According to the "Fisheries Resources and Fishing Operations in Hong Kong Waters" (AFD, 1998a), important nursery areas of commercial fisheries resources were identified in Northeast Waters, Port Shelter, Lamma Island and South Lantau; whilst important spawning grounds of commercial fisheries resources were identified at Northeast Waters, Eastern Waters, Southeast Hong Kong in Mirs Bay, South Lamma, South Cheung Chau, Northeast and South Lantau. The important spawning ground at Northeastern Lantau is located 6 km away from the IWMF. The major spawning fish species recorded include *Leiognathus brevirostris* (ponyfish), *Lateolabrax japonicus* (seabrass/perch) and *Clupanodon punctatus* (gizzard shad) (ibid).

8a.5.3 Culture Fisheries

8a.5.3.1 Marine culture fisheries included marine fish culture and oyster culture. Mariculture areas for marine fish included 26 fish culture zones (FCZs) located in various sheltered coastal areas in Hong Kong marine waters and occupied about 209 ha of marine areas with about 1,050 licensed operators in 2009 (AFCD, 2010b). Majority of the licensed farms are small, family-based and consisting of one to two rafts with average total area of around 280 m^2 (AFCD, 2010b).

8a.5.3.2 Although no figures are available on the individual production of FCZ, it was estimated that culture fisheries of marine fish production in 2009 was about 1,437 tonnes valued at $92 million which catered about 9% of local demand for live marine fish (AFCD, 2009b). Recent figures on marine fish culture are presented in **Table 8a.2**.

Table 8a.2 Recent Figures on Hong Kong Marine Culture Fisheries Industry

Parameter	2009	2008	2007	2006	2005	2004	2003	2002	2001
Licensed operator	1,050	1,060	1,070	1,078	1,092	1,125	1,155	1,240	1,370
Production (tonnes)	1,437	1,370	1,532	1,490	1,540	1,540	1,490	1,211	2,470
Value (HK$ million)	92	82	99	89	76	79	76	57	136

Source: AFCD 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009b and 2010b

8a.5.3.3 The species cultured varied depending on the availability of imported fry. Common species under marine culture include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, red snapper, star snapper and pompano (AFCD, 2010b).

8a.5.3.4 There are no FCZs but an oyster culture present in the study area. Oyster culture is only practiced along intertidal mudflat off Tsim Bei Tsui and Ha Pak Nai in Deep Bay. It is located about 3 km away from the proposed Project site. There are 2 common methods of oyster culture used in Hong Kong, namely, the bottom culture method and raft culture method. While bottom culture method is a traditional method, majority of the fishermen adopted the raft culture method. The former cultures oysters with spat collected by laying rock, concrete tile or post as cultch on the mud flat to marketable size during May or June and the latter leaves oysters in baskets suspended from rafts. In order to speed up the growth process, farmers in recent years have started to import medium size oysters from the Mainland for oysters culturing. Production was about 241 tonnes with a value of HK$ 14 million in 2009 (AFCD, 2010b). Location of oyster culture within the study area is shown in **Figure 8a.1**.

8a.5.4 Artificial Reef

8a.5.4.1 Artificial reefs (ARs) are devices used for attracting and supporting large populations of fish. Since 1998, a total volume of 179,130 m^3 of artificial reefs, in forms of vessels, concrete, quarry rock, and tyre reefs, have been deployed at Sha Chau, Chek Lap Kok, Lo Tik Wan, Northeast and Eastern Waters (AFCD, 2009b). Artificial reefs were found to support more than 220 fish species, including many commercially important species and some rare fish species between 1998 and 2003 (ibid). There are two artificial reef areas within the study area namely, Sha Chau and Lung Kwu Chau, and Chek Lap Kok marine exclusion zone. Locations of the artificial reefs within the study area are shown in **Figure 8a.1**.

8a.5.4.2 Artificial reefs at Sha Chau and Lung Kwu Chau is located 5 km away from the IWMF. There are 66 ferro-cement river barge and concrete-coated containers occupying a volume of 5,580 m^3 (AFCD, 2009b). Comparatively, artificial reefs at Chek Lap Kok marine exclusion zone located 6 km away from the IWMF have a smaller scale. There are 10 river barges and quarry rocks within a volume of 3,600 m^3 (ibid).

8a.5.4.3 The aims of deploying these 2 artificial reef areas are to provide a feeding station for the Chinese White Dolphins, to enhance the habitat quality and marine resources, and to prevent trawling.

8a.6 Identification, Prediction and Evaluation of Environmental Impacts

8a.6.1 Construction Phase

8a.6.1.1 The construction of the IWMF is mainly land-based with only minor work anticipated at seawall for the construction of the saline water outfall.

Loss of fishing resources

8a.6.1.2 No construction work would be carried out at the coastal waters. Therefore, no loss of fishing grounds, fish stock and impact to fishermen's livelihood is expected.

Changes in Water Quality

8a.6.1.3 Indirect impacts on fisheries resources arising from the construction activities are mainly associated with changes of water quality due to drainage and construction site runoff, sewage effluent produced by on-site workforce, and release of PFA leachate from ash lagoon as described in the water quality impact assessment in **Section 5a**.

