

10. SUMMARY OF ENVIRONMENTAL OUTCOMES

10.1 Introduction

An assessment of the potential environmental impacts associated with the construction and operation phases of the Project has been conducted in accordance with the requirements of the Study Brief and *EIAO-TM*. This EIA study predicted that the Project would be environmentally acceptable with the implementation of the recommended mitigation measures. The key environmental outcomes, taking into account estimated population protected from various environmental impacts, environmentally sensitive areas protected, environmentally friendly options considered and incorporated in the preferred option, environmental designs recommended, key environmental problems avoided, compensation areas included and the environmental benefits of environmental protection measures recommended, are summarised in the following sections.

10.2 Estimated Population and Environmentally Sensitive Areas Protected from Various Environmental Impacts

Environmentally friendly options and designs as well as various mitigation/ control measures were considered to avoid and / or minimise environmental impacts due to the construction and operation of the Project. The following populations and environmentally sensitive areas have been protected:

- Po Toi have limited access to public transportation except for ferry services. Mainly residential, working and transient populations at Po Toi, nearby country park and marine reserve, nearby islands such as Tung Lung Chau, existing and future users of the marine waters in the vicinity of Po Toi are present and subject to less potential visual impacts by the selection of the currently proposed Project site; and
- All sensitive uses of marine waters, marine ecological resources and fisheries resources in the Southern WCZ have been protected from the potential change in water quality during construction phase and operation phase.

10.3 Environmentally Friendly Options Considered and Incorporated in the Preferred Option

Environmentally friendly options which have been considered for the Project to minimise potential environmental impacts include the followings and each of them is described below:

- Migration to environmentally friendly modernised mariculture;
- Site selection to avoid encroachment onto environmental sensitive areas; and
- Site sitting at deeper waters to avoid organic accumulation and the need of sediment removal.

10.3.1 Migration to Environmentally Friendly Modernised Mariculture

AFCD has been actively supporting the modernization and sustainable development of the local fisheries industry and enhancing their competitiveness through a multi-pronged approach. Amongst the various measures that have been recommended, the designation of new FCZs and the promotion of the adoption of advanced and environmentally friendly culture practices are practical means to promote mariculture development. The sustainable development of mariculture and the designation of new FCZs can have the following benefits:

- Increase local mariculture production to support local demand for live marine fish, with a quality, healthy, safe, diversified and stable supply with low carbon footprint;
- Provide an avenue for capture fishermen, who face various operational challenges, to switch to a sustainable operation mode, which in turn alleviates local fishing pressure and promotes the conservation and recovery of fisheries resources and preservation of the marine environment;

- Allow mariculturists of the existing FCZs to consider pursuing modernised and sustainable modes of operation in the new FCZs, such that the marine environment of the existing FCZs can improve when the level of mariculture activities there decreases;
- Larger production scale enabled with technology can allow operating costs to be optimised, and hence improving cost-efficiency and competitiveness;
- Provide high value-added fisheries products and assists the fisheries sector to seize the opportunities in the Greater Bay Area (GBA) and other places;
- Attract new entrants and business opportunities to further grow the sector and related trades organically, also providing employment opportunities.

Overall, the sustainable development of mariculture in Hong Kong, by means of designating new FCZs, plays a critical role in fostering support for the fisheries industry which is an important local cultural asset with a long history and valuable contributions to Hong Kong's economy and society. A sustainable fisheries industry will help establish and maintain marine biodiversity such that our future generations can enjoy a diverse and rich marine ecological environment.

10.3.2 Site Selection to Avoid Encroachment onto Environmentally Sensitive Areas

The criteria for the site selection of sustainable mariculture were reviewed with reference to international guidelines (e.g. the Food and Agriculture Organization (FAO)), which include minimum water depth, wave exposure, water quality and the compatibility with the existing usage and environment. A site search using constraint mapping was conducted to identify suitable locations in Hong Kong waters for the development of new FCZs considering these site selection criteria. The Project site is one of the selected sites that have avoided encroaching key marine ecological habitats, including marine parks and marine reserve, country parks and special areas, SSSIs, coral communities with high ecological value. The Project is also at some distance away from key marine ecological habitats, including marine parks and marine reserve, country parks and special areas, SSSIs, coral communities with high ecological value, mangroves, horseshoe crabs, marine mammal habitats, wintering or nesting grounds for birds (including White-Bellied Sea Eagles). Impacts to these marine ecological sensitive receivers from the potential change in water quality due to mariculture operation are minimized.

