

7 ECOLOGICAL IMPACT ASSESSMENT

7.1 Introduction

This section presents the results of the assessment of ecological value of the habitat and the potential impacts from the construction and operation of the drainage system of the Project (Drainage Improvement in Tsuen Wan and Kwai Chung – Tsuen Wan Drainage Tunnel - Investigation), on ecological resources in the Study Area. Field surveys covering a period of 4 months (August to November 2003) were undertaken to establish the baseline ecological conditions of the Study Area. The methodology and results of the literature review and baseline surveys are presented in **Appendix F**. Measures required to mitigate identified adverse impacts are recommended, where appropriate.

7.2 Relevant Legislation and Guidelines

A number of international conventions and local legislation and guidelines provide the framework for the protection of species and habitats of ecological importance. Those related to the Project are:

- *Country Parks Ordinance* (Cap 208);
- *Forests and Countryside Ordinance* (Cap 96);
- *Wild Animals Protection Ordinance* (Cap 170);
- *Animals and Plants (Protection of Endangered Species) Ordinance* (Cap 187);
- *Town Planning Ordinance* (Cap 131);
- *Hong Kong Planning Standards and Guidelines Chapter 10* (HKPSG);
- *The Technical Memorandum on Environmental Impact Assessment Process under the Environmental Impact Assessment Ordinance (EIAO TM)*;
- *United Nations Convention on Biodiversity* (1992); and
- *PRC Regulations and Guidelines*.

The *Country Parks Ordinance* provides for the designation and management of Country Parks and Special Areas. Country Parks are designated for the purpose of nature conservation, countryside recreation and outdoor education. Special Areas are created mainly for the purpose of nature conservation.

The *Forests and Countryside Ordinance* prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. The subsidiary *Forestry Regulations* prohibit the picking, felling or possession of listed rare and protected plant species. The list of protected species in Hong Kong which comes under the *Forestry Regulations* was last amended on 11 June 1993 under the *Forestry (Amendment) Regulation 1993* made under Section 3 of the *Forests and Countryside Ordinance*.

Under the *Wild Animals Protection Ordinance*, designated wild animals are protected from being hunted, whilst their nests and eggs are protected from destruction and removal. All birds and most mammals including all cetaceans are protected under this Ordinance, as well as certain reptiles, amphibians and invertebrates. The Second Schedule of the Ordinance that lists all the animals protected was last revised in June 1992.

The purpose of the *Animals and Plants (Protection of Endangered Species) Ordinance* is to restrict the import and export of scheduled species. The Ordinance is primarily related to controlling trade in threatened and endangered species and restricting the local possession of them.

The *Town Planning Ordinance* provides for the designation of areas such as “Coastal Protection Areas”, “Sites of Special Scientific Interest (SSSIs)”, “Green Belt” and “Conservation Area” to promote conservation or protection or protect significant habitat.

Chapter 10 of the *HKPSG* covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong, and Government departments involved in conservation.

Annex 16 of the *EIAO TM* sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating ecological impacts.

The Peoples’ Republic of China (PRC) is a Contracting Party to the *United Nations Convention on Biological Diversity* of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. The Government of the Hong Kong Special Administrative Region has stated that it will be “committed to meeting the environmental objectives” of the Convention (PELB 1996).

The PRC in 1988 ratified the *Wild Animal Protection Law* of the PRC, which lays down basic principles for protecting wild animals. The Law prohibits killing of protecting animals, controls hunting, and protects the habitats of wild animals, both protected and non-protected. The Law also provides for the creation of lists of animals protected at the state level, under Class I and Class II. There are 96 animal species in Class I and 156 in Class II. Class I provides a higher level of protection for animals considered to be more threatened.

7.3 Assessment Methodology

The Study Area was defined as the area within 500 m of either side, and along the full stretch of the alignment of the Tunnel Option No. 3 the shortest tunnel alignment (discussed in *Section 2* and recommended in the Option Selection Report, and endorsed by the Drainage Services Department), as well as the intake and outfall structures. Following a literature review of available ecological data characterising the Study Area, reconnaissance surveys were undertaken in August 2002 to update and field check the validity of the information gathered in the review. A number of more focused baseline field surveys were then carried out to determine the existing ecological conditions. The surveys were designed to fill any

identified data gaps in order to facilitate a compliant assessment of the Project's impacts upon ecology and the development of appropriate mitigation measures. Special attention was paid to those areas which will be directly impacted by the proposed construction areas. The baseline surveys cover a 4-month period from August to November 2003.

The following baseline surveys were identified as being required:

- Habitat and vegetation surveys;
- Dragonfly and butterfly surveys;
- Herpetofauna survey including night survey;
- Bird survey;
- Mammals survey including night survey;
- Stream fauna survey; and
- Intertidal survey.

Details of the baseline field survey methodology are presented in **Appendix F**.

7.4 Results of Baseline Field Surveys

This section presents a summary of the findings of the baseline field surveys performed during the period August to November 2003. The results of the literature review and baseline field surveys are presented in full in **Appendix F**. The baseline ecological conditions were evaluated based on the criteria laid out in *Annex 8 & 16* of the *EIAO TM*.

Most of the Study Area located below and immediately above the catchwater running along the southern boundary of Shing Mun Country Park was highly urbanised or degraded by agriculture practice and village housing. Terrestrial habitats found within the Study Area included woodland, plantation, grassland, village-orchard, stream channel, intertidal habitat (artificial/disturbed seashore) and disturbed/urbanized areas (**Table 7.1**, details refer to **Appendix F**). A total of 240 plant species were recorded, about 30% of which were exotics (**Appendix F**).

Table 7.1 Habitat Types recorded within the Study Area

Habitat type	Size	Ecological Value	Notes
Woodland	79.1 ha	Moderate	Species of conservation interest recorded included Emerald Dove, Rhesus Macaque, Black Kite, Chinese Pond Heron and Little Egret.
Plantation	181.2 ha	Low to Moderate	Species of conservation interest recorded included Japanese Pipistrelle, Pallas Squirrel Common Buzzard.
Grassland	89.4 ha	Low	Species of conservation interest recorded included Red Admiral and Japanese Pipistrelle
Village-Orchard	40.5 ha	Low to Moderate	Neither rare nor protected species were recorded during the survey.

