

13 ECOLOGICAL IMPACT ASSESSMENT

13.1 Introduction

13.1.1 Background

This chapter evaluates the ecological conditions present within the assessment area. This assessment is based upon a review of available literature and on surveys conducted in the area to fill information gaps. From this evaluation of ecological conditions, potential ecological impacts arising from the development of the NENT NDAs are identified, the significance of these impacts is assessed and mitigation measures are proposed, where appropriate, to avoid, minimise and/or compensate for the significant ecological impacts identified.

The ecological assessment has been conducted in accordance with the requirements of Annexes 8 and 16 of the TM-EIAO as well as the requirements set out in Section 3.1.14 of the EIA Study Brief (SB).

13.1.2 Local Legislation, Standards and Guidelines

The relevant legislation and associated guidelines applicable to the present study for the assessment of ecological impact include:

Forests and Countryside Ordinance (Cap. 96) and its subsidiary legislation, the Forestry Regulations;

Wild Animals Protection Ordinance (Cap. 170);

Environmental Impact Assessment Ordinance (Cap. 499) and relevant annexes 8, 11, 16, 20 and 21 of the associated Technical Memorandum;

EIA Study Brief No. ESB-176/2008;

Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and its subsidiary legislation; Hong Kong Planning Standards and Guidelines (HKPSG) Chapter 10, "Conservation";

Planning, Environment and Lands Bureau Technical Circular 1/97 / Works Branch Technical Circular 4/97, "Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures";

EIAO Guidance Note No. 6/2002 - Some Observations on Ecological Assessment from the Environmental Impact Assessment Ordinance Perspective;

EIAO Guidance Note No. 7/2002 – Ecological Baseline Survey for Ecological Assessment;

EIAO Guidance Note No. 10/2004 – Methodologies for Terrestrial and Freshwater Ecological Baseline Survey

Revised versions of EIAO Guidance Notes 6/2010, 7/2010 and 10/2010
(issued December 2010)

13.1.3 Study Area and Assessment Area

Two NDAs have been identified: at Kwu Tung North (KTN NDA) and Fanling North (FLN NDA) (see **Figure 1.1**). These NDAs will proceed concurrently as one integrated project; accordingly they have been considered together for the purposes of this assessment. For consistency, where geographical location is of relevance, findings from KTN have been presented first. The ‘Study Area’ for this Ecological Impact Assessment (EcolIA) covers the two NDAs together with all areas within 500m of the boundaries of the NDAs, and all areas within 500m of infrastructure projects (connecting roads and other services) to be implemented as part of development (**Figure 13.1**). The ‘Assessment Area’ comprises the Study Area and any areas beyond which may be impacted by the project in accordance with Section 3.4.14.2 of the Study Brief.

13.1.4 Previous Stages of the EIA Process

Potential ecological impacts of the project have previously been assessed in the Stage 1 and Stage 2 Ecological Impact Assessments, prepared during 2009 and 2010, the Stage 3 Ecological Impact Assessment prepared during 2012 (see **Section 1.1**). The preparation of and findings from these assessments and feedback from public engagement (see **Section 2.3.2**) have been used to identify and refine potential ecological impacts and mitigation requirements. In particular, during the land use planning and design process assessed in these previous stages of the study alternatives were considered to address potential significant ecological impacts. These included the following:

13.1.4.1 Alternatives to safeguard the conservation value of Long Valley and river channels including Sheung Yue River and tidal section of Ng Tung River

The recognised site of conservation importance at Long Valley (part of the Long Valley and Ho Sheung Heung Priority Site for Enhanced Conservation) is within KTN. Alternatives that would ensure that the ecological value of this site would not be adversely impacted by the NDA project and would be safeguarded in the long term were considered. Alternatives included retaining the existing zoning as Agriculture, rezoning as Conservation Area, rezoning as Other Uses (Nature Park) and excluding some or all of the area from the NDAs. The selected alternative, rezoning the part of Long Valley to the east of the Sheung Yue River as Other Uses (Nature Park) and retaining the agricultural zoning of the section to the west was selected as this would (with further *in situ* mitigation measures) reduce potential ecological impacts to Long

Valley from the Project to an acceptable level and secure the long term conservation value of the area whilst taking into account the interests of stakeholders of land in the surrounding area.

Only low-density and low-rise developments are proposed to avoid direct encroachment upon the flight-line between Ho Sheung Heung Egretty and Sheung Yue River. Further, different height bands are designated within the “OU(C,R&D)” zone along Sheung Yue River to establish a stepped building height profile increasing from the riverside of Sheung Yue River towards Fanling Highway and the NDA Town Centre. In particular, developments fronting the riverside are subject to a maximum building height of 7 storeys while those at the rear are subject to a maximum building height of 10 storeys.

A footbridge crossing the Sheung Yue River is proposed in order to connect the railway station and the existing resident near Yin Kong Village via the open space network in KTN. The location is governed by a number of factors (e.g. the open space arrangement, the existing access ramp to the river, most direct route), including reducing disturbance and fragmentation impacts on waterbirds foraging in the Sheung Yue River.

A second footbridge crossing the Sheung Yue River adjacent to the tidal section of the Ng Tung River is proposed to connect the footpath, cycle track and utilities network between KTN and FLN. The location has been selected based on the location of the existing Sheung Shui Slaughter House and the need to reduce disturbance and fragmentation impacts on fauna in Long Valley and waterbirds foraging in the Sheung Yue River.

See **Section 2.3.2, Section 2.3.6.2, Section 2.3.6.3, Section 2.4.1.9 and Section 2.4.1.10).**

13.1.4.2 Proposed Kwu Tung Interchange

A new grade-separated interchange, the Kwu Tung Interchange, is proposed as the major access from Fanling Highway to the KTN NDA. Along the Fanling Highway section to the south of the NDA there are many constraints to a new interchange or highway improvement works; both from existing residential buildings at Europa Garden and the need for the new interchange to be located at a minimum distance of 1km from other major interchanges at Pak Shek Au and San in the west. However, placing the interchange to the east of the Sheung Yue River, would have significant ecological impacts on Long Valley.

Having considered the constraints, it is proposed to locate the major interchange at about 400m east of the Sheung Yue River, thus avoiding Long Valley (see **Section 2.4.1.2).**

13.1.4.3 Alternatives to avoid potential impacts of the Fanling Bypass on sites of ecological significance

It was originally proposed that the Fanling Bypass would be an aboveground link commencing in the west of KTN NDA, running parallel to the west side of the Sheung Yue River, crossing the Ng Tung River then continuing through the north of FLN NDA, connecting in an interchange with Sha Tau Kok Road and joining the Fanling Highway near Wo Hop Shek. Potential significant ecological impacts from this alignment to habitats and species of conservation significance in Long Valley were identified; in particular to wetland habitats of conservation value, waterbirds, flight-lines between Ho Sheung Heung Egretty and foraging areas in Long Valley, and linkages for waterbirds to the Deep Bay area. Potential significant ecological impacts from the bypass being constructed at grade were identified throughout its length.

The alignment route was highly constrained by topography, river channels, existing urban development and infrastructure. Options for placing the bypass on viaduct and constructing submerged or tunnelled sections (the latter by using either, cut and cover, or bored methods) were considered. For the section of the bypass to the west of Man Kam To Road, none of these options was both technically feasible and able to reduce predicted ecological impacts to an acceptable level, so the alternative of adopting an alternative road network for KTN and FLN such that the section of the bypass to the west of Man Kam To Road was no longer required was chosen. Meanwhile, the alternative of placing the eastern section of the bypass on viaduct was adopted as this is predicted to reduce (along with additional *in situ* mitigation measures in certain locations) the potential ecological impacts along this section to an acceptable level (see **Section 2.4.1.4** and **Section 2.4.1.5**).

13.1.4.4 Alternatives to avoid, minimise or compensate for potential impacts to Man Kam To Egretty

During the course of ecological surveys conducted under this study a previously unknown egretty was discovered close to the Man Kam To Road and within the footprint of the roundabout interchange proposed to form the western terminus of the Fanling Bypass (as described above); **Figure 13.1** illustrates the location of the egretty. Alternatives to avoid or minimise impacts to the egretty by adjusting the location of the roundabout were considered but all these were constrained by existing infrastructure and the Ng Tung River to the south (**Section 2.4.1.4**). Accordingly compensation by provision of an alternative egretty location was adopted as the only feasible mitigation measure. Alternatives for the alternative location were considered, and a suitable site was identified to the west of the existing egretty, with a similar location close to the Ng Tung River and closer to major egret foraging areas in Long Valley than the existing egretty site (see **Section 13.8.2.7**).

13.1.4.5 Alternatives to avoid and minimise impacts to stream and marsh habitats at Ma Tso Lung

The Ma Tso Lung Stream and its riparian habitats were identified as being an ecologically significant area during the course of this and the Lok Ma Chau Loop studies. An essential road link from KTN to the Loop is proposed under both studies and planning and land use constraints limit alignment options for this road (**Section 2.4.1.8**). Alternatives to avoid all significant impacts to ecologically significant stream and its riparian habitats were considered and evaluated.

The option of constructing the LMC Loop Eastern Connection Road on viaduct for a length of 130m where the alignment would be within 30m of Ma Tso Lung Stream was considered from an ecological perspective. This option has the benefit that direct impacts on the stream would be avoided. However, engineering constraints would require the height of the viaduct to be less than 2m above ground for the section within 30m of the stream. The shading effect of the viaduct, only 2m above the ground, would have the consequence that it would be impossible for vegetation to grow for much of the width of the viaduct. This would result in direct loss of the existing riparian habitat. Whilst this direct habitat loss could be mitigated, the indirect ecological impacts would have to be considered, as the unvegetated area of such a length would form a significant barrier for fauna using the riparian corridor along the banks of the river. In addition, the unvegetated area would be liable to surface run-off and sediment would be washed into the stream causing adverse impacts to stream fauna. Surface run-off could be avoided by surfacing the area but this would increase the barrier effect of the unvegetated area.

Accordingly, options for diverting the stream were considered and it was resolved to divert the stream for 130m, which would allow for a minimum 15m buffer area to the west of the stream and a 15m to 30m buffer to the east of the stream following diversion. The diverted stream will be restored with natural bed, the riparian corridor will be restored with floodplain flora and riparian tree and shrub species and a permanent barrier will be installed on the east side of the road to prevent terrestrial fauna from straying onto the road and being killed. It is considered that this option will have lower ecological impacts than a narrower buffer and a shorter diverted section, or a wider buffer and a longer diverted section. **Figure 13.6b** illustrates the alignment chosen.

All feasible alignment options for the road require that it cross the stream at some point; in order to minimise impacts on the stream at the crossing point, a location was chosen where the road will be perpendicular to the watercourse. In addition, the design option as using a viaduct to cross the stream was adopted as this will avoid impacts on the stream and minimise impacts on the corridor (**Figure 13.6b**).

The location of a new sewage pumping station (a DP-2 project) was changed from the east to the west side of the LMC Loop Eastern

Connection Road; thus avoiding direct and indirect impacts on the stream.

13.1.4.6 Alternatives to avoid and minimise loss of, or disturbance to, ecologically significant habitats and species through successive RODP drafts

Throughout the NDAs Study process, and in particular during the course of successive RODP drafts, alternatives to avoid and minimise potential ecological impacts were considered. At an early stage in the process, 'no-go' areas for development which might result in significant adverse ecological impacts were identified including, in addition to previously recognised sites of ecological importance which were confirmed as such in this study (notably Long Valley and the Ho Sheung Heung *fung shui* wood), the Ng Tung River corridor north of the confluence with the Sheung Yue River and most hill areas). Alternatives were then considered, wherever feasible, during the RODP refinement process that would avoid or minimise any other habitats of ecological significance or sites used by species of ecological significance where feasible to the maximum practicable extent. Habitats where alternatives to avoid and/or minimise significant habitat loss were considered and adopted where feasible included most secondary woodland, most plantation of higher ecological value, especially larger blocks, and all wetland habitats except small, previously channelised streams in urban areas.

13.1.4.7 Alternatives for compensatory habitat provision

Despite making efforts to avoid or minimise predicted impacts to habitats of conservation significance, loss of some such habitats (wetland and woodland) proved unavoidable, either as a consequence of direct habitat loss, increased predicted disturbance impacts or habitat fragmentation. Alternatives for compensating for such unavoidable loss that were considered included compensation as close to the original site as was feasible, compensation elsewhere in the NDAs and compensation outside the NDAs, both in and beyond the NDA Study Area. For all but the first of these alternatives, consideration was also given as to whether areas chosen for compensation should be aggregated or constructed and maintained as separate areas. It was decided that in-situ compensation was appropriate and feasible. Consolidating compensation areas at a location elsewhere in the NDAs was chosen as the most practical alternative for implementation and the alternative most likely to meet the mitigation requirements. A wetland compensation area was identified in Long Valley and sites for woodland compensation were identified in grassland habitat of low ecological value in KTN.

Under the EIAO, it is recommended that mitigation measures should seek to avoid, minimise and compensate impacts (in that order of preference). Based on the findings of the draft ecological impact assessments, therefore, the RODP for the NDAs has been revised in

order to avoid or minimise identified impacts. The environmental acceptability of the proposed NDA development would, therefore, be assessed under the subject submission based on the latest RODP.

13.2 Ecological Resources and Development Context of the NDAs and Surrounding Areas

This section provides an overview of the ecological resources in the Study and Assessment Areas in accordance with the requirements of Sections 3.4.14.2 and 3.4.14.3 of the Study Brief. It also details the recognised sites of conservation importance in the Project Area and its vicinity in accordance with Section 13.4.4(vi) of the Study Brief and identifies concurrent and approved projects under consideration that may be of relevance to the assessment process for the current Project.

13.2.1 Location of the NDAs

The NDAs are located in the northern New Territories and are situated to the west (KTN) and the north (FLN) of the existing towns of Sheung Shui and Fanling. The southern boundary of KTN is defined by the Fanling Highway while the northern and western boundary of KTN and the northern boundary of FLN are delineated by hills. These hills separate the NDAs from the lowlands on the south side of Inner Deep Bay and the Shenzhen River catchment. The hills to the north of the NDAs are bisected by the Ng Tung River, which connects the NDAs hydrologically to the Shenzhen River catchment and also provides a corridor linking the NDAs ecologically with Inner Deep Bay, this linkage being most significant for more vagile fauna, especially waterbirds.

13.2.2 Recognised Sites of Conservation Importance in the NDAs and in their vicinity

Recognised sites of conservation importance in Long Valley and in its vicinity are described below and are shown in **Figure 13.1**.