In addition, the Project is at some distance away from existing, planned / potential marine usages, including existing FCZs, artificial reefs, coastal protection areas, seawater intake points, designated areas of marine dredging and mud disposal, existing anchorages, marine vessel fairways, restricted areas, submarine cables, pipelines and outfalls, private moorings, planned / potential coastal developments & reclamation, beaches and diving hotspots, thus potential environmental nuisance from mariculture operation to these marine usages is minimized.

The Project is at some distance away from air quality, noise and visual sensitive receivers and thus environmental impacts to these sensitive receivers are also minimized.

10.3.3 Site Sitting at Deeper Waters to Avoid Organic Accumulation and the Need of Sediment Removal

The Project site is located at deeper waters with water depth of -20 m to -35 m and higher water flushing rate. Sufficient distance between the bottom of the fish cage and the seabed as well as among fish cages can be maintained to minimise water quality impact. This setting together with the open sea environment allows adequate water dispersion and prevents the build-up of organic content and degradation of the nearby marine environment. Consequently, organic content is also not built up on the seabed and maintenance dredging and sediment removal are therefore not required for FCZ in deep waters, and the associated water quality impacts and related ecological and fisheries impacts can be avoided.

10.4 Environmental Designs Recommended and Key Environmental Problems Avoided

Environmental designs have been recommended to further minimise the identified environmental impacts. The designs include the followings and each of them is discussed below:

- Control maximum standing stock level to safeguard water quality;
- Adopt modern prefabricated fish culture raft to minimise on-site construction works and chemical uses;
- Adopt modern fish farm designs to lower carbon footprint and waste generation, minimise potential fish escape and introduction of foreign species to local marine ecological environment; and
- Adopt fish farm designs and layout to maintain adequate water flushing.

10.4.1 Control Maximum Standing Stock Level

Carrying capacity (i.e. maximum standing stock) of the Project site has been determined with well-established modelling system to ensure environmental sustainability. The modelling system takes into account factors such as tidal flushing rate of the site, organic and nutrients loading from fish farms, and the statutory/indicative water quality objectives applicable to the local waters to determine the carrying capacity of FCZs, thus providing an objective and scientific assessment on the environmental acceptability of FCZs. AFCD will limit the number of marine fish culture license issued to control mariculture operation at the Project site within the maximum allowable standing stock level. Impacts on water quality as well as marine ecological and fisheries resources will therefore be minimised.

10.4.2 Adopt Modernised Prefabricated Fish Culture Raft to Minimise On-site Construction Works and Chemical Uses

A majority of the framework of the fish cages will be prefabricated off-site, and then tow the fish farm framework to the Project site for assembly and anchorage. Prefabrication work off-site can minimize the construction activities and work duration on-site and hence reducing the duration when potential impacts to the environment can occur. It is expected to avoid the generation of C&D materials and chemical wastes, and potential water quality impact from construction site run-off during the construction of the Project. Generation of underwater sound is minimised in this method, with less disturbance to marine and fisheries habitats. Also, less labour input required on site would result in reduction of waste generated from human activities.

10.4.3 Adopt Modernised Fish Farm Designs and Advanced Mariculture Technologies

Unlike traditional fish farm designs which are mainly simple designs made of timber, modernised fish farm designs and the use of advanced mariculture technologies would minimise environmental impacts. Modernised fish farm designs are built of weather-resistant materials, such as high-density polyethylene (HDPE) and the use of steel truss cages are more durable, which would be less likely to get damaged or repaired and result in less waste generation. The design of submersible / semi-submersible fish cage would also be less susceptible to adverse weather conditions. Advanced mariculture technologies (e.g. real-time surveillance and water quality monitoring, renewable energy sources such as solar and wind) and automation (e.g. fish feeder) can reduce labour intensive activities, hence reduce potential disturbance to ecology and environment from feed wastage, workforce wastes, vessel trips, etc.