Habitat type	Size	Ecological Value	Notes
Stream/Channel	7.54 ha (ca. 5km)		
Intake I-1 Channel		Low	Man-made channel with smooth channel bed and lack of pool areas
Sam Dip Tam Stream		Moderate	Residential sewage inputs were found in the middle course of the-stream, above the proposed Intake I-2. Species of conservation interest recorded included Hong Kong Newt, Chinese Pond Heron, Little Egret and White-throated Kingfisher
Tso Kung Tam Stream		Moderate	Residential sewage inputs were found just upstream to the proposed location for Intake I-3. Species of conservation interest recorded included Little Egret, Striated Heron, Plumbeous Redstart.
All Other Streams/Channels within the Study Area		Low to Moderate	Species of conservation interest recorded included Hong Kong Cascade Frog
Urbanised/Disturbed Area	165.4 ha	Low	Species of conservation interest recorded included <i>Arundina graminifolia</i> and Common Rat Snake. The Common Rat Snake was recorded near the proposed Intake I-2.
Intertidal Habitat (Artificial/Disturbed Seashore)	1 km	Low	The Outfall O-1 will be located on the highly disturbed habitat with low species diversity and richness (only 6 species of intertidal fauna were recorded during baseline surveys). All recorded faunal species were common and widespread in Hong Kong. Almost all of the coastlines within the Study Area have been modified to artificial seawalls, including boulder and vertical seawalls, or severely disturbed by recently deployed rocks due to other projects.

The proposed Ecological Park at Tso Kung Tam Valley shares the same environment as the Study Area of the Intake I-3 with woodland, plantation, village-orchard, grassland and stream habitats. The habitats potentially affected due to the Intake I-3 include plantation, village-orchard and stream habitats. Except the Tso Kung Tam Stream of moderate ecological value, both of the plantation and village-orchard were identified of low to moderate ecological value.

Species of conservation interest recorded within the Study Area during the surveys included orchid *Arundina graminifolia*, Japanese Pipistrelle *Pipistrellus abramus*, Rhesus Macaque *Rhyacornis fuliginous*, Pallas Squirrel *Callosciurus erythraeus styani*, Striated Heron *Butorides striatus*, Chinese Pond Heron *Ardeola bacchus*, Little Egret *Egretta garzetta*, Black Kite *Milvus lineatus*, Common Buzzard *Buteo buteo*, Emerald Dove *Chalcophaps indica*, White-throated Kingfisher *Halcyon smyrnensis*, Plumbeous Redstart *Rhyacornis fuliginous*, Common Rat Snake *Ptyas mucosus*, Hong Kong Newt *Paramesotriton hongkongensis*, Hong Kong Cascade Frog *Amolops hongkongensis*, Red Admiral *Vanessa indica* and Freshwater crab *Cryptopotamon anacoluthon*.

Only three species of conservation interest (Common Rat Snake, Striated Heron and Plumbeous Redstart) recorded in the vicinity of the proposed surface structures during the

surveys. The two bird species Striated Heron (usually foraging in coastal mangrove and occurring in wooded stream mainly during winter) and Plumbeous Redstart (winter visitor, occurring in rocky stream) were recorded close to Intake I-3. Common Rat Snake was recorded close to Intake I-2.

7.5 Potential Impacts

The proposed drainage tunnel is approximately 5.13 km long running below ground with 4 surface structures, including 3 intake structures and an outfall. The potential ecological impact arising from the drainage improvement works, based on the results of the recent baseline surveys, revised layout drawings and construction methods of Tunnel Option No. 3 the shortest tunnel alignment (discussed in *Section 2* and recommended in the Option Selection Report, and endorsed by the Drainage Services Department), may arise from the construction and operational phase impacts detailed below.

7.5.1 Construction Phase

- Direct habitat loss and habitat fragmentation resulting from land take for the construction activities for the surface structures of the proposed drainage tunnel;
- Direct impacts to inactive/less mobile/habitat-specific wildlife nesting/inhabiting the affected area and surrounding habitats, and associated impacts to wildlife including restriction of wildlife utilisation (ie transit, feeding and roosting), degradation of habitat quality/ ecological function, as a result of temporary and permanent loss, isolation and fragmentation of ecological habitat, and noise, construction activities;
- Direct and indirect impacts to watercourses, including deterioration of water quality, silty run-off and sedimentation effect, as a result of construction activities and discharge; and
- Impacts to the surrounding habitat due to physical disturbance of this habitat including construction activities, increased human activities, inappropriate storage or dumping of construction material, or hill fire.

7.5.2 Operational Phase

- Potential hydrological disruption to the natural downstream habitats and aquatic fauna; and
- Impacts to the hydrology and water quality of the coastal habitats in the vicinity of the outfall.

Apart from the potential ecological impacts, potential conflicts of the land use of the proposed Ecological Park may also arise from the construction of Intake I-3 which is unavoidably located within the proposed Ecological Park (details refer to Section 2).

7.6 Impact Assessment

The proposed drainage tunnel will be constructed 7 m to 200 m below the existing ground level. The major impacts on the ecological resources will be the construction of surface

structures including the 3 stormwater intakes (Intakes I-1, I-2 and I-3) and an outfall structure (**Figures 7.1 to 7.6**).

7.6.1 Construction Phase

In general, the construction of the proposed drainage tunnel including temporary and maintenance access, sand/boulder trap, intake and outfall structures (including vertex chamber and drop shaft), site formation, excavation, hand digging, drilling and blasting works (at Intakes I-2 and I-3), will lead to the loss of existing habitats, particularly stream/channel, plantation, village-orchard, intertidal habitat (artificial/disturbed seashore) and urbanised/disturbed areas, as well as the effect of habitat fragmentation and isolation.

The details of the construction sequences, methods and programme are presented in *Section 2*.

Intake I-1

Most of the works at Intake I-1 including the construction of maintenance works area and spiral access ramp will be undertaken on sloping area which mainly involve slope cutting works, installation of soil nails, construction of retaining walls, site formation and excavation, pilings. All of the areas to be affected by Intake I-1 were identified as low quality, man-made and highly disturbed habitats including man-made channel with smooth concrete bottom, plantation and urbanised/disturbed habitat (**Figure 7.1** and **Table 7.2**). Neither rare nor protected species will be affected, and no aquatic fauna were recorded in the vicinity of Intake I-1 during the baseline surveys.