13.2.2.1 Long Valley and Ho Sheung Heung Priority Site

An area at Long Valley and Ho Sheung Heung was identified by the Environment, Transport and Works Bureau (ETWB) and AFCD as one of the twelve Priority Sites for enhanced conservation under the New Nature Conservation Policy (NNCP). The principal intention of the Priority Sites is to enhance the ecological value of land under private ownership. Measures are proposed in the NNCP to encourage this, including Management Agreements (MAs) and Private-Public Partnership. In the Long Valley and Ho Sheung Heung Priority Site, the Hong Kong Bird Watching Society (HKBWS) and Conservancy Association (CA) in association with local farmers and landowners, are currently involved in a

joint MA to manage parts of Long Valley using agricultural practices which enhance the habitat value for wildlife, in particular wetland birds. The application for the 4th phase of the MA at Long Valley was endorsed by the Environment & Conservation Fund Committee (ECFC) on 19th January 2012 and commenced in March 2012 and will be completed in February 2015. Similar MA schemes were completed in 2007, 2010 and 2012. Findings of these studies are referred to in this Report where appropriate.

All of the Priority Site is within the KTN NDA, and hence potentially affected by the Project, either directly or indirectly. As the Priority Site includes both areas of high ecological value and developed areas of much lower ecological value, it is not considered appropriate to treat the Priority Site as a whole as a sensitive receiver in the evaluation of ecological impacts. Accordingly, impacts on areas within the Priority Site, in particular Long Valley, Ho Sheung Heung *fung shui* and secondary woodland, and the main river channels, are addressed separately in this report.

13.2.2.2 Inner Deep Bay and Shenzhen River Catchment Important Bird Area (including Deep Bay Wetland outside Ramsar Site Priority Site)

Long Valley is contained within the Inner Deep Bay and Shenzhen River Catchment Important Bird Area (IBA), recognised by BirdLife International. The IBA listing is based largely on the international importance of Deep Bay for birds, including globally threatened species, but Long Valley is included as part of the Shenzhen River catchment on the basis of the large diversity of birds present, including globally threatened species (BirdLife International 2013). This designation of the area as an IBA does not confer legal protection on Long Valley.

The part of the IBA within KTN NDA will potentially be affected by the Project, either directly or indirectly; the remainder of the IBA and the Deep Bay Wetland outside Ramsar Site Priority Site may be indirectly affected as a consequence of its ecological and hydrological linkages with the Project Area. Effects are, however, likely to be small or negligible on much of the IBA due to its remoteness from the Project Area.

13.2.2.3 Deep Bay Wetland Area (including Mai Po Nature Reserve, Mai Po Inner Deep Bay Ramsar Site, Mai Po Marshes SSSI and Inner Deep Bay SSSI)

Although Deep Bay itself is located outside the boundary of the NDA Study Area, rivers passing through the NDAs drain into the Shenzhen River, which feeds into Deep Bay. Deep Bay is recognised as an internationally important wetland area, supporting a large abundance and diversity of wetland species including a number of threatened species. The core part of the Deep Bay wetland ecosystem is recognised

internationally under the Ramsar Convention as the Mai Po Inner Deep Bay Ramsar Site. Mai Po Nature Reserve is located within the Deep Bay system, alongside Shenzhen River.

The Deep Bay Wetland Area may be indirectly affected as a consequence of its ecological and hydrological linkages with the Project Area. Effects are, however, likely to be small or negligible on much of the area due to its remoteness from the Project Area.

13.2.2.4 Wetland Conservation and Wetland Buffer Areas

The high ecological value of fish ponds in the Deep Bay area was highlighted in the Study on the Ecological Value of Fish Ponds in the Deep Bay area (Aspinwall 1997), one of the recommendations of which was that an area of fishponds and other wetlands in the northwest New Territories be designated as a buffer area. As a consequence, the Wetland Conservation Area (WCA) and a Wetland Buffer Area (WBA) of approximately 500m width were established around the areas described in **Section 13.2.2.3** above. These recommendations were incorporated into Town Planning Board Guidelines (TPB PG-No. 12B). The purposes of these two zones are summarised as follows:

Wetland Conservation Area: Aside from the permitted essential infrastructure works or development required to support the conservation of ecological value of the area, no development detrimental to wetland habitats should be permitted within the WCA. Any essential works carried out in the WCA must comply with the 'no net loss of wetland' policy and should impose no disturbance impact. Any loss of wetland area or function will require compensatory habitat creation/enhancement.

Wetland Buffer Area: Although certain development is allowed in the WBA, ecological impact assessments should be conducted for any proposal to demonstrate that the development will not result in loss of ecological function of the WCA, i.e. the development would not disturb avifauna and other wildlife utilising fish ponds in the WCA. Certain uses are exempted from the requirement for an ecological impact assessment.

No part of the NDAs fall within the WCA, but a small area of the NDA Study Area is within the WBA (**Figure 13.1**). There are not expected to be any affects on this area as a consequence of the Project.

13.2.2.5 Ho Sheung Heung and Man Kam To Road Egrettries

Ho Sheung Heung Egretty is located a short distance to the north of KTN NDA (within the FCA). The egretty and some of the nearby wetland habitat (used by foraging egrets) is zoned as a Conservation Area (CA) under the Ma Tso Lung and Hoo Hok Wai DPA Plan which was adopted in March 2012 (Plan No. DPA/NE-MTL/2). Ho Sheung Heung Egretty is utilised by Chinese Pond Herons, Eastern Cattle Egrets and Little Egrets.

In 2007, this was the largest egretty present in Hong Kong, with a total of 119 nests, however it has declined in importance since then, primarily because of a decline in the number of nesting Chinese Pond Herons. In 2012 it only held 49 nests and was seventh in size of the 21 occupied egrettries in Hong Kong in that year.

Another egretty was identified in 2009 in the Study Area during the course of fieldwork for this EIA. This is located at Man Kam To Road (within the FLN NDA). This site supports a lower abundance of ardeids than are present at Ho Sheung Heung with a total of 27 nests of Chinese Pond Herons and Little Egrets found in 2012. It is possible these comprise birds that previously bred at the Ho Sheung Heung Egretty.

Birds breeding in egrettries move to nearby wetlands in order to forage for food for both themselves and their chicks. This often leads to well-defined flight-lines between the egretty and important foraging locations. Impacts on these flight-lines could occur through the presence of built structures or construction equipment. Such obstacles may include buildings, roads or railways along the route taken by birds, especially if these are similar in height to the birds' flight path. The presence of obstacles along the flight-line potentially impacts breeding success at the egretty, either by preventing foraging at favoured locations, or by increasing the energy demands on the birds as they fly for a longer distance in order to avoid an obstacle along the favoured flight path. In an extreme case this could lead to abandonment of the egretty, but it may also mean that insufficient food is brought to chicks in the nest, resulting in decreased chick survival and thus decreased productivity at the egretty. It is important therefore to know about not only the location of the egretty but also flight-lines between the egretty and foraging locations.

Ho Sheung Heung Egretty will not be directly affected by the Project, but there may be indirect affects as some flight-lines from the egretty and some foraging areas of egrets breeding at the egretty are within areas which will be affected. Man Kam To Road Egretty will be unavoidably and directly affected by the Fanling Bypass (see **Section 13.1.4.3**).

13.2.2.6 *Fung shui* wood

Ho Sheung Heung *fung shui* wood is located to the west of Ho Sheung Heung village. It covers an area of 4.57ha. The woodland was damaged by fire in 2006, which divided it into two halves, but planting of the damaged area and natural regeneration, has partially restored linkages between the two parts of the wood. The wood is entirely within the KTN NDA. While it will not be directly impacted by the Project, it is located close to development areas, hence is potentially affected.

Two other, smaller, *fung shui* woods are present in the Study Area. That at Tsung Pak Long (0.66ha) in KTN NDA is in an area proposed to be zoned as Green Belt and will not be affected by the Project; that at Kam Tsin is outside the Project Area and will also not be affected.

13.2.2.7 Compensatory Planting Areas and Retained Meanders established under the ‘Main Drainage Channels for Sheung Shui, Fanling and Hinterland’ Project

Compensatory planting areas (referred to as Mitigation Plantation in this report) and retained meanders (referred to as Mitigation Wetland) were established as mitigation for the ecological impacts of the above Project along the Ng Tung, Sheung Yue and (mitigation plantation only) Shek Sheung Rivers. All but one of these areas is located within the Project Area and will unavoidably be affected by the Project, either directly or indirectly.

13.2.2.8 Ecologically Important Streams

An Ecologically Important Stream (EIS) system identified by AFCD is located in the Study Area at Kau Lung Hang. The sections of stream identified as ecologically important include Kau Lung Hang Lo Wai, Kau Lung Hang Sang Wai and the Tai Wo Streams to the east and upstream of the MTR East Rail Line and the local access roads, together with a section of the Ma Wat River south of Nam Wa Po. Thus, all ecologically important stream sections are outside, and upstream of, the Project Area boundary and hence will not be affected by the Project. The EIS supports a large population of a rare freshwater fish species *Acrossocheilus parallens*.

13.2.2.9 Sites of Special Scientific Interest, Special Areas and Country Parks

There are no gazetted sites of conservation importance (Sites of Special Scientific Interest, Special Areas or Country Parks) within or close to the Study Area and hence none of these will be affected.

Mai Po Marshes SSSI and Inner Deep Bay SSSI are wetland sites located downstream from the NDAs and are potentially impacted by development within the NDAs (see **Section 13.2.2.3**).

13.2.2.10 Frontier Closed Area

The NDAs are located close to the part of Hong Kong which was designated as the Frontier Closed Area (FCA) in 1962. Part of this area is within the NDA Study Area and may be affected by the Project, and a small area, at Ma Tso Lung, is within the Project Area and will be directly affected.

Though not formally recognised as a site of conservation importance, in the past the FCA has had very little disturbance as a result of limitations on human access into the area and, as a consequence, is considered to be potentially important for wildlife. The restrictions on access by people

are in the process of being lifted, commencing in February 2012 and scheduled to extend to all but 400ha by 2015; as yet the lifting of restrictions has had only limited effects. The locations of the NDAs mean that these are subject to rather more disturbance than the FCA, although less developed areas at the north of KTN NDA may provide suitable conditions for some of the scarcer species occurring in the FCA.

The following areas in or close to the Study Area were also identified as supporting fauna of ecological significance:

- Hoo Hok Wai (not directly affected by the Project, but potentially affected due to ecological and hydrological linkages, albeit it is rather remote from the Project Area);
- hilly area between Chau Tau and Ma Tso Lung villages (not directly affected but the southeastern fringes may be indirectly affected);
- re-instated fish ponds between Ng Tung River and Ho Sheung Heung Egretty (potentially indirectly affected);
- Ng Tung, Sheung Yue and Shek Sheung Rivers (within the Project Area and potentially affected significantly);
- an area of active and inactive agricultural land, and inactive fish ponds to the southwest of Sandy Ridge, bounded to the west by the Ng Tung River and to the south by Man Kam To Road, where an Eurasian Otter has been recorded (outside the Project Area and not predicted to be affected significantly); and
- hilly areas in the southeast of FLN NDA, south of Wo Hop Shek and above Kau Lung Hang (no affects predicted as they are rather remote from and upstream/uphill of the Project Area).

13.2.3 Development Projects in the Area

Other large-scale projects, which are concurrent, are proposed or are under investigation in the Assessment Area could have a bearing on the ecological impacts arising from development of the NDAs. In particular, these developments, combined with the development of the NDAs, could lead to significant cumulative impacts. The following proposed developments are relevant to the NDAs. Further details relating to these developments, and the implications of these on the NDAs, are provided throughout the text as appropriate.

13.2.3.1 Proposed Boundary Crossing Point at Liantang/Heung Yuen Wai

It is proposed that a new Boundary Crossing Point (BCP) should be constructed at Heung Yuen Wai to connect with Liantang on the Shenzhen side of the border. Part of the development of this BCP would involve the construction of a highway connecting to the existing road network. The connection would be made close to the interchange between the Fanling Bypass proposed under the NDA study and the existing Fanling Highway. An EIA for the BCP (Mott MacDonald 2010) and connecting road was approved with conditions in March 2011 (Register No.: AEIAR-161/2011).

13.2.3.2 Changes to the Boundary of the Frontier Closed Area (FCA)

The existing FCA boundary is located to the north of the proposed NDAs. Restrictions on human access into the FCA limit the levels of disturbance to habitats in within the FCA as well as limiting development pressure on these habitats. The lack of disturbance and development is considered to provide conditions suitable for wildlife which are less common in the rest of the New Territories. As noted in **Section 13.2.2.8**, commencing in February 2012, the FCA is largely to be opened up to human access and development, with all but 400ha of the FCA to be freed from access restrictions by approximately 2015. The potential impacts of opening up the FCA were considered and evaluated in the Land Use Planning for the Closed Area Feasibility Study (Arup 2010). Of particular relevance in relation to the current Project is the future of the Hoo Hok Wai area, as this is probably a foraging area for ardeids breeding at Ho Sheung Heung Egrettry.

13.2.3.3 Proposed Development of Lok Ma Chau Loop (LMC Loop)

The LMC Loop comprises an undeveloped area of land on the boundary of Hong Kong and Shenzhen which was isolated during channels of Shenzhen River. It is proposed to develop this area for educational uses. An EIA is currently underway for this proposed development (EIAO Study Brief Application Nos.: ESB-201/2008 and ESB-238-2011). It is proposed that one access route to the LMC Loop development would pass through KTN NDA, and that the NDA could also provide facilities to support the LMC Loop development.

13.2.3.4 Construction of Cycle Tracks and the Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung River and at Nam Sang Wai, Yuen Long

Construction of a cycle track from Sha Po Tseun to the Shek Sheung River is proposed. Within the NDA study area it will run through KTN, passing along the northern side of the Fanling Highway, the western (Ho Sheung Heung) side of the Sheung Yue River and the western (Long Valley) side of the Shek Sheung River. An EIA (Atkins China, 2008) for this project was approved without conditions on 12 Mar 2009 (Register No.: AEIAR-133/2009).

In addition, a Study Brief (ESB-179/2008) has been issued for a cycle track proposed to be constructed at Nam Sang Wai, Yuen Long. This location is a distance from the current project's Study Area but may be of relevance in the assessment of potential cumulative impacts on the Deep Bay Wetland ecosystem.

13.2.3.5 Provision of Cremators at Wo Hop Shek Crematorium

An EIA (Hyder 2008) has been approved for this project (AEIAR-119/2008), which is located in the southeast of the Study Area to the south of Fanling, outside the Project Area boundary. Construction of this project is currently in progress and it is scheduled to be completed by around 2014 (Allied Environmental Consultants Ltd. 2012). Construction is not, therefore, expected to be concurrent with the NDAs Project.

13.2.3.6 Site Formation and Associated Infrastructural Works for Development of Columbarium, Crematorium and Related Facilities at Sandy Ridge Cemetery

An application for a Study Brief (ESB 257-2013) for this project was issued in March 2013. The proposed project area is located to the east of the Lo Wu Boundary Crossing Point and hence is over 1km from the closest point within the NDAs and is separated from the NDA Study Area by Sandy Ridge and Lo Wu MTR Station. Road works associated with the project are proposed in a small part of the existing developed area of Sheung Shui.