With the more durable fish farm building materials, weather-resistant designs and application of advanced technologies, the impact on marine ecological resources will be minimised. The introduction of invasive species and escape of cultured fish are not anticipated with use of durable fish

net / cages, together with the regular maintenance of fish farm equipment, unacceptable impacts on local ecology and fisheries resources are therefore not anticipated. Lower carbon footprint from mariculture operation and less waste generation are also expected with the use of advanced mariculture technologies.

Commercial pellet feed or alternative feed with better FCR will be adopted as the major fish feed at the new FCZ. Pellet feed generally floats on the water surface that could minimise feed wastage to seabed, thus reducing the potential pollution loading and minimising impacts to water and sediment quality. On the other hand, pellet feed contains less moisture (~10%) that can be easily stored at FCZ and minimise the potential transmission of parasitic and infectious disease to fishes, thus reducing potential organic waste generation due to feed wastage and fish carcasses and dead fish arising from the fish culture operation.

10.4.4 Adopt Fish Farm Designs and Layouts to Maintain Adequate Water Flushing

Sufficient separation distance between fish cages and between the cage bottom and seabed will be maintained to allow adequate water flow in between and reduce impacts on water quality such as changes in flow regime and build-up of organic content, reducing the subsequent ecological and fisheries impacts in the vicinity and degradation of the nearby marine environment. The sizable fish farm cages can also avoid overcrowding of fish stock and with good mariculture practice and dispersion by the open sea, organic content is not built up on the seabed. Maintenance dredging and sediment removal are therefore not required for FCZ in deep waters, and the associated water quality impacts and related ecological and fisheries impacts can be avoided.

10.5 Summary of Key Environmental Problems Avoided and Sensitive Areas Protected

A summary of the key environmental problems avoided with the environmentally friendly options (**Section 10.3**) and recommended environmental designs (**Section 10.4**) of the Project is provided in **Table 10.1**.

Table 10.1 Key Environmental Problems Avoided, Sensitive Areas Protected and Environmental Outcomes Achieved

Design Approach	Key Environmental Problems Avoided, Sensitive Areas Protected and Environmental Outcomes Achieved
Migration to environmentally friendly modernised mariculture	<ul style="list-style-type: none"> Adverse impacts from mariculture activities to water quality, marine ecology, fisheries and waste management would be avoided.
Site selection to avoid encroachment onto environmental sensitive areas	<ul style="list-style-type: none"> Direct impact from anchorage, assembly and operation of FCZ to marine ecological resources such as artificial reefs, coastal protection area are avoided. Adverse impacts to marine ecology and fisheries due to encroachment onto environmental sensitive areas would be avoided.
Site sitting at deeper waters to avoid organic accumulation and the need of sediment removal	<ul style="list-style-type: none"> Adverse impacts from maintenance dredging and sediment removal works to water quality, marine ecology and fisheries would be avoided.
Control maximum standing stock level	<ul style="list-style-type: none"> Adverse impacts from mariculture activities to water quality, marine ecology and fisheries would be avoided.

Design Approach	Key Environmental Problems Avoided, Sensitive Areas Protected and Environmental Outcomes Achieved
Adopt modern prefabricated fish culture raft	<ul style="list-style-type: none"> Adverse impacts from on-site construction to water quality, marine ecology, fisheries and waste management would be avoided.
Adopt modern fish farm designs and advanced mariculture technologies	<ul style="list-style-type: none"> Adverse impacts from mariculture activities to water quality, marine ecology, fisheries and waste management would be avoided.
Adopt fish farm designs and layout to maintain adequate water flushing	<ul style="list-style-type: none"> Adverse impacts from mariculture activities to water quality, marine ecology, fisheries and waste management would be avoided.

10.6 Environmental Benefits of Environmental Protection Measures

Appropriate environmental protection measures and mitigation measures have been recommended to reduce environmental impacts due to the construction and operation of the Project. The key measures are summarised in **Table 10.2**.