Table 7.2 Overall Habitat Loss due to the Drainage Improvement Works

Proposed Surface Structures	Impacted Habitats	Permanent loss (Land Take for the Surface Structures)	Potentially Temporary Loss (Works Areas) during the Construction ^{(1) (2)}	Ecological Value of the Affected Habitat
Intake I-1	Stream/Channel	15m (<0.01 ha)	140m (0.15 ha)	Low
	Plantation	0.13 ha	0.22 ha	Low to Moderate
	Urbanized/ Disturbed Area	Nil	0.12 ha	Low
Intake I-2	Stream/Channel	60 m (0.06 ha)	Additional 0.03 ha at the same stream section	Moderate
	Village-Orchard	0.05 ha	Nil	Low to Moderate
	Urbanized/ Disturbed Area	0.03 ha	Nil	Low
Intake I-3	Stream/Channel	75 m (0.02 ha)	Additional 0.11 ha at the same stream section	Moderate
	Plantation	0.51 ha	0.04 ha	Low
	Village-Orchard	0.10 ha	Nil	Low to Moderate
Outfall O-1	Intertidal Habitat (Artificial/ Disturbed Seashore)	55 m (0.15 ha)	65 m (0.02 ha)	Low
	Plantation	0.48 ha	1.16 ha	Low to Moderate

Proposed Surface Structures	Impacted Habitats	Permanent loss (Land Take for the Surface Structures)	Potentially Temporary Loss (Works Areas) during the Construction ^{(1) (2)}	Ecological Value of the Affected Habitat
	Urbanized/ Disturbed Area	0.11 ha	0.21 ha	Low

- Note: (1) All of the areas within the boundary of Works Area were assumed to be affected during the construction, and therefore the sizes of the potentially affected areas are considered as the worst case scenario.
 (2) Areas excluded the permanent resumed land for the Project.

Intake I-2

The construction activities in Intake I-2 will mainly involve the channel modification works, construction of retaining wall on the western side of the channel, vortex chamber and its associated on-line approach channel, the dropshaft and underground deaeration chamber, the man access shaft and connecting tunnel. The habitats to be affected permanently due to the construction of Intake I-2 structures include stream/channel of natural bottom, village-orchard and urbanized/ disturbed area (**Figure 7.2** and **Table 7.2**). The intake structures will be located mainly at the stream section of partial modification (with concrete lining underneath the existing bridge crossing) and disturbance (pollution due to residential sewage discharge)(**Figure 7.9**). The tentative construction sequences of the proposed intake and channel flow diversion works will be divided into 4 phases (details are presented in *Section 2*). The habitats to be affected during each phase are summarised in **Figure 7.3** and **Table 7.3**.

Table 7.3 Habitats to be Affected during Construction of Intake I-2

Phase	Habitats to be Affected during Construction	Construction Activities
1	Stream/Channel – mainly stream bank (55m/ <0.01 ha) Village-Orchard (0.03 ha) Urbanized/ Disturbed Area (0.01 ha)	Channel modification to match the new Dry Weather Flow Channel (DWFC) Bridge crossing concrete slabs modification to re-construct and re-locate the DWFC Channel widening (modify the stream bank into stream/channel) and concrete wall construction Provision of natural bedding (granular bed) Construction period: 01 Oct 07 to 29 Feb 08
2	Stream/Channel (30m/ 0.03 ha) Urbanized/ Disturbed Area (0.01 ha)	Site formation works Drop shaft, audit tunnel and deaeration chamber construction (the first 10m of the structures will be constructed by hand digging only, drill and blast method will be adopted for the deeper section) Construction period: 01 Mar 08 to 31 Aug 09
3	Stream/Channel (55m/ 0.05 ha) Urbanized/ Disturbed Area (0.01 ha)	Construction of intake chamber and guide wall Construction of superstructure of drop shaft Construction period: 01 Nov 09 to 31 Mar 10
4	Nil (at the same location of the completed part of Phase 3)	Construction of guide wall on the completed slab constructed under Phase 3 Construction period: 01 Feb 11 to 07 Mar 11
Man access	Village-Orchard (0.02 ha)	Construction of man access shaft and connecting tunnel by the drill and blast method Construction period: 01 Mar 10 to 31 Mar 11

Intake I-3

The construction activities in Intake I-3 will mainly involve the construction of the vortex chamber and its associated on-line approach channel, dropshaft, aeration chamber and audit tunnel, access road and slope works. The habitats to be affected permanently due to the construction of Intake I-3 include stream/channel, village-orchard and urbanized/ disturbed area (**Figure 7.4** and **Table 7.2**). The intake structures will be located mainly at the stream section of partial disturbance (pollution due to residential sewage discharge). The tentative construction sequences of the proposed intake and channel flow diversion works will be divided into 4 phases (details are presented in *Section 2*). The habitats to be affected during each phase are summarised in **Figure 7.5** and **Table 7.4**. Since Intake I-3 is located within the boundary of the proposed location of Tso Kung Tam Ecological Park (proposed by LCSD and still in planning stage), assessing the impacts on the existing habitats due to the proposed drainage tunnel are considered to be equivalent to and representative for the proposed Ecological Park.

Table 7.4 Habitats to be Affected during Construction of Intake I-3

Phase	Habitats to be Affected during Construction	Construction Activities
Road access	Plantation (0.47 ha) Village-Orchard (0.1 ha)	Formation of access road and associated slope works Slope stabilisation works on the south western side of the drop shaft Construction period: 01 Dec 07 to 31 May 08
1	Stream/Channel (14m/ <0.01 ha) Plantation (0.04 ha)	Construction of vortex chamber and drop shaft Construction period: 01 Jun 08 to 31 March 09
2	Stream/Channel (75m/ 0.08 ha)	Modification of existing stream bed and construction of approach channel with concrete lining Provision of natural bedding (granular bed) Construction period: 01 Nov 09 to 31 Mar 10
3	Stream/Channel (75m/ 0.04 ha) Plantation (0.04 ha)	Modification of existing stream bed and construction of approach channel with concrete lining Provision of natural bedding (granular bed) Construction period: 01 Nov 10 to 15 Mar 11

Outfall O-1

The works at Outfall O-1 will include the construction of tunnel portal, cascade, box culvert underneath the improved Castle Peak Road, spiral access ramp and laying of rip-rap on the seabed of the outlet. All of the areas to be affected by Outfall O-1 were identified as low quality, man-made and highly disturbed habitats including artificial/ disturbed intertidal habitat, plantation and urbanised/disturbed habitat (**Figure 7.6** and **Table 7.2**). Neither rare nor protected species will be affected.