13.2.3.7 Development of Organic Waste Treatment Facilities, Phase 2

A Study Brief (ESB 226/2011) has been issued under the EIAO for an organic waste treatment facility at Sha Ling, to the east of Kong Nga Po. This facility is planned to recover reusable materials which are currently disposed of in landfill sites. It would be constructed on the site of an

existing livestock waste composting plant which it would replace. The site straddles the 500m line from the nearest point in the NDAs (Cheung Po Tau in FLN). Given that the site is an existing livestock waste control centre, habitat loss impacts are likely to be minimal, if any.

13.2.3.8 Proposed Residential Development East of Ping Kong, Sheung Shui

A Study Brief (ESB No: 230/2011) has been issued under the EIAO for a proposed residential development to the east of Ping Kong. The proposed scheme would involve construction of about 184 three-storey houses on an area of 20.9ha. At the closest point, this development is approximately 1,300m from KTN NDA and 1,600m from FLN NDA and is separated from the NDAs by the existing towns of Fanling and Sheung Shui.

13.2.3.9 Proposed Residential Developments in and around the Deep Bay Wetland Area

A number of residential developments are under construction or proposed in and around the Deep Bay Wetland Area. While these are remote from the Study Area for the current Project, they are potentially of relevance in the assessment of cumulative impacts to the Deep Bay Wetland ecosystem.

An EIA Report has been approved for a Comprehensive Residential Development at Wo Shang Wai, Yuen Long (AEIAR-120/2008) and this project is under construction. An EIA Report has been approved for a Development at Fung Lok Wai, Yuen Long at Lot 1457 R.P. in D.D. 123, but construction has not yet commenced.

In addition, EIA Study Briefs have been issued for the following projects: Proposed Comprehensive Development and Wetland Protection near Yau Mei San Tsuen (ESB-182/2008); Proposed Residential Development within 'Residential (Group D)' Zone at Various Lots in D.D. 104, Yuen Long (ESB-2004/2009), Proposed Residential Development within 'Recreation' ('REC') Zone at Various Lots in D.D. 104, Yuen Long (ESB-207/2009) and Proposed Low-rise and Low-density Residential Development at Various Lots and their Adjoining Government Land in D.D. 104, East of Kam Pok Road, Mai Po, Yuen Long (ESB-210/2009); Proposed Comprehensive Development with Wetland Enhancement (CDWE) at Nam Sang Wai and Lut Chau (ESB-234/2011 and ESB-244/2011); Proposed Comprehensive Development at Lin Barn Tsuen, Yuen Long (ESB-239/2011) and Proposed Alternative Comprehensive Development at Lin Barn Tsuen, Yuen Long (ESB-254/2012); and Proposed Comprehensive Development at Wing Kei Tsuen, Yuen Long (ESB-240/2011).

13.3 Review of Existing Literature Related to Ecological Conditions in the Study Area

This Section details studies/surveys that have been reviewed and from which relevant findings have been utilised in accordance with the requirements of Section 3.4.14.4(i) of the Study Brief (in order to determine areas that required further survey). In this Section the most significant observations from these previous studies are summarised. How the significance of observations has been assessed in the current study is described in **Section 13.4.3.8**. Where appropriate, findings are also included and discussed in **Section 13.5** (Ecological Profile of the Study Area) and **Section 13.6** (Description and Ecological Evaluation of Habitats and Species). Details are also included in the relevant Appendices.

13.3.1 Previous Environmental Impact Assessment for the NDAs

Both NDAs were previously surveyed for an Environmental Impact Assessment (Maunsell 2003). Fieldwork for the ecological impact assessment was conducted during 1999 and included surveys of vegetation, avifauna, invertebrates (butterflies and dragonflies), freshwater fish, mammals and herpetofauna.

The report identified the importance of Long Valley as a site of High Ecological Value with a relatively large area of freshwater wetland with limited fragmentation, low levels of human disturbance and proximity to the Deep Bay wetlands. During the surveys Long Valley was found to have high ecological value for fauna but the floral diversity was limited by vegetation control as part of the normal agricultural practices.

This report also identified the Mitigation Meanders as being of High Ecological Value. This evaluation was a prediction as it is stated in Maunsell (2003) that channelisation works were in progress at that time. Fish ponds to the north of the Ng Tung River were also shown as being of High Ecological Value in Figure 8.4q of Maunsell (2003), but this appears to be contradicted in the habitat evaluation in Maunsell (2003) where the ecological value of fish ponds in Fanling North was stated to be Moderate to High.

13.3.2 Management Agreements (MAs) at Long Valley

As noted in **Section 13.2.2.1**, commencing in 2005 and continuing to the present, MAs under the NNCP have been implemented whereby the conservation value of the Priority Site has been enhanced by non-governmental organisations (the CA and HKBWS). Surveys conducted as an element of these MAs have included surveys of birds, amphibians, reptiles and mammals using the Long Valley and Ho Sheung Heung areas (HKBWS 2012, HKBWS in litt., Hung & Pang 2008, Wan 2010).

Bird surveys as an element of these MAs have been conducted regularly at Long Valley since December 2005 by the HKBWS¹. Many of the species recorded during the HKBWS surveys (spanning more than six years of weekly surveys, with the addition of observations from other birdwatchers) are irregular in occurrence at Long Valley, but the high number of species recorded reflects the importance of this site for birds.

Camera trapping of mammals was carried out in Long Valley and at Ho Sheung Heung *fung shui* wood between February 2009 and February 2010. This study completed a total of 2,852 hours of camera trapping at these sites. During this period, single pictures were obtained of a Eurasian Wild Pig *Sus scrofa* and a Small Indian Civet *Viverricula indica*, both at Ho Sheung Heung *fung shui* woodland. Domestic cats and dogs were more frequently photographed, but these may be associated with the nearby village houses. This represents a very low observation rate for mammals; the occurrence index (photographs per 100 camera trapping days) for these two species in areas of Hong Kong surveyed by Shek (2006) is 9.8 for Small Indian Civet and 9.2 for Eurasian Wild Pig.

13.3.3 AFCD Biodiversity Survey

AFCD maintains a Biodiversity Database for the long-term monitoring of biodiversity in Hong Kong. Data collected by AFCD between 2002 and June 2012 reports the presence of five species of mammal, 112 species of bird, 15 species of reptile, 11 species of amphibian, seven species of fish, 34 odonate species and 57 species of butterfly in the KTN NDA. In the FLN NDA, AFCD surveys reported the presence of one mammal species, 57 species of bird, ten species of reptile, ten species of amphibian, 16 species of fish, 35 odonate species and 42 species of butterfly. It should be noted, however, that the AFCD's territory-wide biodiversity survey does not necessarily cover or represent the existing ecological conditions of the NDA Study Area.

Camera trapping to survey for mammals has previously been conducted by AFCD in the Fanling area, close to the interchange for the proposed Fanling Bypass. Species recorded include East Asian Porcupine, Small-toothed Ferret Badger, Red Muntjac, Masked Palm Civet, Leopard Cat, Eurasian Wild Pig and Small Indian Civet (AFCD in litt, Shek *et al.* (2007)).

13.3.4 Hong Kong Biodiversity Survey

The University of Hong Kong published the results of a biodiversity study of Hong Kong in 2001 (Dudgeon & Corlett 2001). Although the sites and species recorded do not provide complete coverage of the area, data are included from within the Study Area for KTN NDA. No species were identified in surveys conducted under this study in the NDA Study Area which were not also reported in other studies or surveys in the same

¹ Data downloaded from <http://www.hkbws.org.hk/BBS/viewthread.php?tid=12044&extra=page%3D1>

areas. However a bat which was suspected to be a Pomona Leaf-nosed Bat was observed, this species has not been reported in the Study Area by other studies.

13.3.5 EIA for Liantang/Heung Yuen Wai Boundary Control Point

The EIA report for Liantang/Heung Yuen Wai BCP was approved in March 2011. This report covers not only the site of the BCP but also the proposed connecting road. The interchange of this connecting road with the Fanling Highway is located close to the proposed interchange of the Fanling Bypass (**Figures 13.1 to 13.3**). The most significant observations made in this study in the current Study Area were those of Indian Forest Skink and Copperhead Racer, and Eastern Lilysquatter. The first two of these species were observed in the area to the east of Tong Hang Tung Chuen and Indian Forest Skink was also found east of Wo Hop Shek. Eastern Lilysquatter was reported from near Kau Lung Hang. These three species are not otherwise known in the Study Area. Other species of conservation significance reported by this study, all in these two areas, were also reported under other studies.

13.3.6 Feasibility Study for FCA

Following the announcement by the Security Bureau in 2006 that the FCA would be reduced to 400ha by 2015, the Planning Department commissioned the Land Use Planning Feasibility Study to formulate a planning framework to guide the conservation and development of the Study Area (the FCA at that time), based on the principle of sustainable development. The study included a Strategic Environmental Assessment, the findings and recommendations from which served as inputs to various stages of the Study. This study was completed in 2010; fieldwork for the study was undertaken in 2008.

As is shown in **Figures 13.1 to 13.3**, the Study Area for the FCA Study included the northern part of KTN NDA. Surveys conducted under this study found relatively few species of conservation significance in the NDA Study Area. However, the only observation of Eurasian Otter in the Study Area (to the east of the Ng Tung River to the north of Fu Tei Au) came from this Study.

13.3.7 EIA for LMC Loop Development

The Planning and Engineering Study on the Development of the Lok Ma Chau Loop (LMC) includes as its Study Area the LMC Loop, the LMC Meander, Hoo Hok Wai (HHW) and two areas designated for infrastructural connections, one of which runs through the Ma Tso Lung area to link up with the KTN NDA. Ecological surveys for the Study were conducted from June 2009 to May 2010. During these surveys the high ecological value of the fish ponds and associated wetlands at HHW for

large waterbirds was confirmed, as was the importance of the flight-line corridor connecting this area with wetlands elsewhere in the Deep Bay area. The Study also confirmed the importance of HHW, the LMC Meander and the LMC Loop for Eurasian Otter, while the crab *Somanniathelphusa zanklon* were recorded in Ping Hang Stream, and Rose Bitterling was recorded in a stream near LMC Road.

In respect to the NDA Study Area, the stream network in the Ma Tso Lung area was considered to be of moderate to high ecological value due to the presence of Three-banded Box Terrapin (listed as Critically Endangered by IUCN (2013) and found during surveys conducted under the current study) and diverse stream fauna. The marsh at Ma Tso Lung was considered to be of low to moderate ecological value due to its potential for enhancement and connectivity with nearby wetland. The ecological value of the seasonally wet grassland adjacent to the marsh was considered to be low to moderate; numbers and diversity of fauna were low, though small numbers of Chinese Bullfrog were noted. Of other habitats in the Ma Tso Lung Area, secondary woodland, plantation and shrubland were all considered to be of low to moderate ecological value, as was upland grassland between Lok Ma Chau Tsuen and Ma Tso Lung Tsuen. In addition to the fauna species discussed above, other species meeting the conservation concern criteria of Fellowes *et al.* (2002) included Small Snakehead, *Somanniathelphusa zanklon* and Ruby Darter, recorded in lower-lying areas, and Chinese Cobra, Common Rat Snake, Small Three-ring, Spotted Angle, Danaid Egg-fly and Red Muntjac recorded on the slopes of the valley. Spotted Angle is not otherwise known from the Study Area, while the observation of Red Muntjac is the only confirmation that this species still occurs in the Study Area. This species was considered to be formerly present in the Long Valley area by Hung and Pang (2008).

13.3.8 EIA for Lok Ma Chau Spur Line

The Sheung Shui to Lok Ma Chau Spur Line passes through the KTN NDA. The original proposal was for this railway to be situated on a viaduct through the Long Valley area, but the final alignment was revised so that the railway is actually located in a bored tunnel underneath KTN and Long Valley. As part of the EIA (BBV 2002), baseline surveys were conducted along the alignment corridor during 2000-2001; surveys conducted at Long Valley are relevant to the NDA study.

This study noted the importance of wetland habitats in Long Valley, especially for bird species of conservation importance, 29 species of which were recorded in Long Valley in surveys reported under this study. The occurrence of Eurasian Eagle Owl, not otherwise known from the study area was reported, however it is not clear if the observations relate to areas within the NDA Study Area. The most significant findings of other fauna reported under this study were of Reeve's Terrapin from Long Valley; and the relatively high abundance and diversity of the

herpetofauna in Long Valley. The importance of Long Valley for butterflies was also noted, but data were largely derived from surveys undertaken by Bascombe, as reported in Maunsell (2003)

13.3.9 EIA for Cycle Tracks between Sha Po Tsuen and Shek Sheung River

An EIA for the construction of cycle tracks and associated supporting facilities for the section between Sha Po Tsuen and Shek Sheung River was approved in 2009. This includes a section at Long Valley in the KTN NDA. Surveys conducted for the EIA included surveys of the drainage channels around Long Valley (Sheung Yue and Shek Sheung Rivers). These surveys recorded the presence of waterbirds in the Sheung Yue River channel; 14 species were noted, of which ten were considered to be of conservation significance. Of these species, Grey Heron and Little Egret were reported in the largest numbers on a regular basis, though a single flock of 44 Pied Avocets was noted on one occasion.

Also of considerable relevance to the current study are: the habitat evaluations of the river channels and adjacent habitats, especially Long Valley and plantation, including mitigation plantation; predicted ecological impacts on these habitats and species utilising them; and the mitigation measures proposed. Long Valley wetland habitats were evaluated as of high ecological importance under this study, the river channels were considered to be of moderate ecological importance, but the plantation along the river channels (including mitigation plantation) was considered to be of low ecological importance. Impacts of the cycle track project on all of these habitats were predicted to be of low significance and, with mitigation it was considered that there would be no significant overall loss of valuable ecological habitat. With mitigation, residual impacts of the project on surrounding habitats and species were considered to be minor. This mitigation included the proposal to carry out works near Long Valley during the dry season (between October and March) to avoid the breeding season of Greater Painted-snipe and to prevent any potential disturbance to breeding and nesting birds.

13.3.10 Egretty Counts in Hong Kong

The number of active nests in each of the Hong Kong egrettries is counted annually by the HKBWS as part of the Mai Po Inner Deep Bay Waterbird Monitoring Programme under AFCD's contract. This includes counts at the two egrettries present in the Study Area (Ho Sheung Heung and Man Kam To Road). Results of the monitoring from recent years are included in **Tables 13.1 and 13.2.**

Table 13.1 - Number of egret nests recorded at Ho Sheung Heung Egretty 2007 – 2012 (from Anon 2007, 2008a, 2009, 2011, 2012a, 2012b)

Species	2007	2008	2009	2010	2011	2012	Mean
---------	------	------	------	------	------	------	------

Great Egret	-	1	-	-	-	-	0.2
Little Egret	31	25	34	42	36	33	33.5
Eastern Cattle Egret	17	18	14	25	12	12	16.3
Chinese Pond Heron	71	29	23	19	2	4	24.7
Total	119	73	71	86	50	49	74.7

Table 13.2 - Number of egret nests recorded at Man Kam To Road Egrettry 2009 - 2012 (from Anon 2009, 2011, 2012a, 2012b)

Species	2009	2010	2011	2012	Mean
Little Egret	-	2	3	6	2.8
Chinese Pond Heron	15	22	20	21	19.5
Total	15	24	23	27*	22.3

*Peak number of nests reported; only five nests remained in July following clearance of bamboos containing part of the colony (HKBWS 2012b).