8a.6.1.4 During construction period, site runoff from sources such as exposed soil surfaces, stockpiles, wash waters from dust suppression sprays, and fuel and lubricants from construction vehicles and mechanical equipments may contain increased loads of sediments, suspended solids and contaminants. Furthermore, piling work would penetrate into the base of the Middle Lagoon where PFA is stored and this might ultimately lead to leakage of leachate from the ash lagoon. These contaminated waters, together with sewage effluent produced by on-site workforce, would run into the coastal waters directly or indirectly (i.e. through the aquatic system).

8a.6.1.5 Sediment or SS could be lethal or sublethal to fish and other fisheries resources through reduction in survivorship, growth rate and reproductive potential due to stress incurred by the need to constantly flush out deposited material. High SS level may clog gill structure of fish and cause physical damage and hinder transfer of oxygen. Fish egg and larval fish (fry) are more susceptible to deleterious impacts from sedimentation through smothering and clogging of their respiratory systems. Adult fish are more likely to move away when they detect certain SS level and therefore less sensitive to effects from SS.

8a.6.1.6 Increase in SS in water column combining with a number of other physical or biotic factors would reduce DO in water column. Elevated SS reduces light penetration, lowers the photosynthetic rate of phytoplankton and eventually would lower the rate of oxygen production in water column. Also, the release of inorganic substances from the sediments 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.

8a.6.1.7 Organic and inorganic (i.e. heavy metal) water pollutants from fuel, lubricants and PFA leakage could also cause lethal or sublethal effects, such as growth inhibition, enzyme alteration and changes in physiological activities to fisheries resources (USEPA, 1980a, 1980b, 1980c, 1987).

8a.6.1.8 According to the water quality impact assessment, surface runoff from land-based construction activities near the coastal waters, sewage effluent and PFA leakage would cause insignificant change in sediment, SS, organic and inorganic water pollutants. It is unlikely to cause unacceptable impact on the aquatic environment from an ecotoxicological point of view. Moreover, important fisheries resources, such as fish spawning ground, oyster cultures, and artificial reefs are a fair distance away from the proposed works area. Organic and inorganic pollutants, if any, would be diluted by the large volume of marine water to acceptable levels shortly after they are discharged from the IWMF site. With the implementation of mitigation measures proposed in water quality impact assessment in **Section 5a** of this Report, such as the use of silt/sediment and grease traps, and effective site drainage would minimize any impacts to the marine environment resulting from land-based construction activities. No adverse impact associated with water quality change is expected on fisheries resources during the construction phase.

8a.6.2 Operation Phase

8a.6.2.1 Potential sources of water quality impact associated with the operation of the IWMF project include:

- Wastewater from the operation of the IWMF; and
- Seawater intake/saline water discharge from the proposed desalination plant.

Loss of fishing resources

8a.6.2.2 The IWMF would confine to terrestrial area. Loss of fishing grounds, fish stock and impact to fishermen's livelihood is therefore not expected.

Changes in Water Quality

8a.6.2.3 The IWMF would adopt a "zero-discharge" scheme that no processed effluent would be discharged into Deep Bay during operation phase. Approximately 1,520 m^3/day of saline water from the proposed desalination plant would be discharged to the coastal water. According to the water quality impact assessment of this Report, the salinity would be 1.7-1.8 times higher than the ambient condition. With a low discharge volume, the concentrated saline water would be immediately diluted by marine waters to the level as the feedwater. Thus, the impact would be localized (47 m) and confined to coastal waters. Fisheries production at the waters in the vicinity of the IWMF is low and the impact zone is a fair distance away from the fisheries sensitive receivers (i.e. oyster production area, fish spawning ground and artificial reefs). Besides, the discharged saline water would comply with the standards for effluents discharged into the coastal waters of Deep Bay WCZ. Marine fishes usually have a higher salt tolerance than their freshwater counterparts. Therefore, the impact due to discharge of saline water on fisheries resources is insignificant and considered acceptable.

8a.6.2.4 No wastewater effluent, persistent organic pollutants (POPs), heavy metals and other contaminants would be released during operation phase of the Project. No other biocides / anti-fouling chemicals (such as chlorine and C-treat-6) would be used for the proposed desalination plant. There would be no temperature elevations in the brine water discharge as compared to the ambient water temperature. No adverse impact on fisheries is anticipated.

Impingement and Entrainment

8a.6.2.5 Water intake may cause physical damage on fisheries resources due to collisions with the screen. The magnitude of impact depends on the volume and rate of the water intake as well as the sensitivity and productivity of the affected area. Since the rate of the water intake is slow (2,610 m^3/day), and the affected area is not regarded as an important spawning nor nursery ground (AFD, 1998), no unacceptable adverse impact due to intake of seawater on fisheries resources is expected.

8a.6.2.6 The overall evaluation of construction and operation phase fisheries impacts associated with the Project is summarized in **Table 8a.3** below.