The summarised potential impacts during construction phase will be:

Habitat Loss

- Permanent and temporary loss of the existing habitats including stream/channel, plantation, village-orchard, intertidal habitat (artificial/disturbed seashore) and disturbed/urbanized areas due to the construction of the permanent access ramp, maintenance/ turning area, intake/outfall structures and sand/boulder trap (details refer to

Figures 7.1 - 7.6 and Table 7.2). In general, with the exception of moderate ecological value of the middle course of Sam Dip Tam Stream (location of Intake I-2) and Tso Kung Tam Stream (location of Intake I-3), all of the affected habitats are of low ecological concern.

- Direct impact to the bottom of the stream channels reducing the number of riffles and pools due to the land take for the surface structures, as well as secondary impacts to the associated aquatic fauna. The upstream or downstream movement of the aquatic fauna will also be restricted; and
- Loss of foraging and feeding ground of the associated wildlife, particularly species of conservation interest (Common Rat Snake, Striated Heron and Plumbeous Redstart) recorded in the vicinity of the proposed surface structures during the August-November surveys (**Table 7.5**).

Table 7.5 Impacts on the Species of Conservation Interest

Species of Conservation Interest	Major Impacts	Location Recorded
Striated Heron (all birds are protected under WAPO in Hong Kong, bird of local concern)	Part of their foraging habitat (stream) will be affected	Downstream of Intake I-3
Plumbeous Redstart (all birds are protected under WAPO in Hong Kong, bird of local concern)	Part of their foraging habitat (stream) will be affected	Downstream of Intake I-3
Common Rat Snake (listed in Appendix 2 of CITES (Zhao 1998) and considered of potential regional concern)	Associated habitats will be partially affected	Urbanized/ disturbed area near proposed location of Intake I-2

Habitat Fragmentation and Isolation

- Fragmentation and isolation of the continuous patches of plantation (with low to moderate ecological value) restricting the wildlife movement at Intakes I-1, I-3 and Outfall O-1 resulting from land take for the construction activities for the proposed channels. Minimal effects of habitat fragmentation and isolation due to the loss of other habitats will be expected.

Impacts to Water Quality

- Impacts to Water Quality indirect impacts to aquatic ecological resources during the construction phase include sediment release and chemical spillage associated with the site formation, drill and blast works. Potential impacts to water quality from sediment release are listed below:
 - increased concentrations of suspended solids (SS); and
 - an increase in nutrient concentrations in the water column.

The aquatic organisms within the lower course of the stream may be susceptible to the effects of increased sediment loads. Effects can be lethal (ie suffocation) or sub lethal (eg reduction in reproductive potential due to stress incurred by constantly having to flush out the depositing material). The effects of sedimentation on organisms will also depend on

other factors, such as an organism's tolerance, growth orientation of sessile organisms and water movement. Given that increases in SS levels downstream are expected to be low and temporary, and within environmentally acceptable limits (as defined by the WQOs and tolerance criteria) (details refer to *Section 5 Water Quality Impact Assessment*), unacceptable impacts to the downstream aquatic fauna arising from minor elevations in SS levels are not expected to occur.

High levels of nutrients (total inorganic nitrogen - TIN and ammonia) in water can cause rapid increases in phytoplankton often to the point where an algal bloom occurs, particularly in stream pools. An intense bloom of algae can lead to sharp increases in DO levels in surface water. However, at night and when these algae die there is usually a sharp decrease in the levels of dissolved oxygen in the water, as dead algae fall through the water column and decompose on the bottom. Anoxic conditions may result if DO concentrations are already low or are not replenished. This may result in mortality to aquatic organisms due to oxygen deprivation. The water quality assessment has indicated that the levels of Chlorophyll a, TIN and ammonia do not change appreciably from background conditions during the Project works (details refer to *Section 5 Water Quality Impact Assessment*). It is thus expected that unacceptable impacts to the downstream habitats and the associated aquatic fauna, will not occur.

No chemical spillage affecting the downstream habitats and associated aquatic fauna will be anticipated given that regular checks on good construction practice will be conducted (details refer to *Section 5 Water Quality Impact Assessment*).

Other Impacts

- Secondary impacts to the surrounding habitats (generally with low ecological value) and associated wildlife, particularly species of conservation interest (Common Rat Snake, Striated Heron and Plumbeous Redstart) recorded in the vicinity of the proposed surface structures, may arise from the potential for increased noise impact, drilling and blasting, human activities and disturbance such as import, storage or dumping of construction material and construction site runoff. The impacts are expected to be low owing to the temporary nature and small scale of the construction works, and given that regular checks on good construction practice will be conducted.

7.6.2 Operational Phase

The Intake I-1 is designed to intercept up to 94% of the stream flow ($59 \text{ m}^3/\text{s}$) in a 200-year rainfall event. Since the Intake I-1 is located on the existing artificial concrete channel and the lower courses of the stream/channel are underground man-made structures, no operational impacts will be expected.

The Intakes I-2 and I-3 are designed to capture 66% ($53 \text{ m}^3/\text{s}$) and 38% ($97 \text{ m}^3/\text{s}$) of the upland flow under a 200-year storm respectively. The side weir with a crest height of 1.3 m (Intake I-2) or 1.4 m (Intake I-3), used to intercept the stormwater, would come into operation when rainfall exceeds 30mm/hr. *Section 2.5* details the interception at each intake. The major operational impact due to the Project is the potential hydrological disruption, mainly influencing the water flow and level, to the natural stream habitats downstream to the intake structures, particularly Intakes I-2 and I-3. The intake structures may alter the flow velocity of the stream water influencing the downstream microhabitats and associated

aquatic fauna. The downstream water level may be reduced and this may reduce the stream habitats and therefore restrict the movement of aquatic fauna. The reduction in the water level may also reduce the number of riffles and pools of the lower course of the streams. As a consequence, the aquatic faunal communities and population may be influenced. The tunnel, however, is not expected to affect groundwater levels (note it is a lined tunnel) or the ecological resources above the tunnel. There will be no drawdown effect on the water table, and a programme of monitoring is included to demonstrate this.

The collected stormwater will be discharged to the sea via the Outfall O-1. The significant change of seawater salinity and flushing effects of the stormwater near the Outfall O-1 may affect the associated intertidal floral and faunal communities of the coastal habitats and nearshore benthic habitats. The distribution and abundance of marine organisms are determined by the physical environment, including the substratum, seawater salinity and water current. During the operational phase, the reduction of seawater salinity and strong flushing of the stormwater may alter the species diversity and abundance of the intertidal marine organisms inhabited in the vicinity of the outfall although these are acknowledge to be of low ecological value.