13.3.11 Drainage Improvement Works

Ecological impacts of the channelisation of the Ng Tung, Shek Sheung and Sheung Yue Rivers were assessed under the EIA Study for the Main Drainage Channels for Fanling, Sheung Shui, Fanling and Hinterland. The importance of Long Valley for wetland birds was acknowledged, resulting in the retention of meanders as mitigation for ecological impacts (Maunsell 1997). The implementation of this project resulted in significant changes to the Study Area, both as a consequence of the channels of the major rivers, and the implementation of mitigation measures to compensate for impacts to wetland and woodland habitats. Partly due to the time that has elapsed and partly due to the changes instigated by these works, some data collected in the Study are of limited relevance to the context of the current study.

However, Maunsell (1997) detailed findings of an unpublished study of the butterfly fauna of the Ho Sheung Heung area undertaken by Bascombe. These findings have been quoted by several subsequent studies, notably BBV (2002) and Maunsell (2003).

13.3.12 Drainage Improvement in the Northern New Territories – Package B, KTN 01 at Tsung Yuen, Kwu Tung North, Sheung Shui

This report (submitted in 2012) assesses a proposed underground reception drain along Ho Sheung Heung Road and the upgrading of an artificial irrigation channel adjacent to Tsung Yuen Village. Long Valley fell within the 500m Study Area for the study. Wet and dry season field surveys were undertaken between November 2011 and May 2012. Species recorded were typical of the habitats in the area, though the largely dry season survey period meant that data were not representative of species more abundant in the wet season, including amphibians, dragonflies and butterflies. No species additional to those recorded in the current or other studies were observed. Residual impacts of the project with mitigation were considered to be mitigated to an acceptable level.

13.3.13 Provision of Cremators at Wo Hop Shek Crematorium

Four months of ecological surveys were conducted across the wet season in order to assess the impacts of the provision of additional cremators at the existing Wo Hop Shek Crematorium. Habitats, flora and major faunal groups were surveyed between March and June 2006 in the Study Area for the Project. Low numbers of species were recorded during the faunal surveys, all typical of the habitats present. The most significant finding was Short-legged Toad *Xenophrys brachykolos* recorded in semi-natural woodland. The exact location of this sighting is not certain but was either just inside or just outside the Study Area for the current project, to the southeast of the crematorium. Woodlands on the slopes of hills within the Study Area were classified as being of Moderate or Moderate to High ecological value. Other remaining habitats were generally Low or Low to Moderate ecological value (Hyder 2008). This project is currently still underway but is scheduled to be completed prior to the commencement of the current project.

13.4 Survey Methodology

13.4.1 Background

Ecological surveys of the Study Area were conducted in accordance with the requirements of the EIAO-TM and the Study Brief, with particular regard paid to the requirements of Section 3.4.14.4 of the latter. Section 3.4.14.4(i) notes that the assessment should review the findings of relevant studies and surveys, including the NENT Study, completed in 2003, for which 12 months of ecological surveys had been undertaken in 1998/99 covering a full year's seasonal variation. All available information from the NENT Study and other relevant studies and surveys regarding the ecological character of the Study Area was collated and reviewed. This review took into account that the survey work for the NENT Study was carried out before the establishment of the EIAO Study Brief mechanism.

In Section 3.4.14.4(ii) it is stated that the assessment should evaluate the information collected from Section 3.4.14.4(i) and identify any information gap relating to the assessment of potential ecological impacts and determine whether ecological surveys are required to bridge any identified information gap for the purpose of establishing a comprehensive and updated ecological profile. This process was carried out via both field survey (to determine whether there had been any significant change in habitats) and desktop review.

Thus, in Section 3.4.14.4(iii) it is stated that field surveys necessary to bridge any identified information gap, the duration of which should be at

least nine months covering both wet and dry seasons, should be undertaken.

In order to meet these requirements, the following survey methodology was followed.

Firstly, aerial photographs were utilised to identify the continuous and contiguous urban area of Sheung Shui and Fanling. Subsequently, an initial field survey of all habitats except for the continuous and contiguous urban area of Sheung Shui and Fanling, the delineation of which did not need to be ground-truthed, was carried out to identify and delineate the following:

- Dryland terrestrial habitats, including forest, shrubland and grassland, that had previously been identified as ecologically important habitats and/or as supporting species of conservation significance;
- All areas identified as wetland habitats in the NENT Study and/or which appeared to be wetland from examination of aerial photographs, such habitats are particularly likely to experience change in a relatively short period and are known to be particularly important in Hong Kong for fauna of conservation significance;
- All areas where previous or current ecological mitigation or conservation measures were in place;
- Long Valley, including the area north of the Sheung Yue River and south and east of Ho Sheung Heung;
- Areas not falling into at least one of the above categories; i.e. dryland habitats that had not previously been identified as being of ecological importance.

Routes for systematic surveys were then determined. Potential ecological impacts on golf course habitat, located to the south of the Fanling Highway, were not envisaged to be significances, even if evaluated on a precautionary basis; and it was considered that habitat mapping of the golf course area could be undertaken in a satisfactory manner using aerial photographs. Accordingly, this habitat was excluded from survey routes.

Survey routes, covering all other habitats in the Study Area, were then devised to ensure that the requirements of the EIAO-TM and the Study Brief (in particular Section 3.4.14.4(ii)) were met. Particular attention was paid to wetland habitats (e.g. Long Valley, marsh, watercourses, mitigation wetlands, pond), which generally support a relatively high number of species of conservation significance. Sampling points for surveys of aquatic stream fauna were selected based on an initial field survey of all watercourses to determine those that might potentially be of conservation significance.

Non-wetland habitats likely to be of conservation significance were also surveyed, including Ho Sheung Heung *fung shui* woodland and other areas of secondary woodland and mitigation plantation, as well as shrubland, grassland/shrubland and grassland at Crest Hill. Dryland habitats west of Sheung Yue River and south of Ng Tung River, as well as in river valleys were also surveyed. Riparian corridors, an important habitat for wetland-dependent and wetland-associated fauna were surveyed where accessible.

In addition, all development areas and their environs were included in surveys and methodologies for flora and fauna. The latter included, in particular, grassland and dry agriculture between Fanling and the Ng Tung River, which were included in floral surveys and faunal survey routes.

The main survey period for the assessment covered the 12 months between July 2008 and June 2009; survey periods for some fauna groups were shorter than this, in accordance with the recommended survey seasons detailed in EIAO Guidance Note No. 7/2010.

Given the long duration of the NDA study and the evolving process of RODP preparation, further surveys to cover any residual information gaps were conducted, as required, until the end of April 2013. These additional surveys have been used to verify and update the ecological baseline information and confirm that this information remains valid, as well as to collect additional ecological baseline information of the Study Area.

In addition, data collected as part of other studies and published during the course of this Study were also incorporated. These included the following:

- The final report of the Land Use Planning for the Closed Area – Feasibility Study (Arup 2010) which contained the results of surveys in adjacent areas, including an area of abandoned ponds and wet agriculture north of Fu Tei Au near Sha Ling, to the east of Ho Sheung Heung Egretty;
- The EIA Report for Construction of Cycle Tracks and the Associated Supporting Facilities Sha Po Tsuen to Shek Sheung River (Atkins China. 2008) which contained data from surveys of waterbirds in Sheung Yue River;
- The Final Report for Provision of Crematoriums at Wo Hop Shek Crematorium (Hyder 2008) which contained data from surveys of areas near the cemetery, in the southeast of the Study Area;
- The Environmental Impact Assessment Report for Liantang/Heung Yuen Wai Boundary Control Point (Mott MacDonald 2010) which also provided data from the southeast part of the Study Area.

- The Final Report for Review, Design and Tender Documentation for Drainage Improvement Works at Tsung Yuen, Kwu Tung North. Environmental Review for KTN01 Document No. 296472/005/C (Mott MacDonald 2012) which included data from the northern part of Long Valley;
- Monitoring data in relation to birds, herpetofauna and mammals which had been collected since 2005 under the Management Agreements at Long Valley (see **Section 13.3.2**), Publications such as Hung & Pang (2008) and Wan (2010) summarised and analysed some of the data collected, while data are also made available at intervals on the website of the Hong Kong Bird Watching Society²;

Finally, the Ma Tso Lung area was surveyed for the ongoing LMC Loop Study during the period between June 2009 and May 2000, and findings in relation to the wetland and grassland habitats (in particular) of that area were used to inform assessments in relation to that northern part of the KTN NDA. Survey methods utilised in that study followed those documented in the EIAO Guidance Note No. 10/ 2004. Of relevance to the current Study Area were surveys conducted for mammals, birds, herpetofauna, butterflies, dragonflies and stream fauna. Surveys for birds were conducted monthly for twelve months; except for aquatic fauna which was surveyed once in the wet season and once in the dry season, surveys for other fauna were conducted monthly during the active periods for these groups (as detailed in the EIAO Guidance Note No. 10/ 2004). Details of survey methodologies and periods for habitat, botanical and faunal surveys carried out for the current study are provided in **Section 13.4.2** below.

13.4.2 Habitat and Botanical Survey Methodologies

Initial maps of habitats within the Study Area were prepared from HKSAR Government aerial photographs taken in 2007 and 2008. The maps were then ground-truthed in order to ensure these reflected current conditions and to distinguish between habitats (in particular wet and dry agriculture, dry lowland grassland and seasonally wet grassland, and secondary woodland, plantation and orchard) which could not always be reliably distinguished on aerial photographs. Ground-truthing in the field was undertaken during September 2008 and May 2009 (the latter period primarily in order to identify seasonally wet habitats).

Additional surveys were conducted during April to July 2012 and in April 2013 in order to confirm the habitats present and to update the habitat maps (where required) in areas of lowland agricultural land, grassland and wetland which are subject to relatively rapid habitat change due to human influences and natural processes.

² <http://www.hkbws.org.hk/BBS/viewthread.php?tid=12044&extra=page%3D1>

Botanical surveys of habitats identified during the mapping process were carried out during September to October 2008 and May 2009; with further surveys in July 2012 and April 2013. These characterised the vegetation conditions present in each habitat, including the typical species of plant present.

13.4.3 General Approach to Faunal Survey Periods and Methodologies

The EIA Study Brief specified that duration of field surveys should be at least nine months; it was decided to extend this to 12 months from July 2008 to June 2009 in order to fully cover seasonal differences in species and numbers of the most vagile group (birds), to maximise chances of encountering low density and cryptic species and to cover the active periods of all seasonally active groups within the same continuous period. Survey periods for faunal groups are detailed in **Table 13.3**.

Given the long duration of the NDA study and the evolving process of RODP preparation, further surveys to verify validity of information collected in 2008-2009, to collect additional information and cover any residual information gaps for all faunal groups were conducted, as required, until the end of April 2013. These additional surveys have been used to update the ecological baseline information and confirm that this information remains valid.

Table 13.3 – Survey period for floral and faunal surveys; July 2008 to June 2009 (except where indicated)

Month	J	A	S	O	N	D	J	F	M	A	M	J
Habitat mapping			x								x	
Botanical survey			x	x							x	
Mammals	x	x	x	x	x	x	x	x	x	x	x	x
Birds (day-time)	x	x	x	x	x	x	x	x	x	x	x	x
Birds (night-time)	x		x		x		x		x		x	
Egretty flight-line surveys*	x										x	x
Herpetofauna	x	x							x	x	x	x
Fish and other stream fauna				x	x				x	x		
Dragonflies	x	x	x							x	x	x
Butterflies	x	x	x							x	x	x

* Surveys at Ho Sheung Heung Egretty were conducted in May to July 2009; surveys at Man Kam To Road Egretty were conducted during June to July 2009 and May to July 2011.

13.4.3.1 Mammals

Since mammals in Hong Kong, including many those of conservation significance, are secretive and often nocturnal, surveys were conducted in parallel with bird and herpetofauna surveys (including some qualitative night-time surveys) in an effort to increase the body of baseline data on mammal diversity and numbers in the Study Area. In addition to direct

observation, any observations of signs of mammal activity (such as tracks, scats or burrows) were actively sought. As a corollary, survey frequencies for terrestrial mammals followed those detailed below in respect of birds and herpetofauna.

Review of previous studies or surveys suggested that a number of bat species were present in the Study Area, as is typical of agricultural areas in Hong Kong, though no species of conservation concern were known to occur with certainty. Bat roosts were sought during day-time surveys of birds and herpetofauna.

Bat detector survey was undertaken during the night-time survey. The survey started shortly after sunset and covered habitats of potential importance to bats, especially wetlands and woodlands. During the survey, echolocation calls of foraging bats were recorded (using frequency division). The structure of the echolocation calls from these recordings was later analysed to identify species as far as possible (the lack of literature on echolocation call structure makes the field identification of some bat species in Hong Kong impossible, and some species remain unidentified from the recordings). The relative abundance of each species in the habitat was estimated from the field and from recordings using a scale from 1 (single individual recorded) to 5 (very abundant).

Those areas of the Study Area covered by mammal surveys and survey routes are shown in **Figure 13.2**.

13.4.3.2 Birds

Systematic bird surveys followed a line transect and started within one hour of dawn, to coincide with the period of maximum bird activity. All bird species found during the surveys were recorded, and numbers of any species of conservation importance (according to criteria listed in **Section 13.4.3.8**) and wetland-dependent species were counted. Species lists for each NDA were also supplemented by observations of birds during other faunal surveys.

Baseline bird surveys were conducted once per month during July 2008 to June 2009 and twice per month in Long Valley south and east of the Sheung Yue River during September 2008 to April 2009. Night-time bird surveys were conducted every two months during July 2008 to June 2009. These followed a similar methodology and transect to the daytime surveys, and started shortly after dusk.

The channelised Sheung Yue River to the west of Long Valley was also known to be important to foraging birds, especially egrets breeding at the Ho Sheung Heung Egretty and probably also the Man Kam To Road Egretty. In order to better understand the use of the channels by waterbirds in relation to tidal changes, surveys were conducted along the Sheung Yue River channel on twice per month during August 2008 to June 2009. During the surveys, a line transect was followed alongside

the channel recording all wetland-dependent birds present within the channel. Due to the tidal nature of the channel, which influences the activity and abundance of birds present, surveys were conducted in the morning and afternoon on each survey date to cover varying stages of the tidal cycle. The Ng Tung and Shek Sheung Rivers were surveyed in the course of standard bird transects as field surveys showed that the numbers of most species using these rivers were much smaller and, in the case of the Ng Tung River, less influenced by the tidal cycle (as shown **Figure 13.4**).

Those parts of the Study Area covered by bird surveys and transect routes are shown in **Figure 13.3**, and bird survey areas and routes followed for survey transects along the Sheung Yue, Ng Tung and Shek Sheung Rivers are shown in **Figure 13.4**.