Table 10.2 Key Recommended Environmental Protection / Mitigation Measures and their Associated Benefits

Aspect	Key recommended environmental protection / mitigation measures	Associated Benefits
Water Quality	<ul style="list-style-type: none"> Standing stock should not exceed 1765.4 ton at any given time. AFCD will ensure the production scale of the Project site will not exceed the maximum standing stock level by controlling the mariculture production scale permitted under individual license. The licensees will adopt the operational measures and best practice for mariculture activities (see Appendix 2A). Proper storage and disposal of solid wastes, sewage / wastewater, chemical wastes and organic wastes shall be carried out under the relevant Ordinances. In case of potential circumstances (e.g. red tide event, outbreak of fish disease), the licensees will review the need of fish raft relocation and propose the fish raft relocation plan as necessary for agreement with AFCD. 	<ul style="list-style-type: none"> Protect the neighbouring water sensitive receivers in particular coral communities.
Marine Ecology	<ul style="list-style-type: none"> The mitigation measures designed to mitigate water quality impacts through proper fish farm management shall be adopted. 	<ul style="list-style-type: none"> Minimise impacts to marine ecological sensitive receivers in the vicinity to the Project site, such as coral communities and marine mammal habitats.

Aspect	Key recommended environmental protection / mitigation measures	Associated Benefits
Fisheries	<ul style="list-style-type: none"> ■ The mitigation measures designed to mitigate water quality impacts and proper fish farm management designated to mitigate marine ecological impacts shall be adopted. 	<ul style="list-style-type: none"> ■ Minimise impacts to fisheries sensitive receivers in the vicinity to the Project site, such as spawning ground of commercial fisheries resources.
Waste Management	<ul style="list-style-type: none"> ■ Nomination of approved personnel (e.g. environmental officer of the contractor(s), representative of the project proponent) to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility of all wastes generated at the site. ■ Training of site personnel in proper waste management and handling procedures by AFCD. ■ Provision of sufficient waste disposal points and regular collection for disposal. ■ Appropriate measures to reduce windblown / floating litter and dust during transportation of waste by transporting wastes in enclosed containers. ■ A recording system (e.g. log book for mariculture operation) for the amount of wastes generated, recycled and disposed of and the disposal sites for checking by AFCD. ■ Prior to the commencement construction phase and operation phase, training should be provided to contractor(s) and all staff working at the Project site respectively. ■ Proper collection, storage and disposal of solid wastes, chemical wastes and organic wastes shall be carried out under the relevant Ordinances. ■ To avoid entrapment of floating refuse within the Project site, fish cages / rafts and vessels should be properly designed to avoid or minimise any trapped or accumulated refuse. ■ Use of good quality feed, i.e. pellet feed, to reduce uneaten feed wastage. ■ The fish farmers will keep detailed operational records to allow more accurate estimation of fish feed input and to minimise unnecessary wastage of feeds. 	<ul style="list-style-type: none"> ■ Minimise waste generation. ■ Ensure proper handling of wastes by site staff and contractors.

Aspect	Key recommended environmental protection / mitigation measures	Associated Benefits
	<ul style="list-style-type: none"> The uneaten feeds should be cleaned up immediately to minimise leaching to the adjacent water. 	
Visual	<ul style="list-style-type: none"> Pre-construction and construction period for the Project site should be reduced as far as practical. Sensitive architectural design will be considered where practicable. Light intensity and beam directional angle should be controlled at the Project site at the design stage to reduce light pollution and glare (e.g. hooded lights, specific directional focus, etc.). In addition, lighting will be limited to auxiliary structures to reduce night-time impacts. 	<ul style="list-style-type: none"> Minimise impacts to visual sensitive receivers in the vicinity to the Project site. Enhance visual appearance of fish farm during operation.
Cultural Heritage	<ul style="list-style-type: none"> Implement a buffer area of 20 m radius from each of the 4 sonar contacts (D-SC005, D-SC009, D-SC013, and D-SC055) to avoid tug boat anchoring, and anchoring of the fish rafts/cages in the areas. The locations and relocations of fish rafts / cages are regulated by the Marine Fish Culture Ordinance (Cap. 353), and AFCD will ensure the locations of anchoring of vessels and fish rafts/cages will not be located within the buffer area. 	<ul style="list-style-type: none"> Minimise impacts to sites of marine archaeological interest within the Project site.

10.7 Compensation Area

As the Project has adopted environmentally friendly options and environmental designs as well as various environmental mitigation/ control measures, adverse impacts on water quality, marine ecology, fisheries, waste management, visual and cultural heritage are not anticipated. Thus, compensation area is considered not necessary for the Project.