7.6.3 Cumulative Impact

With the exception of Intake I-3, there are no planned projects in the vicinity of the intake and outfall structures of the drainage tunnel. Considering that the ecological impacts arising from the construction and operation of Intake I-3 are low to moderate only (see *Section 7.6.4* below) and, as the best assumption in the absence of detailed design information from LCSD, that the proposed Ecological Park would adopt any necessary measures to minimise potential ecological impacts arising from its implementation, the potential for cumulative ecological impacts arising from these two projects would remain low.

7.6.4 Impact Evaluation

Habitat Loss

Potential impacts to ecology have been evaluated according to *Table 1* of *Annex 8* of the *EIAO TM*. **Tables 7.6** to **7.8** present an evaluation of the habitat loss due to the Project.

Table 7.6 Overall Impact Evaluation for Stream/Channel

Evaluation Criteria	Intake I-1	Intake I-2	Intake I-3
<i>Habitat quality</i>	The habitat quality of the Intake I-1 Channel is low. The existing channel has concrete bottom.	Moderate. The Intake I-2 located on middle course of Sam Dip Tam Stream has natural bottom and partially modified stream bank (particularly at the bridge crossing). Residential sewage input was recorded upstream of the Intake I-2.	Moderate. The Intake I-3 located on middle course of Tso Kung Tam Stream has natural bottom and stream bank. Residential sewage input was recorded upstream of the Intake I-3.

Evaluation Criteria	Intake I-1	Intake I-2	Intake I-3
<i>Species</i>	The potential exists for direct and indirect impacts to the wildlife inhabiting the stream. However, neither rare nor protected species will be affected, and no aquatic fauna were recorded during the surveys.	The potential exists for direct and indirect impacts to the wildlife inhabiting the stream. However, neither rare nor protected species will be affected. Common Rat Snake recorded in the urbanised/disturbed areas close to the Intake I-2 is potentially be affected. The downstream aquatic fauna may be affected due to the construction runoff during construction.	The potential exists for direct and indirect impacts to the wildlife inhabiting the stream. Species of conservation concern potentially affected included Striated Heron, Plumbeous Redstart. The downstream aquatic fauna may be affected due to the construction runoff during construction.
<i>Size/Abundance</i>	Approximately 140 m (0.15 ha) of the stream will be temporarily affected. Only a small section of the existing channel will be affected (15m (<0.01 ha)).	Approximately 60 m (0.06 ha) of the stream will be lost and approximately 0.03 ha of stream habitat will be temporarily affected. No additional areas will be affected temporarily during the construction.	Approximately 75 m (0.02 ha) of the stream will be lost and approximately 0.11 ha of stream habitat will be temporarily affected. Approximately 0.06 ha of the stream will be temporarily affected.
<i>Duration</i>	The impact will persist during the construction phase. The temporary affected areas will be reinstated after the completion of the works.	The impact will persist during the construction and operational phases.	The impact will persist during the construction and operational phases.
<i>Reversibility</i>	The habitat loss could be recreated, if lands available, but this requires a certain period of time to let the habitat mature.	The habitat loss could be recreated, if lands available, but this requires a certain period of time to let the habitat mature.	The habitat loss could be recreated, if lands available, but this requires a certain period of time to let the habitat mature.
<i>Magnitude</i>	The scale of the habitat loss is small in the context of the surrounding similar habitats.	The scale of the habitat loss is small in the context of the surrounding similar habitats.	The scale of the habitat loss is small in the context of the surrounding similar habitats.
Overall Impact Conclusion	Low	Low to Moderate	Low to Moderate

Table 7.7 Overall Impact Evaluation for Plantation and Village-Orchard

Evaluation Criteria	Plantation	Village-Orchard
<i>Habitat quality</i>	Low to Moderate.	Low to Moderate.
<i>Species</i>	The potential exists for direct and indirect impacts to the wildlife inhabiting the areas. However, neither rare nor protected species will be affected.	The potential exists for direct and indirect impacts to the wildlife inhabiting the areas. However, neither rare nor protected species will be affected.
<i>Size/Abundance</i>	Area loss are small in size: approximately 1.12 ha loss and 1.42 ha temporarily affected.	Area loss are small in size: approximately 0.15 ha loss.

Evaluation Criteria	Plantation	Village-Orchard
<i>Duration</i>	The impact will persist during the construction and operational phases. But the temporary affected areas will be reinstated after the completion of the works.	The impact will persist during the construction and operational phases. But the temporary affected areas will be reinstated after the completion of the works.
<i>Reversibility</i>	Plantation is man-made habitat. The habitat loss could be recreated but required certain period of time to let the habitat to be mature.	Village-orchard is man-made habitat. The habitat loss could be recreated easily.
<i>Magnitude</i>	The scale of the habitat loss is small in the context of the surrounding similar habitats.	The scale of the habitat loss is small in the context of the surrounding similar habitats.
Overall Impact Conclusion	Low	Low

Table 7.8 Overall Impact Evaluation for Intertidal Habitat (Artificial Disturbed Seashore) and Urbanized/Disturbed Area

Evaluation Criteria	Intertidal Habitat (Artificial Disturbed Seashore)	Urbanised/ Disturbed Areas
<i>Habitat quality</i>	Low.	Low.
<i>Species</i>	The potential exists for direct or indirect impacts to the wildlife inhabiting the areas. However, neither rare nor protected species will be affected.	The potential exists for direct or indirect impacts to the wildlife inhabiting the areas. Common Rat Snake recorded in the urbanised/disturbed areas close to the Intake I-2 is potentially be affected.
<i>Size/Abundance</i>	Approximately 55 m (0.15 ha) of the artificial/ disturbed seashore will be lost. Approximately 65 m (0.02 ha) of the artificial/ disturbed seashore will be temporarily affected	Area loss are small in size: approximately 0.14 ha loss and 0.33 ha temporarily affected.
<i>Duration</i>	The impact will persist during the construction and operational phases. But the temporary affected areas will be reinstated after the completion of the works.	The impact will persist during the construction and operational phases. But the temporary affected areas will be reinstated after the completion of the works.
<i>Reversibility</i>	The habitat loss could be recreated but required certain period of time to let the habitat to be mature.	Urbanised/ disturbed areas is man-made habitat. The habitat loss could be recreated easily.
<i>Magnitude</i>	The scale of the habitat loss is small in the context of the surrounding similar habitats.	The scale of the habitat loss is small in the context of the surrounding similar habitats.
Overall Impact Conclusion	Low	Low

In conclusion, with the exception of low to moderate impact to the middle course of Sam Dip Tam Stream (location of Intake I-2) and Tso Kung Tam Stream (location of Intake I-3), the direct ecological impact due to the construction and operation of the drainage channel is expected to be low, and will not contribute to any potential cumulative impact.