Table 8a.3 Potential Fisheries Impact Evaluation during Construction and Operation Phase

Criteria	Construction Phase Impact	Operation Phase Impact
Nature of impact	Impact on fisheries resources is limited to increase in suspended solid, organic and inorganic water. Pollutants could be diluted by large volume of water. The effect would be temporary, reversible in nature.	Indirect impact due to discharge of saline water which could be diluted by large volume of water. The effect would be permanent but localised and reversible. Indirect impact arising from impingement and entrainment would also be permanent but localised and reversible.
Size of affected area	Small. The quantity of SS and water pollutants is small and would be very localized when diluted by large volume of water.	Small. The volume of saline water discharge would be small, and could be diluted by large amount of water. The impact zone is estimated to be localized and small (47 m from the discharge). The impact zone due to impingement and entrainment would be localised and small.
Loss of fisheries resources / production	Small. Temporary loss to an insignificant portion of the total fisheries production in Hong Kong is expected.	No. Fish would re-route from the impact zone to nearby available waters. Since the rate of the water intake is slow (2,610 m^3/day), negligible loss of fisheries resources is expected due to impingement and entrainment.
Destruction and disturbance of nursery and spawning grounds	No destruction and disturbance of important nursery and spawning grounds for commercial fisheries species.	No destruction and disturbance of important nursery and spawning grounds for commercial fisheries species.
Impact on fishing activity	Insignificant impact. The fishing ground in the vicinity of the IWMF supported a low number of vessels, adult fish production and fisheries production value. The size of fishing ground affected is insignificant. The affected vessel could fish in other areas in nearby waters.	Insignificant impact. The fishing ground in the vicinity of the IWMF supported a low number of vessels, adult fish production and fisheries production value. The size of fishing ground affected is insignificant. The affected vessel could fish in other areas in nearby waters.
Impact on aquaculture activity	No impact to oyster culture area which is located at a fair distance away from the IWMF.	No impact to oyster culture area which is located at a fair distance away from the IWMF.
Overall fisheries Impact	Very low	Insignificant

8a.7 Mitigation of Environmental Impacts

8a.7.1.1 Following EIAO-TM Annex 17, mitigation measures are discussed in this section to avoid, minimize, and compensate any identified fisheries impacts. In view of the insignificant and localized water quality change arising from the construction and operation activities

of the proposed Project, it is anticipated that no major fisheries impacts would be resulted, hence no specific mitigation measure on fisheries resources is proposed.

8a.7.1.2 Nevertheless, in order to minimize and control water quality in the vicinity, mitigation measures such as use of effective site drainage in land-based construction site are proposed in the Water Quality Impact Assessment as detailed in **Section 5a**. These recommendations would further protect fisheries resources from indirect impacts and minimize adverse impact on fisheries resources resulted from the Project.

8a.8 Evaluation of Residual Environmental Impacts

8a.8.1.1 The only residual environmental impact due to the proposed Project is the increase of saline water discharge to the surrounding marine environment. In view of its small scale and very localized nature of the water quality change, the impact to fisheries resources is considered to be minor and acceptable.

8a.9 Evaluation of Cumulative Environmental Impacts

8a.9.1.1 The construction of the proposed Project is scheduled to commence in 2013 and complete in 2016. The construction of the proposed Project would coincide with the construction/implementation programmes of the Sludge Treatment Facility (STF) (2010-2012) and Black Point Gas Supply (BPGS) (2011-2013). The overlapping period between the construction phases of these projects is only 1 to 2 years. No significant impacts on fisheries resources have been identified from STF (EPD, 2008). As refers to **Section 5a.9.1.1**, with the implementation of the recommended mitigation measures, no unacceptable residual impacts on water quality are expected arising from the proposed Project. Therefore, even though the water quality mixing zone due to the BPGS would extend to the coastal waters off the Project site (CPPC, 2010), the proposed Project would not contribute to any cumulative impacts on fisheries resources. The water quality mixing zone is anticipated to be within the environmentally acceptable limits (CPPC, 2010).

8a.9.1.2 Both the STF and the IWMF would encompass seawater intake/ saline water discharge. During operation phase, however, cumulative potential impacts are expected to pose by the IWMF and the abovementioned STF in increasing saline water discharge on fisheries resources. The volume of saline water discharge is considered insignificant and could easily be diluted by large amount of marine water (refer to **Section 5a.7.2.8 and Section 5a.9.1.1**). It is expected that fisheries resources in the impact zone, which also inhibit in more saline waters in Eastern Waters, could tolerate the increased salinity. The associated fisheries impacts are thus expected to be acceptable.

8a.10 Environmental Monitoring and Audit

8a.10.1.1 Mitigation measures recommended for water quality impact assessment will be regularly audited. No unacceptable fisheries impacts would be expected from the Project. No specific monitoring programme for fisheries would be required.

8a.11 Conclusion

8a.11.1.1 No loss of fishing ground and resources is expected during construction and operation phase of the proposed Project. Mitigation measures, such as use of effective site drainage, would be implemented during construction phase to protect fisheries resources. With proper implementation of the recommended mitigation measures, no significant adverse impact on fisheries resources would be expected.

8a.11.1.2 Overall, the construction and operation phase impacts on fisheries resources identified are deemed acceptable. Therefore, no specific mitigation measures and monitoring programme would be required.

8a.12 References

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