13.4.3.3 Egretty Flight-lines

Two egrettries are known within the Study Area: Ho Sheung Heung Egretty and Man Kam To Road Egretty, the latter having been found during the course of bird surveys undertaken for this study. Surveys of flight-lines were conducted at both egrettries. These surveys lasted for a period of two hours, starting in the early morning (between 06:00 and 06:30) to cover the peak period of activity for foraging egrets. During the surveys, any birds seen leaving the egretty were watched to record the direction of flight and, as far as possible, the distance flown. The flight height of birds leaving the egretty towards the KTN Project Area was also recorded to permit assessment of the potential impacts of building height on flight-lines.

Five flight-line surveys were conducted at the Ho Sheung Heung Egretty between May and July 2009. Birds were observed from two vantage points (**Figure 13.3**), permitting the observation of birds flying north towards Hoo Hok Wai and south towards Long Valley and east over the Ng Tung River towards FLN. At the Man Kam To Road Egretty two flight-line surveys were conducted during late June and early July 2009 and another three were conducted between May and July 2011. Surveys were conducted from the bridge where the Man Kam To Road crosses Ng Tung River (**Figure 13.3**).

13.4.3.4 Reptiles

The review of previous surveys and studies, in particular the NENT Study, suggested that the Study Area supported a relatively small number of reptile species, all of which were typical of lowland areas in Hong Kong and none of which were of conservation significance. Reviewed in this context, updating of the survey data in accordance with the Study Brief followed the standard survey protocol described in **Section 13.4.1** above.

Reptile surveys were conducted once per month during July to September 2008 and March to June 2009. On each survey date, a transect survey was conducted on which all reptiles observed foraging or basking in the open were identified and counted. Many reptiles are cryptic or secretive, and active searching was carried out in appropriate microhabitats, such as underneath stones, logs or other objects lying on the ground. Any observations of reptiles during other faunal surveys were also included in order to provide a more thorough assessment of the reptile communities present in the area. Reptiles were also searched for during stream surveys (see **Section 13.4.3.7**)

Survey routes and areas covered by reptile surveys are shown on **Figure 13.2**.

13.4.3.5 Amphibians

All amphibians are wetland-dependent during at least a part of their life cycle; unsurprisingly, the review of previous surveys and studies showed that the main areas of importance to amphibians in the Study Area were lowland wetland habitats or those close to wetlands. Reviewed in this context, updating of the survey data in accordance with the Study Brief following the standard survey protocol described in **Section 13.4.1** above was considered appropriate, as this focused on such habitats.

Amphibian surveys were conducted once per month during July to September 2008 and March to June 2009. In addition, night-time surveys were conducted once per month during March to June 2009. These surveys of amphibians concentrated on recording the distinctive vocalisations of advertising males, for which the peak activity occurs in the early wet season, especially after dusk and during or after rain. During surveys transect routes were followed, but surveys deviated from these routes to ensure that habitats suitable for amphibians were visited and all amphibians seen or heard were identified and counted. In addition, amphibians were also searched for during stream surveys (see **Section 13.4.3.7**).

Survey routes and areas covered by amphibian surveys are shown on **Figure 13.2**.

13.4.3.6 Butterflies/Dragonflies

The review of previous surveys and studies found that areas along the Sheung Yue River at Ho Sheung Heung and Tsung Pak Long had been identified as of importance for butterflies by Bascombe (1993). Many of these species were not found in surveys undertaken for the NENT Study, which took place after extensive habitat alterations arising from channelisation of the river. Accordingly, surveys in this area to confirm the findings of the NENT Study were considered appropriate in the present study.

With this exception, previous studies, including surveys for the NENT Study, had not found a high diversity or abundance of butterflies or dragonflies, nor had localities supporting species of conservation importance been found. Reviewed in this context, updating of the survey data in accordance with the Study Brief following the standard survey protocol described in **Section 13.4.1** above was considered appropriate. This included a focus on habitats along the Sheung Yue River that (at least formerly) were of importance to butterflies, and wetlands (including streams) which are the habitats of primary importance to dragonflies; as well as the Ho Sheung Heung and Crest Hill area which had been identified as of importance to butterflies in the past, as noted above.

These two groups were surveyed simultaneously by means of a transect survey of the NDA and adjacent habitat. Particular attention was given to favoured habitats for the groups, including woodland/shrubland for butterflies and wetland habitats and streams for dragonflies. All adult butterflies and dragonflies seen during the surveys were recorded and counted. Surveys were conducted monthly during July to September 2008 and April to June 2009.

Survey routes and areas covered by butterfly and dragonfly surveys are shown on **Figure 13.2**.

13.4.3.7 Stream Fish and Invertebrates

Review of previous studies and surveys revealed limited information on fish and other stream fauna in the Study Area. Accordingly, fish and aquatic invertebrates were surveyed in all river channels and in both channelised and natural streams. As far as possible, streams were surveyed along their full length within the Study Area, though this proved impractical in some locations due to topographical and access constraints.

Fish and aquatic invertebrates were surveyed by direct observation and trapping using a hand net; whenever possible, these captured individuals were identified *in situ* and released immediately, although some invertebrates were preserved in 70% ethanol solution for later identification.

Survey locations where stream fish and invertebrate surveys were surveyed quantitatively are shown in **Figure 13.2**. Combined, quantitative surveys for these groups were conducted at least once during the survey period at these locations.

13.4.3.8 Species of Conservation Significance and Protected Species

Section 3.4.14.4(iv)(e) of the Study Brief requires that species that are rare, endangered and/or listed under local legislation, international conventions for conservation of wildlife/habitats or Red Data Books are

given due consideration in establishing an ecological profile of the assessment area.

In this report, the following legislation, conventions and criteria in respect to rare, endangered and protected species are considered to be of relevance and hence have been given due consideration.

Species are considered to be of conservation significance based on criteria and lists provided by BirdLife International (2013), the IUCN Species Survival Commission (IUCN 2013), the China Red Data Book (CRDB) (Wang 1998) and Fellowes *et al.* (2002). Categorisations of relevance to this study are listed below:

International criteria

- Critically Endangered (CR);
- Endangered (EN);
- Vulnerable (VU);
- Near Threatened (NT);
- Data Deficient (DD);
- Least Concern (LC).

Listing under the first four of these categories is considered to be of relevance when assessing whether an observation of a species is of significance, subject to the other criteria discussed below. Listing as DD is noted in the report but is not considered of relevance to the assessment process for this study.

National (China) Criteria

- Endangered (EN);
- Vulnerable (V);
- Near Threatened (NT);
- Rare (R);
- Indeterminate (I).

Listing under the first four of these categories is considered to be of relevance in assessing whether an observation of a species is of significance, subject to the other criteria discussed below. However, for some species, the conservation status in China may differ from Hong Kong and thus not all species of conservation significance in China are of conservation significance in Hong Kong. Such species are discussed in **Section 13.5**. Listing as I is noted in the report but is not considered of relevance to the assessment process for this study.

Local (Hong Kong) Criteria

- Global Concern (GC);
- Regional Concern (RC);
- Local Concern (LC).

Listing by Fellowes *et al.* (2002) under any of these categories is considered to be of relevance in assessing whether an observation is of significance, subject to the other criteria discussed below. While Fellowes *et al.* (2002) was used as the baseline criterion for determination of species of local conservation significance, more recent sources, including Hong Kong Bird Reports, Chan *et al.* (2011) (for butterflies), Tam *et al.* (2011) for dragonflies and the AFCD Biodiversity Database were utilized in the evaluation of the significance of observations of species listed by Fellowes *et al.* (2001) in the light of current knowledge as to their status.

The conservation status of flora was not evaluated by Fellowes *et al.* (2002). In the absence of such evaluation, flora records are considered to be of relevance in assessing whether an observation of a species is of significance if they are included in international or national lists of species of conservation concern (as described above); and are protected under Hong Kong legislation; and were not considered by Xing *et al.* (2000), Wu and Lee (2000) and Baretto *et al.* (2011) to be common or very common; and were found in a wild state.

Reference to the conservation status under the criteria described above (except LC under international criteria) is made for all species in **Appendices 13.1 to 13.9** of this report. However, an observation of a species is not necessarily of relevance to the ecological evaluation process and hence is not necessarily referred to in the habitat and impact evaluation process. Such observations include the following:

- Observations of species in habitats atypical of the habitats typically utilised by the species in the Study Area, for example wetland-dependent species in woodland habitats or dryland species in wetland habitats, as such habitats are not of significance to such species;
- Observations of species on an irregular or occasional basis in small numbers, especially if a species is vagile and/or opportunist and utilises a number of common habitats;
- With respect to species listed as of conservation concern by Fellowes *et al.* (2002), due regard has been paid to as to whether an observation meets the restrictedness criteria as defined by these authors. Thus, species which are listed by Fellowes *et al.* as being of conservation concern on the basis of breeding or roosting sites have not been evaluated as of conservation significance in this report unless these observations refer to breeding or communal roosting sites;

- With respect to impact evaluation, observations of a species in a habitat or area where impacts on that species would be of minimal severity, and/or where the habitat is widespread in the Study Area, hence the effect on carrying capacity of the Study Area for that species would be low;
- Species for which the Hong Kong population is not considered to be of natural origin.

In respect to the foregoing, and elsewhere in this ecological assessment, species have been evaluated as typically utilising a habitat by combining findings from the literature review, findings from surveys conducted under the current study, and the professional experience of the study team.

Protection status of fauna and flora under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and the Forestry Regulations (under Cap. 96) in Hong Kong and protection status in China are listed in **Appendices 13.1 to 13.9** of this report; except in respect to birds and bats in Hong Kong as all species in these groups are protected. Protection status of species in China has not been used as an evaluation criterion in this report, for two reasons. Firstly, the Hong Kong SAR has a different legal system to China; hence Chinese law does not affect the protection status of fauna and flora in Hong Kong. Secondly, whilst the protection status of a species in Hong Kong is generally aligned with its local conservation status, the protection status of a species in China is intended to reflect the threats to that species and its status in China; this may often not correspond to the conservation status of a species in Hong Kong.

Protection status of species in Hong Kong is noted in **Section 13.5** of this report. However, it is not considered relevant to the evaluation of habitats and impacts on habitats or species with two exceptions:

- In the absence of local conservation criteria for flora in Fellowes *et al.* (2002), protected plant species which were not considered to be common or very common by Xing *et al.* (2000), Wu and Lee (2000) and Baretto *et al.* (2011) are considered to be of significance in the evaluation of impacts on habitats, as described above;
- Death or damage to individuals of protected species is considered in the evaluation of potential mortality impacts on fauna and flora.

13.5 Ecological Profile of the Study Area

13.5.1 Introduction

The following section of the assessment provides an ecological profile of the Study Area based on results of field surveys undertaken under the current study and data from relevant previous and concurrent studies and surveys, together with a description of the ecological characteristics of all of the habitats present. Data and analysis follow the requirements of the EIAO-TM and Section 3.4.14.4(iv) of the Study Brief.

13.5.2 Description of the Physical Environment

The Study Area comprises slightly over 2000ha in the northern New Territories. Except for small areas in the extreme west and north, the entire area is within the catchment of the Ng Tung River and its tributaries. The Ng Tung River itself is a tributary of the Shenzhen River which drains westwards into Deep Bay. Much of the Study Area is a flat lowland floodplain at an elevation of less than 20m. This plain is bounded to the northwest by low hills rising to 183m at Tai Shek Mo near the northern edge of the Study Area and to the northeast by another range of hills which reach 164m at High Hill.

There are no topographical features defining the western and southern boundaries of the Study Area, but to the southeast and east it is defined by a range of higher and more rugged hills which reach 440m at Cloudy Hill (Kau Lung Hang Shan).

13.5.3 Overview of Habitats Present

Most habitats in the Study Area are typical of the northern New Territories. These lowlands support a complex mixture of habitats, including a variety of active agricultural uses, abandoned agricultural land, woodlands (including plantation and secondary woodland), village land and urban development (**Figure 13.5**). Being located on flat land in river valleys, some areas are seasonally or permanently wet. The area also contains a number of low hills, which support a less complex mix of grassland, shrubland, plantation and woodland habitats.

Wetland areas, especially those near Long Valley at the western end of the Study Area, are of particular ecological importance. These show ecological connection to the more extensive Deep Bay wetlands and attract many of the same species, especially birds. Long Valley itself contains one of the largest remaining areas of wet agriculture in Hong Kong and contains a mixture of wetland habitats supporting various species with a limited distribution in the territory.

Table 13.4 - Habitats within the NDA Study Area and NDA Boundaries^{1,2}

Habitat	KTN NDA	KTN Study Area	FLN NDA	FLN Study Area
Dry Agriculture	14.12	14.91	9.24	15.87
Wet Agriculture	19.53	23.27	0.58	3.53
<i>Fung Shui</i> Wood	5.28	5.94	-	-
Golf Course	-	30.72	-	-
Grassland	95.75	250.38	32.49	199.88
Grassland/ Shrubland	2.88	6.50	0.45	41.50
Major Watercourse	8.79	22.95	27.10	36.49
Marsh	5.60	11.17	-	-
Minor Channelised Watercourse	0.24	4.29	2.11	12.67
Minor Natural Watercourse	0.29	0.29	-	-
Mitigation Wetland	1.45	1.57	2.66	2.75
Mitigation Plantation	7.95	10.58	8.92	13.19
Orchard	2.65	8.23	6.83	11.36
Plantation	91.12	169.21	26.09	235.15
Pond	10.97	15.49	2.79	7.64
Seasonally Wet Grassland	4.22	13.06	1.21	1.76
Secondary Woodland	6.76	38.56	0.09	70.93
Shrubland	11.95	57.83	-	5.05
Urban/ Residential Area	125.56	260.50	40.71	450.89
Village Area	37.12	67.35	10.51	100.60
Waste Ground	6.58	7.43	0.65	2.64
Total	458.83	1020.23	172.43	1211.90

¹ Note that Study Areas for KTN and FLN overlap; Ng Tung and Shek Sheung Rivers are treated as the boundary between the KTN and FLN areas to avoid double-counting of areas.

² Note that in **Table 13.4** habitats which were evaluated collectively as 'Long Valley' are listed separately. The area of each habitat within Long Valley is listed in **Table 13.16**.

13.5.4 Ecological Characteristics of the Study Area

Ecological characteristics of the study area are described below based on data from relevant previous studies and surveys and survey findings from the current study. In view of the large size of the Study Area, ecological characteristics of KTN and FLN are generally described separately. This is considered appropriate as, while there are important ecological linkages between the two NDAs, there are also significant physical and ecological differences, especially in lowland habitats. In particular, the undeveloped floodplain area in KTN is much broader than FLN, where it forms a relatively narrow corridor between the developed area of Sheung Shui and Fanling and the hills to the north. In addition, while linkages are provided by the Ng Tung River corridor for birds, the developed area of Sheung Shui largely severs linkages between the area north of Fanling and lowland habitats in KTN for terrestrial fauna.

Accordingly, in the following section, floral and faunal species (found during this and in previous relevant studies) and habitats are described and evaluated, first for KTN and then for FLN. The locations of records of

flora and non-avian fauna of conservation significance (where known) are illustrated in **Figure 13.6**.