The most sensitive potential impacts will be the loss of stream sections of natural bottom and bank due to the land take for the Project. Since the affected sections of Sam Dip Tam Stream and Tso Kung Tam Stream (location of Intakes I-2 and I-3) are partially disturbed (with relative less aquatic faunal diversity) due to the residential sewage, relatively low

diversity of aquatic fauna was recorded in the affected sections, and small in size (the affected length are 60m (0.06 ha and additional 0.03 ha will be temporarily affected) and 75m (0.02 ha and additional 0.11 ha will be temporarily affected) respectively). The impacts due to the land take for the surface structures, as well as the secondary impacts to the associated aquatic fauna, are therefore considered acceptable.

Habitat loss (permanent or temporary) due to the Project during construction or operation will reduce the areas of foraging and feeding grounds of the wildlife (particularly the species of conservation interest recorded close to the Project areas, including Common Rat Snake, Striated Heron and Plumbeous Redstart). The impacts are expected to be low owing to the extensive habitats, including plantation and stream/channel, available in the proximity, as well as the temporary nature and small scale of the construction works, and given that regular checks on good construction practice and appropriate works programme will be conducted.

The habitats within the proposed Ecological Park to be affected included stream/channel (approximately 75m (0.07 ha), but 0.05 ha of the stream habitat will be reinstated), plantation (approximately 0.51 ha) and village-orchard (approximately 0.1 ha), the direct ecological impact (habitat loss) due to the construction and operation of the drainage channel is expected to be low to moderate due to the smaller size of the affected areas and the extensive similar habitats in the vicinity. The impacts on Striated Heron and Plumbeous Redstart (species of conservation interest) and the associated wildlife, including herpetofauna, butterfly, dragonfly, aquatic fauna and bird, recorded within the Study Area of Intake I-3 (refer to **Appendix F**) are expected to be low owing to the large extent of similar habitats in the vicinity that will remain unaffected by the drainage improvement works, as well as the transient nature and small scale of the construction works, and given that regular checks on good construction practice and appropriate works programme will be conducted. The associated wildlife and aquatic fauna inhabited in the vicinity of Intake I-3 and the proposed Ecological Park is not expected to be affected. With the minimisation of the scale of the Project (see *Section 7.7.2*) and provision of natural stream bottom as detailed in *Section 7.7.3* and compensatory planting, which will aim at regenerating attraction and habitats to wildlife and aquatic fauna to recolonise, no unacceptable impacts are expected.

Other Associated Impacts

Habitat Fragmentation and Isolation - In general, the surface structures will be located in, or very close to, man-made habitats (ie plantation and village-orchard) and disturbed areas (stream sections under stress of pollution). The scale of the habitat loss is small in the context of the surrounding similar habitats. Consequently, the impact of habitat fragmentation and isolation are not considered unacceptable.

Water Quality – The construction works of intake structures can only be conducted during dry season when the streams/channel of low water flow. Increases in SS levels downstream are expected to be low and temporary, and within environmentally acceptable limits (as defined by the WQOs and tolerance criteria) (details refer to *Section 5 Water Quality Impact Assessment*). No serious construction runoff affecting the downstream habitats and associated aquatic fauna will be anticipated given that regular checks on good construction practice will be conducted. There will be no drawdown effect on the water table, and a programme of monitoring is included to demonstrate this.

Hydrological Disruption – Under the normal circumstances, the water flow and level of the lower course of Sam Dip Tam Stream and Tso Kung Tam Stream (downstream of intake structures) would not be affected during the operation of the drainage tunnel. No significant operational impacts will be expected. The excessive stormwater, when rainfall is greater than 30mm/hr, will be intercepted by a side weir of the intake structures, with a crest height of 1.5 m (Intake I-2, make use of the existing concrete slab underneath the bridge crossing) or 0.6 m (Intake I-3), to prevent flooding of lowland areas which may hazard or disturb the downstream structures and facilities as well as the lower course of the streams and aquatic faunal communities. Additionally, the possibility of flushing aquatic fauna downstream due to the excessive stormwater (flooding) will now be reduced. Consequently, significant disruption of the hydrology of the lower course of the streams as well as consequent impacts on the aquatic fauna would not be anticipated.

Flushing effects and Reduction of Seawater Salinity during Operation – The impacts on the intertidal organisms, reduction of seawater salinity and flushing effect, due to the excessive stormwater (only when rainfall is greater than 30mm/hr) are temporary. Almost all of the coastlines within the Study Area have been modified to artificial seawalls, including boulder and vertical seawalls, or severely disturbed by recently deployed rocks due to other projects, and only a limited number of species and individuals of intertidal faunal recorded within the areas. The impacts on the intertidal faunal communities due to the occasional and temporal change of seawater salinity and flushing effect near the Outfall O-1 are expected to be of low severity.

Other Impacts – Increased human activities and disturbance due to the Project during construction may affect the surrounding natural habitats and the associated wildlife (particularly the species of conservation interest recorded close to the Project areas, including Common Rat Snake, Striated Heron and Plumbeous Redstart). The blasting works (for shafts, deaeration chamber and audit tunnel construction) will be restricted inside the tunnel (with the provision of enclosure at the opening) and the works will be specially planned and designed to avoid the impacts to the surrounding environment. Impacts to the wildlife due to the blasting works are therefore expected to be low. The overall impacts are expected to be low owing to the temporary nature and small scale of the construction works, and given that regular checks on good construction practice will be conducted.

7.7 Mitigation Measures

Annex 16 of the *EIAO TM* states that the general policy for mitigation of significant ecological impacts, in order of priority, is:

Avoidance: Potential impacts should be avoided to the maximum extent practicable by adopting suitable alternatives;

Minimisation: Unavoidable impacts should be minimised by taking appropriate and practicable measures such as constraints on intensity of works operations or timing of works operations; and

Compensation: The loss of important species and habitats may be provided for elsewhere as compensation. Enhancement and other conservation measures should always be considered whenever possible.

At each stage, residual impacts are to be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures have been developed in accordance with this approach to mitigate the impacts.

7.7.1 Avoidance

The mechanism of the intake structure is to divert a portion of stream flow into the tunnel under high flow condition while the stream flow will be maintained under normal condition to nourish the riparian habitats downstream. An engineered hydraulic structure is therefore required to be located on the existing stream/channel to intercept the desired proportion of the stream flow under different conditions. This interception arrangement must be an 'on-line' arrangement so as to have the direct interaction with the stream flow.

Following the option selection as discussed in *Section 2*, the surface structures are chosen to locate mainly on existing disturbed areas and have generally avoided the upstream natural and undisturbed stream habitats of higher species diversity and abundance of aquatic organisms:

Intake I-1: Intake I-1 is located at low quality, man-made and highly disturbed habitats including man-made channel with smooth concrete bottom, plantation and urbanised/disturbed habitat.

Intake I-2: Intake I-2 is located mainly at the stream section of partial modification (with concrete lining underneath bridge crossing) and disturbance (pollution due to residential sewage discharge). The major construction activities at the stream (Phases 1, 3 and 4), including shaft construction, modification of existing channel and construction of guide wall and approach channel, are scheduled to avoid wet season (only to be undertaken during dry season (from October to March)) of high water flow which may adversely affect the downstream natural habitats due to the construction runoff. Although the construction of the shaft and adit tunnel (Phase 2) will be extended into wet season, the majority of the construction site runoff will be confined inside the shaft and adit tunnel. The chance of the construction runoff over spilling into the existing stream would be minimal. The runoff will be properly discharged off-site through pumping under close supervision.

Intake I-3: Intake I-3 is located mainly at the stream section of partial disturbance (pollution due to residential sewage discharge) and located along the stream bank in order to avoid nearly half of the natural stream section. The major construction activities at the stream (Phases 2 and 3) are scheduled to avoid wet season (only to be undertaken during dry season (from November to March)) of high water flow which may adversely affect the downstream natural habitats due to the construction runoff.

Outfall O-1: Outfall O-1 is located at low quality, man-made and highly disturbed habitats including artificial/ disturbed intertidal habitat, plantation and urbanised/disturbed habitat.

7.7.2 Minimisation

In order to minimize the extent of works as well as the associated ecological impacts, the final layout plan has been revised (deviated from the PPFS arrangement) through the replacement of the twin vortex dropshafts by a single dropshaft. Further to such amendment, the habitat loss (permanent and temporary) due to the Project are greatly reduced, in particular the natural stream habitats at Sam Dip Tam Stream (location of Intake I-2,

temporary loss reduced to zero) and Tso Kung Tam Stream (location of Intake I-3, both permanent and temporary loss reduced by 0.18 ha and 0.17 ha respectively). The permanent loss of the stream habitats for the revised option was totally reduced 0.17 ha compare to the original option. The comparison of the original and revised options is presented in **Table 7.9**.

Table 7.9 Overall Habitat Loss due to the Drainage Improvement Works

Proposed Surface Structures	Impacted Habitats	Original option ⁽¹⁾		Revised option ⁽¹⁾	
		Permanent loss	Temporary Loss ⁽²⁾	Permanent loss	Temporary Loss ⁽²⁾
Intake I-1	Stream/Channel	15m (<0.01 ha)	140m (0.15 ha)	15m (<0.01 ha)	140m (0.15 ha)
	Plantation	0.13 ha	0.22 ha	0.13 ha	0.22 ha
	Urbanized/ Disturbed Area	Nil	0.12 ha	Nil	0.12 ha
Intake I-2	Stream/Channel	140m (0.07ha)	110m (0.07ha)	60 m (0.06ha)	Additional 0.03 ha at the same stream section
	Village-Orchard	0.03 ha	0.08 ha	0.05 ha	Nil
	Urbanized/ Disturbed Area	0.01 ha	0.11 ha	0.03 ha	Nil
Intake I-3	Stream/Channel	180m (0.25ha)	200m (0.23ha)	75 m (0.02ha)	Additional 0.11 ha at the same stream section
	Plantation	0.47 ha	0.04 ha	0.51 ha	0.04 ha
	Village-Orchard	0.09 ha	0.33 ha	0.10 ha	Nil
Outfall O-1	Intertidal Habitat	55 m (0.15 ha)	65 m (0.02 ha)	55 m (0.15 ha)	65 m (0.02 ha)
	Plantation	0.48 ha	1.16 ha	0.48 ha	1.16 ha
	Urbanized/ Disturbed Area	0.11 ha	0.21 ha	0.11 ha	0.21 ha

Note: (1) The design of Intake I-1 and Outfall O-1 has no changes.

(2) Areas excluded the permanent resumed land for the Project.

The previous discussion in *Section 7.6.4* has indicated that the impacts on ecological resources due to the construction and operation of the proposed Project are generally expected not to be high. The following mitigation measures to further minimise impacts and disturbance to the surrounding habitats, are recommended.

Measures for Construction Runoff

- Install sheet piles or placing mass concrete beam/ block and sealing the gap with cement (where applicable for the temporary stream diversion) along the boundary of the works area within the stream habitats, in particular Sam Dip Tam Stream and Tso Kung Tam Stream, before the commencement of works to prevent construction runoff during construction. Provision of adequate designed sand/ silt removal facilities such as sand traps, silt traps and sediment basin in the areas which could potentially be affected may be required.

- Construction impacts to the water quality have largely been avoided during construction through constraints on the works. Full details of these constraints are presented in *Section 5 - Water Quality Impact Assessment*. The constraints were recommended in *Section 5.7* to control water quality impacts to within acceptable levels, are also expected to control impacts to ecology.

Good Construction Practice

- Erect fences along the boundary of the works area before the commencement of works to prevent tipping, vehicle movements, and encroachment of personnel onto adjacent areas, particularly the stream habitats.
- Avoid any damage and disturbance, particularly those caused by filling and illegal dumping, to the remaining and surrounding natural stream habitats.
- Regularly check the work site boundaries to ensure that they are not breached and that no damage occurs to surrounding areas.
- Prohibit and prevent open fires within the site boundary during construction and provide temporary fire fighting equipment in the work areas.
- Treat any damage that may have occurred to individual major trees in the adjacent area with surgery.
- Reinstatement of temporary work sites/disturbed areas, particularly stream of natural bottom and bank, plantation, intertidal habitat, and the areas located within the proposed Ecological Park, immediately after completion of the construction works, ie through on-site tree/shrub planting and re-provision of natural or semi-natural bottom (also refer to *Section 7.7.3*), in order to facilitate the recolonisation of the wildlife recorded during the baseline surveys. Tree/shrub species used should make reference from those in the surrounding area.