13.5.4.1 Flora

Botanical surveys were conducted, in order to verify, update and supplement findings of previous surveys and studies. During these surveys most habitats within the Study Area were found to be dominated by plant species that are common throughout Hong Kong. Full details of the vegetation present in each habitat are given in the habitat assessments (**Section 13.6**); the following is a summary of overall conditions.

A number of mature hillside plantations are present with canopies containing exotic tree species. These support a moderately diverse native understorey, but the herbaceous and woody plant species present are generally common or very common in Hong Kong. Plantation stands dominated by old, mature trees (such as *Dimocarpus longan*, *Cinnamomum camphora*, *Celtis sinensis*, *Ficus virens* var. *sublanceolata* and *Ficus microcarpa*) are common in villages and urban/residential areas. Secondary woodland, especially that at Ho Sheung Heung, and *fung shui* wood at Ho Sheung Heung supports a more diverse understorey and overstorey, with the mature overstorey dominated by *Celtis sinensis*, *Cinnamomum camphora* and *Microcos paniculata*.

Wet and dry agricultural land in Long Valley and adjoining villages is actively managed and planted with commercial crops (such as *Brassica chinensis*, *Ipomoea aquatica*, *Lactuca sativa* and *Nasturtium officinale*). Wet agricultural land also supports common wetland plant species along the vegetated bunds, but plant species diversity in the habitat is generally low.

The Study Area of the FLN NDA is bisected by the channelised Ng Tung River, with lowland grassland and mostly abandoned agricultural land along each side. Habitats within the Study Area are mostly anthropogenic, supporting common to very common plant species with limited conservation value. However, mature plantations and secondary woodland adjacent to villages north of the Ng Tung River and in the southeast of the Study Area support a richer diversity of understorey species, and these plantations and woodlands often show strong ecological linkages with the surrounding hillside grassland and shrubland habitats. A number of mature, old-growth trees (including *Ficus microcarpa*, *Celtis sinensis* and *Cinnamomum camphora*) were recorded within villages and a few mature tree individuals within the Study Area are registered Old and Valuable Trees (including *Cinnamomum camphora*, *Eucalyptus citriodora*, *Ficus microcarpa* and *Melaleuca quinquenervia*).

Flora species of conservation significance and/or protected flora species found in a wild state during the course of surveys conducted for this study

included *Aquilaria sinensis* in four areas. All specimens were saplings, with two in the *fung shui* woodland and one in the secondary woodland at Ho Sheung Heung, one in secondary woodland at Ma Tso Lung, three in secondary woodland south of Pak Shek Au and two in plantation east of Wo Hop Shek. This species is listed as globally Near Threatened and Vulnerable in China, but is common in Hong Kong. In view of the status of this species in Hong Kong and the fact that all specimens found were saplings, a significant impact on this species from the project is not predicted.

The fern *Cibotium barometz* was found alongside the Ngam Pin watercourse. This species is also listed as Vulnerable in China but is very common in Hong Kong. *Gnetum luofuense* was recorded in *fung shui* woodland at Ho Sheung Heung and secondary woodland near Siu Hang Tsuen. Despite being considered globally Near Threatened it is very common in Hong Kong. Two orchid species, *Pecteilis susannae* and *Spathoglottis pubescens* were found in plantation near Cheung Po Tau Stream, Sha Ling. Both these species are protected in Hong Kong, *Spathoglottis pubescens* is abundant and widespread in Hong Kong and was evaluated as of Least Concern in Hong Kong by Baretto *et al.* (2011). However, *Pecteilis susannae* is infrequent and restricted and was evaluated as Endangered by Baretto *et al.* (2011).

In addition, *Ailanthus fordii*, *Aquilaria sinensis* and *Pavetta hongkongensis* were recorded in *fung shui* woodland/secondary woodland at Ho Sheung Heung by Maunsell (2003) and *Aquilaria sinensis* was found east of Tong Hang Tung Chuen by Mott MacDonald (2010).

Specimens of *Rhododendron simsii* found in plantation areas are considered to be planted specimens, and are excluded from further assessment.

A list of all floral species recorded in both the KTN and FLN areas is provided in **Appendix 13.1.2** and **13.1.3**, as is a list of all protected species or those of conservation significance recorded in the Study Area during this and previous studies is provided in **Appendix 13.1.1**. The latter is summarised in **Table 13.5**, together with the areas and habitats in which they were found. Locations of flora of conservation significance and protected flora found during the course of the current and previous surveys and studies are shown in **Figure 13.6**.

Table 13.5 - Flora species of Conservation Significance, and Protected Species, recorded in an apparently wild state in the Study Area during the Current and/or Previous Studies.

Species	Conservation and Protection Status	Areas/ Habitats
<i>Ailanthus fordii</i>	Cap. 96A, Near Threatened ²	Secondary woodland at Ho Sheung Heung

Species	Conservation and Protection Status	Areas/ Habitats
<i>Aquilaria sinensis</i>	Vulnerable ¹ ; Near Threatened ² , Category II ² ;	Secondary woodland and <i>fung shui</i> woodland at Ho Sheung Heung, Ma Tso Lung, south of Pak Shek Au, east of Tong Hang Tung Chuen and plantation east of Wo Hop Shek
<i>Cibotium barometz</i>	Vulnerable ² , Category II ²	Natural watercourse at Ngam Pin
<i>Gnetum luofuense</i>	IUCN Near Threatened ¹	<i>Fung Shui</i> woodland at Ho Sheung Heung, secondary woodland near Siu Hang Tsuen
<i>Pavetta hongkongensis</i>	Cap. 96A	<i>Fung Shui</i> / Secondary woodland at Ho Sheung Heung
<i>Pecteilis susannae</i>	Cap. 96A	Plantation near Cheung Po Tau Stream, Sha Ling
<i>Spathoglottis pubescens</i>	Cap. 96A	Plantation near Cheung Po Tau Stream, Sha Ling

Notes

1. IUCN. 2013
2. South China Institute of Botany & Agriculture, Fisheries and Conservation Department 2003. *Rare and Precious Plants of Hong Kong*. AFCD, Hong Kong.

13.5.4.2 Mammals

Terrestrial Mammals

Historic records suggest that mammal diversity in the KTN area may have been higher in the past, or perhaps simply reflect the incremental accumulation of reports of low density and/or cryptic species over time. Terrestrial mammal species reported by the NENT Study in KTN (Maunsell 2003) comprised Greater Bandicoot Rat, Leopard Cat, East Asian Porcupine and Small Asian Mongoose. The population of Small Asian Mongoose in Hong Kong is not considered to be of natural origin; hence observations of this species do not meet the criteria of conservation significance followed in this study.

Camera trapping surveys carried out at Long Valley and Ho Sheung Heung in 2009/10 (Wan 2010) recorded only single individuals of both Small Indian Civet and Eurasian Wild Pig and domestic dogs and cats during camera-trapping, as well as a sighting of Greater Bandicoot Rat. Further camera-trapping surveys undertaken since 2008 in Ho Sheung Heung *fung shui* woodland and listed in the AFCD Biodiversity database also recorded Small Indian Civet and Eurasian Wild Pig and, in addition, Masked Palm Civet and Leopard Cat.

Based on interviews with local farmers at Long Valley, Hung & Pang (2008) reported the past and continued presence of East Asian Porcupine, Small-toothed Ferret Badger, Leopard Cat and Masked Palm Civet, but only the historic presence of Red Muntjac. They also stated that Greater Bandicoot Rat, East Asian Porcupine and Masked Palm

Civet are rare. Red Muntjac was, however, found in the Ma Tso Lung area in surveys conducted for the LMC Loop Study. Four species of small mammals (Musk Shrew, Roof Rat, Brown Rat and Ryukyu Mouse) were recorded from the Long Valley area in the Hong Kong biodiversity survey (Dudgeon & Corlett 2001). Of these, Ryukyu Mouse has a restricted distribution in Hong Kong, but all the other species are common and widespread (Shek 2006).

Very few terrestrial mammals were recorded during mammal surveys conducted under the present study in KTN: a single Small Asian Mongoose was observed at Long Valley and evidence of Eurasian Wild Pig activity was noted in shrubland at Crest Hill and at the edge of Ma Tso Lung marsh.

Maunsell (2003) recorded Leopard Cat in Fanling North, while Mott MacDonald (2010) recorded Leopard Cat and Eurasian Wild Pig in the Wo Hop Shek area. No terrestrial mammals are listed in the AFCD Biodiversity database for FLN. However, camera trapping surveys conducted by AFCD to the east of Kau Lung Hang recorded East Asian Porcupine, Small-toothed Ferret Badger, Red Muntjac, Masked Palm Civet, Leopard Cat, Eurasian Wild Pig and Small Indian Civet. Though these surveys appear to have been undertaken in the wooded hills beyond the Study Area limit, it seems likely that some of these species occur in the Study Area on occasion.

However, perhaps the most significant mammal observation in the FLN area is a sighting of Eurasian Otter in ponds to the east of the Ng Tung River, north of Fu Tei Au and south of Sha Ling, during surveys conducted under the FCA Study.

Evidence of two terrestrial mammal species was found during surveys in the FLN NDA Study Area: a Small Indian Civet scat was found in grassland/shrubland at Tong Hang. Small Indian Civet is a protected species in Hong Kong, but does not meet the criteria of a species of conservation significance followed in this study. In addition, a Grey Shrew, which is considered an uncommon species in Hong Kong (AFCD Biodiversity Database) was seen in a village area. No evidence (tracks, droppings etc.) was found in FLN to indicate the presence of larger mammal species.

Most terrestrial mammals in Hong Kong, especially larger species, require moderate to large areas of natural or semi-natural woodland habitats with limited human activity and an absence of physical barriers (notably major roads, river channels and settlements) to movements and dispersal. In general, more disturbed habitats can be tolerated only temporarily by mammals (e.g. at times of food shortage during the cool, dry season). Overall, therefore, given the limited cover of woodland habitats, their high degree of fragmentation, the high levels of human disturbance, and the presence of significant barriers to movement (notably highways and river channels) in the area, it is most unlikely that

significant populations of larger terrestrial mammal species are present in either NDA.

Eurasian Otter is a possible exception to the habitat constraints amongst large mammal species recorded or suspected to occur in the area, in that it is a lowland wetland open country species with a Hong Kong distribution limited to the Deep Bay area for which waterways are the primary movement and dispersal corridors. However, with only a single record of this species in the Study Area, it is apparent that its occurrence is constrained by other factors, most likely high levels of human activity.

Eurasian Otter has regularly been reported from Hoo Hok Wai (e.g. Shek (2006)). These and other records from field and questionnaire surveys were summarised for the LMC Loop Study. In view of this, it is not surprising that this wide-ranging and low density species occurs in the Study Area on occasion, (e.g. the Sha Ling record). Eurasian Otter is globally listed as Vulnerable by IUCN and as of Regional Concern by Fellowes *et al.* (2002).

Bats

Maunsell (2003), Mott MacDonald (2012) and the AFCD Biodiversity database reported the presence of Short-nosed Fruit Bat in KTN. In addition, Dudgeon & Corlett (2001) reported the suspected occurrence of Pomona Leaf-nosed Bat, in Long Valley.

At least five bat species were recorded during surveys conducted under the present study. These included Short-nosed Fruit Bat, Brown Noctule, Japanese Pipistrelle and two insectivorous bat species that could not be certainly identified based on echolocation call structure in KTN (see **Appendix 13.2**). Japanese Pipistrelle was abundant in Long Valley and other nearby wetland habitats, and one of the unidentified species was also reasonably common in these habitats.

The AFCD Biodiversity database lists Short-nosed Fruit Bat in plantation in FLN, and fieldwork for this Study also recorded that species, as well as Japanese Pipistrelle and one unidentified species.

The LMC Loop Study recorded predominantly Japanese Pipistrelle in the Loop/Hoo Hok Wai area, with very small numbers of both Brown Noctule and a further unidentified species.

The only positively identified bat species listed Maunsell (2003) which can definitely be ascribed the current Study is Short-nosed Fruit Bat. Though considered to be of conservation importance by Maunsell (2003); Short-nosed Fruit Bat is listed as Indeterminate in the CRDB, hence does not meet the criteria of conservation significance followed in the current study. This species is widely distributed, even in urban habitats, in Hong Kong, hence is of little relevance to the evaluation of habitats or potential impacts on species. Impacts on roosts, may, however, be of significance in respect to potential mortality impacts.

Other bat species listed by Maunsell (2003) were speculative; in view of the difficulty of identifying insectivorous bats in the field, these speculations are not considered further in the current study.

Maunsell (1997) stated that Japanese Pipistrelle and Lesser Yellow Bat had been recorded 'in abundance in the upper reaches of the Indus (Ng Tung) River'. It is not clear from this reference if this observation was from within the Study Area for the current project; hence it is not mapped in **Figure 13.6a**.

Accordingly, Pomona Leaf-nosed Bat and Brown Noctule are the only bat species of conservation importance known (or suspected to occur) within the KTN Study Area, but these data should be viewed on a precautionary basis in view of the difficulty of observing and identifying bats.

Appendix 13.2 lists all species recorded in or near the Study Area in this and previous studies.

Table 13.6 - Mammal Species of Conservation Significance Recorded in the Study Area during the Current and/or Previous Studies.

Species	Conservation and Protection Status	Areas/Habitats
Pomona Leaf-nosed Bat <i>Hipposideros pomona</i>	(Local Concern) ¹	Possibly present in Long valley (Dudgeon and Corlett 2001)
Brown Noctule <i>Nyctalus noctula</i>	Potential Regional Concern/(Regional Concern) ¹	Village area in KTN (Ho Sheung Heung).
Greater Bandicoot Rat <i>Bandicota indica</i>	Local Concern ¹	Long Valley
East Asian Porcupine <i>Hystrix brachyura</i>	Potential Global Concern ¹	Long Valley
Eurasian Otter <i>Lutra lutra</i>	Regional Concern ¹ , Near Threatened ² , Vulnerable ³	Single record in abandoned pond on east side of Ng Tung River near Sha Ling
Masked Palm Civet <i>Paguma larvata</i>	Potential Regional Concern ¹	Ho Sheung Heung <i>fung shui</i> wood, Long Valley
Leopard Cat <i>Prionailurus bengalensis</i>	Vulnerable ³	Ho Sheung Heung <i>fung shui</i> wood, Long Valley, Wo Hop Shek and Tong Hang Tung Chuen in plantation/secondary woodland
Red Muntjac <i>Muntiacus muntjak</i>	Potential Regional Concern ¹	Ma Tso Lung, Long Valley, but considered absent now

Note:

1. Fellowes *et al.* (2002). Letters in brackets represents the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
2. IUCN (2013)
3. China Red Data Book (Wang 1998)

13.5.4.3 Birds

Appendix 13.3 lists all 263 bird species, including 121 species of conservation significance, recorded in the Study Area in this and previous studies.

Maunsell (2003) recorded 39 species of birds at KTN, 61 at FLN and 112 at Long Valley. The high figure for the latter area reflects the diverse mosaic of habitats present, which are attractive to a broad range of species. Most of the 21 species of conservation importance identified in that study occurred in agricultural and marsh habitats at Long Valley.