7.7.3 Compensation

- Provide natural stream bed (approximately 0.03 ha) for the new Dry Weather Flow Channel (created from village-orchard) by laying natural stones at Intake I-2 (**Figure 7.7**). The reinstated stream bed shall mimic the existing natural conditions with certain portion of big boulders creating the lentic and lotic zones for the aquatic fauna, and while it will be developed during detailed design may draw on concepts shown in **Figure 2.18**.
- Provide natural stream bed (approximately 0.05 ha,) for the Approach Channel and Dry Weather Flow Channel by laying natural stones at Intake I-3 (**Figure 7.8**). The reinstated stream bed shall mimic the existing natural conditions (rocky bottom with very limited aquatic plants) with certain portion of big boulders creating the lentic and lotic zones for the aquatic fauna, and while it will be developed during detailed design may draw on concepts shown in **Figure 2.18**.
- Provide natural bottom (ie retain the existing stream bed or reinstate the stream bed by providing boulders/ rocks, riprap or gabion) for the temporarily affected stream sections (**Figure 7.8**) wherever possible, in order to allow natural colonisation of aquatic fauna.

- Provide at least 2.2 ha of compensatory planting on the permanent and temporary affected plantation areas, particularly the slopes along access road and adjacent to Intake I-3 and cascade at Outfall O-1, after construction to stabilise the slope to prevent soil erosion and consequent stream sedimentation. Among the 2.2 ha compensatory planting, at least 0.5 ha of compensatory tree planting on the new formed slope along the access road of the Intake I-3 and 0.5 ha of compensatory tree planting over the cascade (by constructing intermediate platform) at Outfall O-1 will be provided (location refer to **Figures 7.4 – 7.6**). Species used for planting should take reference from the species identified in **Appendix F** and be native to Hong Kong or South China region.
 - To compensate for the lost of felled trees at Intake I-1, compensation trees are proposed along the toe of new form slope and building structure for instant greenery effect and tree seeding planting to restore the existing greenery within the works area (**Figure 7.10**). Trees to be compensated will be in 1:1.6 ratios with approximate planting area of 575 m². Tree species proposed for the compensation are mainly tree species found in this location with this arrangement, all the compensatory trees will blend nicely with the existing vegetation;
 - To compensate for the lost of felled trees at Intake I-2, compensation trees are proposed along the toe of new form slope and building structure for instant greenery effect and to restore the existing greenery within the works area (**Figure 7.11**). Trees to be compensated will be in 1:5 ratios with approximate planting area of 98 m². Tree species proposed for the compensation are mainly tree species found in this location with this arrangement, all the compensatory trees will blend nicely with the existing vegetation;
 - To compensate for the lost of felled trees at Intake I-3, compensation trees are proposed along the toe of new form slope and building structure for instant greenery effect and tree seeding planting to restore the existing greenery within the works area (**Figure 7.12**). Trees to be compensated will be in 1:3.2 ratios with approximate planting area of 3,056 m². Tree species proposed for the compensation are mainly tree species found in this location with this arrangement, all the compensatory trees will blend nicely with the existing vegetation; and
 - To compensate for the lost of felled trees at Outfall O-1, compensation trees are proposed along the toe of new form slope and building structure for instant greenery effect and to restore the existing greenery within the works area (**Figure 7.13**). Trees to be compensated will be in 1:2.6 ratios with approximate planting area of 1,148 m². Tree species proposed for the compensation are mainly tree species found in this location with this arrangement, all the compensatory trees will blend nicely with the existing vegetation.
- Based on the preliminary design to date, the estimated number of trees to be felled is 86, 16, 274 and 246 (including 89 trees in tree group) at Intakes I-1, I-2, I-3 and Outfall O-1 respectively. No trees in the Register of Old and Valuable Trees will be affected. Depending on the space allowed, one to three trees will be planted to compensate for one felled tree. The proposed planting will be mainly native species such as *Celtis sinensis*, *Cinnamomum camphora*, *Ficus microcarpa*, *Schima superba* etc. but will also include a small number of non-native fast growing species such as *Acacia confusa* and *Acacia*

mangium to act as a nurse species (as per CEDD (previously known as TDD) recommendations for best practice in establishment of native woodlands).

- Provide armour rocks for the affected intertidal habitat in order to allow natural colonisation of intertidal organisms.

7.8 Residual Impacts

There will be the loss of approximately 150m (0.08 ha) of stream/channel, 1.12 ha of plantation, 0.15 ha of village-orchard, 55 m (0.15 ha) of intertidal habitat (artificial/disturbed seashore) and 0.14 ha of disturbed/urbanized areas. No adverse residual impact due to the construction and operation of the channels is expected after the implementation of the proposed mitigation measures including provision of 2.2 ha of compensatory planting (including 1 ha of tree planting), approximately 0.08 ha of natural stream bottom (0.03 ha at Intake I-2 and 0.05 ha at Intake I-3) and reinstatement of the intertidal habitat.

7.9 Environmental Monitoring and Audit

The implementation of the ecological mitigation measures stated in *Section 7.7* should be checked as part of the environmental monitoring and audit procedures during the construction period as presented in the separate *Environmental Monitoring and Audit Manual*. No other ecology-specific measures are considered necessary.

In order to ensure the groundwater levels in the stream courses and thus on the surrounding habitats will not be affected, the groundwater levels along the tunnel will be measured throughout the construction and maintenance period.

7.10 Conclusion

The ecological resources recorded within the Study Area included woodland, plantation, grassland, village-orchard, stream channel, intertidal habitat (artificial/disturbed seashore) and disturbed/urbanized, as well as the associated wildlife. Of these habitats, woodland and stream habitat (Sam Dip Tam Stream and Tso Kung Tam Stream) have moderate ecological value. The remaining habitats are of low to moderate ecological value. With the exception of low to moderate impact to the middle course of Sam Dip Tam Stream (location of Intake I-2) and Tso Kung Tam Stream (location of Intake I-3), the direct ecological impact due to the construction and operation of the drainage channel is expected to be low. No rare or protected species near the works areas are affected by the proposed works. The loss of stream sections of natural bottom and bank and hydrological disruption to the natural stream habitats downstream to the intake structures, particularly Intakes I-2 and I-3, have been minimised and properly mitigated. No adverse residual impact is expected after the implementation of the recommended mitigation measures. Since the affected sections of Sam Dip Tam Stream and Tso Kung Tam Stream (location of Intakes I-2 and I-3) are partially disturbed (with relatively less aquatic faunal diversity) due to the residential sewage and the intake structures have been appropriately designed to minimise habitat loss, the impacts due to the land take for the surface structures and hydrological disruption are considered acceptable. Adverse ecological impacts on the proposed Ecological Park are also unlikely.