Regular monitoring and other observations made in Long Valley have reported a total of 278 bird species in this area, including 93 species of conservation significance since December 2005, (HKBWS 2012 and HKBWS *in litt.*).

Surveys for the LMC Loop, the FCA, and other recent studies within or adjacent to the current Study Area did not add any relevant observations of species of conservation significance to those recorded in this study. This is perhaps largely because where the study areas for these other studies overlap with that of the current Study Area, the habitats largely comprise upland grassland, plantation, young secondary woodland and developed areas, none of which support either high densities or numbers of bird species of conservation significance (see **Figures 13.3 and 13.5**). In total, 57 wetland-dependent bird species or species of conservation significance were recorded at KTN on surveys conducted for the current study. This is a high total that reflects the ecological importance of this area, not only at Long Valley, and the diversity of habitats which are present in the NDA as a whole; of terrestrial habitats widespread in Hong Kong only large areas of mature forest are absent. Of these species, 57 species, 43 are considered to be of conservation concern in Hong Kong (Fellowes *et al.* 2002, BirdLife International 2013).

Daytime surveys at Long Valley recorded the presence of 91 bird species, including 37 species considered by Fellowes *et al.* (2002) to be of conservation concern in Hong Kong. During night-time surveys, 14 bird species were recorded, including two species not recorded on daytime surveys and nine of conservation concern. Many of the species recorded at Long Valley are considered to be wetland-dependent.

Species (and their peak counts) for which significant counts were made in Long Valley during the surveys include Little Egret (130), Eastern Cattle Egret (27), Chinese Pond Heron (43), Greater Painted-snipe (43), Black-winged Stilt (49), Little Ringed Plover (65), Wood Sandpiper (119), Common Snipe (101), Pintail/Swinhoe's Snipe (24), Bluethroat (4), Stejneger's Stonechat (14), Black-browed Reed Warbler (13), Zitting Cisticola (12), Red-throated Pipit (26), Yellow-breasted Bunting (12) and White-rumped Munia (260).

Part of the reason for the high abundance and diversity of birds at Long Valley is the diversity of the mosaic of habitats, especially wetland habitats, which are present. Further, it is considered that the relatively large area of continuous and contiguous wetland habitats at Long Valley is of relevance in this regard. This allows birds to utilise Long Valley habitats to fulfill many or all of their requirements (such as food and

shelter) within the area. For example, Greater Painted-snipe forages in shallow ponds and lightly-vegetated wet agricultural land, but is largely dependent upon heavily-vegetated wetland habitats for roosting. This benefit from the inter-relationships between habitats also extends to non-wetland habitats in the habitat mosaic. Examples of such inter-relationships include the utilisation of dry agricultural land for foraging, but marsh for roosting, by a number of passerine bird species and use of wet agricultural land for foraging, but plantation as a refugium from disturbance, by starlings. In addition, Long Valley has benefited since 2005 from habitat management for nature conservation. Much of this management has been actively directed towards improving the diversity and numbers of birds present, including by addressing the requirements discussed above.

Generally, habitats and areas in KTN NDA away from Long Valley were found to support a lower abundance and diversity of birds, especially species of conservation significance. Nevertheless, 32 wetland-dependent bird species or species of conservation significance were recorded on surveys conducted under the current study. Of these species, 25 are considered to be of conservation significance. The smaller numbers and lower diversity of wetland bird species of other wetland areas, when compared with Long Valley, is considered to be a consequence of the small size, fragmentation, lack of diversity and limited connectivity with other wetland habitats of these areas.

A partial exception to the limitations on the ecological value of wetland habitats in KTN and in FLN (with the exception of Long Valley) are the main channelised rivers. These rivers comprise large areas of wetland habitat and are physically and hydrologically linked to Long Valley. However, they are very simple and homogenous habitats and use by birds is highly constrained by these limitations and their hydrological regimes. As a consequence, they are only utilised by a limited number of bird species and only as feeding areas. Essentially, they are only used for foraging by bird species which can forage in open wetland habitats and, at least for a part of the time, by bird species which are not highly sensitive to disturbance. In addition, foraging opportunities are constrained by water depths in tidal sections and in sections where water levels are permanently high.

Thus, the tidal section of Sheung Yue River is regularly used by many of the wetland bird species present in Long Valley that are not deterred or excluded by the constraints discussed in the previous paragraph. As shown in **Appendix 13.3.13**, surveys in this channel recorded the presence of 27 wetland-dependent and wetland-associated bird species over the course of the year. The river is under tidal influence, and this impacted the number of individuals recorded; the number of individuals was generally higher during periods of low tide. Surveys were conducted during both high and low tide on each survey date to compensate for this variation in abundance. Some species were recorded in this channel in significant numbers in a Hong Kong context, notably Little Egret (peak

count 92), Little Ringed Plover (peak count 23) and Green Sandpiper (peak count 12), whereas numbers of other species were either not significant in a Hong Kong context (e.g. Grey Heron) or were not species of conservation significance.

The downstream section of the Ng Tung and Shek Sheung Rivers are also under tidal influence and are used by much the same species, albeit in smaller numbers (**Appendix 13.3.15**). The one exception was Great Cormorant, for which the downstream section of the Ng Tung River is the only area/habitat regularly used in the Study Area. Even here, however, numbers of this species are insignificant in a Hong Kong context. Eleven wetland-dependent or wetland-associated bird species were recorded on these river sections during systematic surveys conducted under the current study.

Atkins (2008) also surveyed the Shek Sheung and Sheung Yue River channels, recording low numbers of species also recorded in this study, with the exception of Pied Avocet, a flock of 44 of which was seen to fly to Long Valley. Mott MacDonald (2012) evaluated the Sheung Yue River as of moderate to low ecological importance, due to its moderate importance as a foraging wetland birds at low tide. Species noted were all found in the current study.

The Ng Tung River channel is also used as a flight corridor by birds moving between foraging and nesting and roosting locations. The Sheung Yue and Shek Sheung Rivers are largely perpendicular to such locations and are not used as corridors to a significant extent (**Figure 13.11a - b**).

Non-wetland habitats away from Long Valley are relatively little used by bird species of conservation importance; with the notable exception of Ho Sheung Heung Egret which is situated in plantation/orchard.

The absence of large areas of mature forest is reflected in the limited numbers of bird species, especially species of conservation significance associated with such habitat in the Study Area. However, some woodland species recorded in the Ho Sheung Heung *fung shui* wood, including Black-naped Monarch, Mountain Tailorbird and Two-barred Warbler are uncommon in this part of the New Territories.

Crest Hill, which contains a number of natural or semi-natural dryland habitats, including young secondary woodland, shrubland and grassland, supports a representative range of species found in such habitat in Hong Kong, but is not considered to be of conservation significance for such species with the exception of Eurasian Hobby which has bred there in the past (Carey *et al.* 2001) and was found there in summer during the current study. Golden-headed Cisticola was found in grassland there in the non-breeding season. However, this species is widespread, if thinly distributed, in upland grassland in the New Territories in winter and it is not considered that Crest Hill is of significance for this species.

While it is not certain if it has occurred in the Study Area, Eurasian Eagle Owl has been recorded in upland grassland above Chau Tau in the southeast of the Study Area.

Both the number of species and the number of species of conservation importance observed in the Study Area is very high in a Hong Kong context. While this is considered to be an accurate reflection of the importance for birds of the KTN area and Long Valley in particular, the high mobility of most species results in birds occurring relatively frequently in small numbers or on a transitory basis in habitats and localities that are atypical of the ecological requirements of the species. This, when combined with intensive survey coverage, results in a relatively high proportion (compared with other faunal groups) of bird species' records relating to observations of species that are of infrequent occurrence and/or in atypical habitats.

Long Valley receives particularly intensive bird survey coverage in a Hong Kong context (for example the HKBWS has undertaken weekly bird surveys in Long Valley since December 2005) and, in this context, the number of bird species of conservation importance recorded in Long Valley on a regular basis and/or in significant numbers is much more important than the total number of species recorded. The same point applies, to a somewhat lesser extent, elsewhere in the Study Area.

A total of 37 wetland-dependent bird species or species of conservation significance were recorded during daytime bird surveys in FLN between July 2008 and June 2009. This includes 26 species considered by Fellowes *et al.* (2002) to be of conservation significance in Hong Kong.

Among the 26 bird species of conservation significance recorded, most are wetland-dependent species. The most important area for these was the channelised Ng Tung River, although some individuals were also recorded in nearby mitigation wetlands, ponds or sometimes agricultural land. Other species of conservation concern were recorded in plantation, grassland and grassland/shrubland. Most of these species were recorded in low numbers, except Red-billed Starling, which was recorded in flocks in a variety of habitats; this species is common around lowlands in the northern New Territories.

A total of 17 wetland-associated species were recorded in the non-tidal Ng Tung River (**Appendix 13.3**). Most were in low numbers, apart from Little Egret, of which up to 43 were recorded in any one count, and Little Ringed Plover, for which the peak count was 51.

Of the 57 species for which records were collected in the Hong Biodiversity Database during 2002 to June 2012, only five species were additional to those recorded in the present study. Of these, two were of conservation significance, Striated Heron, listed as of Local Concern as a breeding species, and Chinese Penduline Tit, listed as of Regional Concern by Fellowes *et al.* (2002). The preferred habitats of Striated Heron in Hong Kong are intertidal and marsh areas especially where

there is mangrove in the breeding season and wooded streams in the winter. Chinese Penduline Tit is a reed-dependent species in Hong Kong. The habitats used by these species are either absent or of very limited presence in FLN, and neither species is likely to be present in the Study Area in significant numbers and hence are not considered of significance in the habitat evaluation and impact assessment process.

Maunsell (2003) recorded 61 species of birds at FLN. Of these, seven species (Little Egret, Chinese Pond Heron, Greater Painted-snipe, Black-winged Stilt, Pallas's Grasshopper Warbler, Zitting Cisticola and Red-billed Starling) meet the conservation significance criteria of the current study. Habitats discussed with respect to their utilisation by birds by Maunsell (2003) were: active wet agricultural land (noted as of importance for rare avifauna species including Greater Painted-snipe); inactive wet and dry agricultural land (noted being used by a number of rare avifauna species); active fishpond (noted as of importance for rare avifauna species including Greater Painted-snipe); and inactive wet and dry agricultural land (noted being used by a number of rare avifauna species).

Surveys for the Liantang/Heung Yuen Wai BCP (Mott MacDonald 2010) and other studies within the current Study Area did not add any species of conservation significance to those recorded in this Study. This is perhaps largely because where the study areas for these other studies overlap with that of the current Study Area, the habitats largely comprise upland grassland, plantation, young secondary woodland and developed areas, none of which support either high densities or numbers of bird species of conservation significance (see **Figures 13.3** and **13.5**).

However, in the Wo Hop Shek/Yuen Leng area Mott MacDonald (2010) recorded a fairly diverse suite of 56 species, including low numbers of eight wetland-dependent species (albeit some were recorded from non-wetland habitats atypical of the species), as well as shrubland birds. Given the high degree of mobility of birds and their propensity to occur in habitats not of ecological significance to the species, it is inappropriate to map the exact locality of all records of species of conservation importance, as this would give a misleading impression of the significance of the locality for the species. A more appropriate alternative is to ascribe bird observations to the habitats in which they occur on a regular basis and/or in significant numbers in the Study Area. This is presented in **Appendix 13.3.1**.

The regularly occurring bird species of conservation significance occurring in the Study Area, together with their typical habitat preferences and, where appropriate, area of occurrence, are listed in **Table 13.7**. Given the differences between the two, a distinction is made between marsh areas at Long Valley (LV) and those away from there.

A number of bird species are listed in the China CRDB which are not listed as of conservation concern under international or Hong Kong

criteria. Those species falling into this category and found in the Study Area, and the reasons why they are not considered to be of conservation significance in Hong Kong (and hence in this report) are noted below. These species are not considered further in the evaluation of habitats and impacts of the Project except where specifically referred to.

- Crested Goshawk – this species was considered to be uncommon by Carey *et al.* (2001). However, it is widespread as a breeding species in wooded habitats throughout Hong Kong and is considered to have increased as woodland has matured.
- Common Emerald Dove – this species was considered to be a scarce but widespread resident by Carey *et al.* (2001). It is found in a variety of wooded habitats including forest, forest edge, fung shui woods, small wooded groves and shrubland and was considered by Carey *et al.* (2001) to be increasing in numbers.
- Greater Coucal – this species is a common and very widespread resident in Hong Kong and occurs in a diverse range of habitats.

Table 13.7 - Bird species both of conservation significance and of regular occurrence in the Study Area and typical habitat utilisation (LV = Long Valley).

Species	Level of Concern *	Species regularly recorded in Long Valley†	Species regularly recorded away from Long Valley†	Typical habitats or areas utilised
Little Grebe <i>Tachybaptus ruficollis</i>	LC	Y	Y	ponds north of Ho Sheung Heung
Great Cormorant <i>Phalacrocorax carbo</i>	PRC	-	Y	larger watercourses
Grey Heron <i>Ardea cinerea</i>	PRC	Y	Y	larger watercourses and less disturbed ponds
Great Egret <i>Egretta alba</i>	PRC (RC)	Y	Y	larger watercourses and less disturbed ponds
Intermediate Egret <i>Egretta intermedia</i>	RC	Y	Y	less disturbed vegetated ponds and marshes
Little Egret <i>Egretta garzetta</i>	PRC (RC)	Y	Y	most wetland habitats not suffering intense disturbance
Eastern Cattle Egret <i>Bubulcus coromandus</i>	(LC)	Y	Y	less disturbed grassy and marshy areas
Chinese Pond Heron <i>Ardeola bacchus</i>	PRC (RC)	Y	Y	most wetland habitats
Black-crowned Night Heron <i>Nycticorax nycticorax</i>	(LC)	Y	Y	most open water wetland habitats; distribution unclear due to nocturnal habits
Yellow Bittern <i>Ixobrychus sinensis</i>	LC	Y	Y	densely vegetated wetland areas

Species	Level of Concern *	Species regularly recorded in Long Valley†	Species regularly recorded away from Long Valley†	Typical habitats or areas utilised
Von Schrenck's Bittern <i>Ixobrychus eurhythmus</i>	RC	Y	-	densely vegetated wetland areas, probably rare
Cinnamon Bittern <i>Ixobrychus cinnamomeus</i>	LC	Y	-	densely vegetated wetland areas
Eurasian Teal <i>Anas crecca</i>	RC	Y	Y	less disturbed pond and watercourses
Black Kite <i>Milvus migrans</i>	(RC)	Y	Y	common and widespread in all habitats
Crested Serpent Eagle <i>Spilornis cheela</i>	(LC)		Y	wooded areas, including Crest Hill
Peregrine Falcon <i>Falco peregrinus</i>	(LC)		Y	open country
Eurasian Hobby <i>Falco subbuteo</i>	(LC)	Y	Y	open country, nests at woodland edge
Japanese Quail <i>Coturnix japonicus</i>	LC NT	Y	Y	open country and grassland
Ruddy-breasted Crake <i>Porzana fusca</i>	LC	Y	Y	marsh, wet agriculture
Pheasant-tailed Jacana <i>Hydrophasianus chirurgus</i>	LC	Y	Y	pond, marsh (LV), wet agriculture
Greater Painted-snipe <i>Rostratula benghalensis</i>	LC	Y	Y	marsh, wet agriculture
Black-winged Stilt <i>Himantopus himantopus</i>	RC	Y	Y	pond, marsh (LV), wet agriculture
Pied Avocet <i>Recurvirostra avosetta</i>	RC	Y	-	pond, marsh (LV)
Oriental Pratincole <i>Glareola maldivarum</i>	LC	Y	Y	marsh (LV), wet agriculture
Pacific Golden Plover <i>Pluvialis fulva</i>	LC	Y	-	marsh, wet agriculture
Little Ringed Plover <i>Charadrius dubius</i>	(LC)	Y	Y	pond, marsh (LV), wet agriculture
Marsh Sandpiper <i>Tringa stagnatilis</i>	RC	Y	Y	pond, marsh (LV), wet agriculture
Common Greenshank <i>Tringa nebularia</i>	RC	Y	Y	pond, marsh (LV), wet agriculture
Wood Sandpiper <i>Tringa glareola</i>	LC	Y	Y	pond, marsh (LV), wet agriculture
Swinhoe's Snipe <i>Gallinago megala</i>	LC	Y	Y	pond, marsh, wet agriculture
Temminck's Stint <i>Calidris temminckii</i>	LC	Y	-	pond, marsh, wet agriculture
Long-toed Stint <i>Calidris subminuta</i>	LC	Y	-	pond, marsh, wet agriculture
Pacific Swift <i>Apus pacificus</i>	(LC)		Y	forages aerially over diverse habitats
Pied Kingfisher <i>Ceryle rudis</i>	(LC)	Y	Y	pond

Species	Level of Concern *	Species regularly recorded in Long Valley†	Species regularly recorded away from Long Valley†	Typical habitats or areas utilised
White-throated Kingfisher <i>Halcyon smyrnensis</i>	(LC)	Y	Y	pond, marsh
Citrine Wagtail <i>Motacilla citreola</i>	LC	Y	Y	pond, marsh (LV), wet agriculture
Red-throated Pipit <i>Anthus cervinus</i>	LC	Y	Y	pond, marsh (LV), wet and dry agriculture
Pechora Pipit <i>Anthus gustavi</i>	LC	Y	-	pond, marsh (LV), wet agriculture
Buff-bellied Pipit <i>Anthus rubescens</i>	LC	Y	-	pond, marsh (LV), wet and dry agriculture
Bluethroat <i>Luscinia svecica</i>	LC	Y	-	marsh, wet agriculture (LV)
Brown-headed Thrush <i>Turdus chrysolaus</i>	LC	-	Y	wooded areas
Pallas's Grasshopper Warbler <i>Locustella certhiola</i>	LC	Y	Y	marsh, wet agriculture
Zitting Cisticola <i>Cisticola juncidis</i>	LC	Y	Y	marsh (LV), dry agriculture
Golden-headed Cisticola <i>Cisticola exilis</i>	LC	Y	Y	marsh (LV), dry agriculture, upland grassland
Chestnut-eared Bunting <i>Emberiza fucata</i>	LC	Y	Y	marsh (LV), dry agriculture
Yellow-breasted Bunting <i>Emberiza aureola</i>	RC VU	Y	Y	marsh (LV), dry agriculture
Japanese Yellow Bunting <i>Emberiza sulphurata</i>	GC VU	Y	-	marsh (LV), dry agriculture
Grey-capped Greenfinch <i>Carduelis sinica</i>	LC	-	Y	open, parkland-type habitats
Chinese Grosbeak <i>Eophona migratoria</i>	LC	-Y	Y	diverse wooded areas
Red-billed Starling* <i>Sturnus sericeus</i>	GC	Y	Y	pond, marsh, wet agriculture
White-shouldered Starling <i>Sturnus sinensis</i>	(LC)	Y	Y	diverse open country areas, wooded areas; apparently restricted to anthropogenic habitats as a breeding species in Hong Kong where it nests in man-made structures.
Black-naped Oriole <i>Oriolus chinensis</i>	LC	-	Y	wooded areas
Collared Crow <i>Corvus torquatus</i>	LC NT	Y	Y	pond, watercourses both natural and channelised

† Species recorded are noted as regularly recorded at Long Valley or away from Long Valley (Y indicates recorded, - indicates not recorded) based on field surveys for this study, Carey *et al.* (2001), other

observations by the Study Team and other studies (Monitoring of priority site by AFCD; Surveys of Long Valley by HKBWS; Sheung Shui to Lok Ma Chau Spur Line EIA).

* Level of Concern generally follows Fellowes *et al.* (2002): LC – Local Concern, RC – Regional Concern, PRC Potential Regional Concern, GC – Global Concern, PGC – Potential Global Concern. Letters in parentheses indicate the assessment is based on breeding and/or roosting sites rather than general occurrence. Level of Concern given in bold refers to global population assessment by BirdLife International: NT – Near-threatened, VU – Vulnerable, EN – Endangered, CR – Critically Endangered.

13.5.4.4 Ho Sheung Heung Egret

As described in **Section 13.3**, there is an important egret at Ho Sheung Heung, located in orchard and plantation. Flight-lines linking this egret were surveyed during the current study and are described in this section.

The major flight-lines observed from the egret are shown in **Figure 13.7**, showing the proportion of individuals (of all species) recorded following each route. To the south of the egret, major flight-lines were observed over the Lo Wu Correctional Institution towards the KTN NDA (Flight-line 1), towards Long Valley (Flight-lines 2 and 3), along the Shek Sheung River (Flight-line 4) and along the Ng Tung River towards the FLN NDA (Flight-line 5). To the north of the egret, most birds were observed following the line of hills (Flight-line 6) or the Ng Tung River (Flight-line 7) towards Hoo Hok Wai, or crossing the river towards an area of ponds and wet agriculture opposite the egret (Flight-line 8).

A total of 785 flights were observed during the surveys, including 298 Little Egret, 225 Eastern Cattle Egret and 262 Chinese Pond Heron. Overall, 58.3% of flights were to the south of the egret (towards Long Valley, the Shek Sheung River or the Ng Tung River), while 28.5% were towards the north (towards Hoo Hok Wai or the Shenzhen River) and 13.2% were over the Ng Tung River towards the east. With regard to flight-lines to the south, 40.4% (of the overall total) were oriented toward Long Valley, while 12.4% were along the Ng Tung River. The Lo Wu Correctional Institution was under construction at the time of surveys, and thus it is possible that the relative importance of the Long Valley-oriented flight-lines might have been impacted. However, in flight-line surveys carried out after construction for *PLNQ 73/2011 Ecological Field Survey of Hoo Hok Wai* commissioned by the Planning Department, 45% of birds were recorded flying from the egret toward Long Valley in June 2012, suggesting there was minimal impact. With regard to the latter study, in total, 56.6% of birds were recorded flying in a southerly direction, 7.5% were recorded flying east towards Sha Ling and 35.9% were recorded flying north towards Hoo Hok Wai. Birds flying towards the north and east would not be affected by proposed developments in the NDA.

Behaviour differed between different species. Approximately 58% of Little Egrets were observed flying south, many of which flew close to the Lo Wu Correctional Institution or followed the tidal section of the Ng Tung River. The majority of Eastern Cattle Egrets (74%) also flew towards the south, mostly between the Lo Wu Correctional Institution and the Shek Sheung River. Slightly larger numbers of Chinese Pond Herons were observed to fly north rather than south (45% flying south); of the birds

flying south, many followed the Shek Sheung River or flew close to the Lo Wu Correctional Institution.

The height of birds flying towards the south was recorded. As shown in **Table 13.8**, most birds heading south were less than 20m above the ground (17% below 10m, 62% between 10 and 20m). This was particularly true for flight-lines heading towards Long Valley, the Shek Sheung River or the FLN NDA (Flight-lines 2, 3, 4 and 5). These birds were constrained by the presence of overhead wires, which presented an obstacle to flying birds. Several individuals approaching at a similar height to the wires were seen to make manoeuvres to avoid collisions, either by returning to the egretty or changing flight height. Most of the birds flying along the line of hills to the west of the Lo Wu Correctional Institution (Flight-line 1) were higher than the wires, but this represented a relatively small proportion of individuals. Whilst the wires posed an obstacle, the birds showed no avoidance of the bridge over the Ng Tung River, which was overflowed by birds using Flight-line 5, indicating that they were habituated to this relatively low horizontal structure.

Table 13.8 - Heights of birds (all species) leaving Ho Sheung Heung Egretty along flight-lines towards the south (values are % of birds on each flight-line within the given height range)

Height (m)	Flight-line*					Overall
	1	2	3	4	5	
0-10	0	6	10	51	3	17
10-20	5	75	80	44	71	62
20-30	2	6	5	3	5	5
30-40	7	10	5	2	11	7
40-50	14	3	0	0	8	3
50-60	9	0	0	0	0	1
60+	64	0	0	0	3	6

* Flight-line 1: over Lo Wu Correctional Institution (LWCI), Flight-line 2: between LWCI and pylon, Flight-line 3: between pylon and Ng Tung River, Flight-line 4: S along Ng Tung River/Shek Sheung River, Flight-line 5: W along Ng Tung River.

To the south of the Ho Sheung Heung Egretty, flight path routes are significantly impacted by the presence of the Lo Wu Correctional Institution which is 13m in height (at the time of the flight-line surveys when construction work was underway, impact may have been more pronounced) and a nearby pylon approximately 45m in height. Approximately 19% of birds were observed flying between these two obstacles (Flight-line 2). The height of flight-lines was also constrained by obstacles in the area. Electric wires apparently presented an obstacle to birds flying south towards the NDA, and most birds were observed flying underneath these cables (less than 20m). Birds on Flight-line 1 were at a higher altitude over the Lo Wu Correctional Institution.

Transect surveys conducted at KTN NDA between April and July 2009 (the peak breeding period for ardeids in Hong Kong) indicated that Long Valley is an important foraging area for all three of the species breeding at Ho Sheung Heung (**Table 13.9**). The Sheung Yue River is also

important for foraging Little Egrets, especially during low tide periods. Wet agriculture north of Long Valley was also shown to be important for foraging Eastern Cattle Egrets during the breeding season. These findings broadly support the observations during the flight-line counts at the Ho Sheung Heung Egretty.

Table 13.9 - Distribution of ardeid species breeding at Ho Sheung Heung during the 2009 breeding season (April – July)

Species	Peak Count in Long Valley	Peak Count in Sheung Yue River	Peak Count elsewhere in Kwu Tung North
Little Egret	39	66	12
Eastern Cattle Egret	13	0	14
Chinese Pond Heron	12	5	5

13.5.4.5 Man Kam To Road Egretty

The Man Kam To Road Egretty was discovered on 19th June 2009. Nests are located in a patch of bamboo to the east of Man Kam To Road, north of the Ng Tung River (within the boundary of the FLN NDA). Due to the proximity of the two sites, and the similarity of foraging areas, it is thought that this egretty may be derived from birds which formerly bred at Ho Sheung Heung, where the population of Chinese Pond Herons has declined in recent years (Anon 2009). Surveys in 2009 recorded up to 15 nests of Chinese Pond Heron (Anon 2009), representing approximately 5% of the population of this species in Hong Kong. Numbers have increased slightly subsequently, with 21 nests of Chinese Pond Heron and six nests of Little Egret recorded in 2012 (Anon 2012b)

Two flight-line surveys were conducted at the egretty in late June and early July 2009 and three flight-line surveys were conducted from May to July 2011 to help investigate the potential indirect impacts to the egretty. In total, 238 observations of Chinese Pond Herons and 20 of Little Egrets leaving the egretty were made during these five surveys. As shown in **Figure 13.8**, most birds flew towards the south-west, either following the Ng Tung River (46.4% of birds) or directly over the developed land (sewage treatment works and slaughterhouse) to the south-west (21.0% of birds). These birds were most likely heading towards foraging sites in Long Valley or nearby channels. A moderate proportion of birds (13.5%) flew east along the Ng Tung River, presumably to foraging sites in the river, mitigation meanders or nearby agricultural land. Few birds flew to sites north of the river or south-east from the egretty.

In contrast to flight-lines from the Ho Sheung Heung Egretty, there was no difference in the height of most flight-lines, with birds flying from the egretty at nest or bamboo height (i.e. 5 – 7m); this was presumably due to the absence of any obstructions at or near the egretty which necessitated birds gaining or losing height and the level topography of

the egret site. Neither vehicles on the Man Kam To Road and on the bridge over the Ng Tung River, nor the bridge itself, appeared to pose any obstruction or cause birds to deviate from a direct line from the egret, at least as far as the flight-lines were visible from the observation point. There was, however, some indication that birds using Flight-line 3 were gaining altitude gently as they flew further away from the egret, perhaps in order to clear the Shek Wu Hui Sewage Treatment Works. This was not quantified due to the difficulty in estimating the height above the ground of birds seen at a relatively low height relative to their horizontal distance from the observer.

An exception to similar height above the ground of flight-lines was Flight-line 5 (along the Ng Tung River to the east): birds following this flight-line lost height once they were over the river then continued along the river at a low level, either at or below the level of the channel sides. Clearance of nesting substrate and a decline in occupancy from 23 nests in June 2012 to five in July 2012 was noted. Despite these changes to the site, nine nests of Chinese Pond Herons were present in April 2013. Ho Sheung Heung was also re-occupied in April 2013.

It is not unusual for the location of egrets to change in Hong Kong. For instance, during the period from 2007 to 2013, twelve egrets were abandoned and seven new egrets were found. Up to four egrets were abandoned (in 2013) and up to three egrets were found (in 2011) in any one year during this period. In addition to egrets being founded and abandoned, it is also not unusual for egret sites to move a short distance, either entirely or partially (Anon 2007, 2008a, 2009, 2011, 2012a, 2012b). The distinction between an egret being abandoned and one moving a short distance followed by Anon (2007, 2008a, 2009, 2011, 2012a, 2012b) is 500m, representing the usual minimum foraging range of a colony.

Accordingly, the possibility that either or both of the Ho Sheung Heung and Man Kam To Egrets might be abandoned, or their locations might change, or that entirely new egrets might be established in the Study Area within the project period of the NDA development must be considered in the evaluation of potential impacts of the project. Consideration should also be given to the need to check for the presence of egrets prior to the commencement of construction activities in areas which are suitable as egret locations. Suitable locations are lowland areas within 500m of wetlands with trees and bamboos available as nesting habitat. Such areas may include developed and village areas as well as more natural habitats. Consideration must also be given to the requirement to implement additional mitigation measures to address impacts on any new egrets, egret flight-lines and foraging areas.

In this regard, it should be noted that whereas it is relatively rare for an egret site to be abandoned for an entire breeding season and then re-occupied in subsequent years (Young and Cha 1995, Carey *et al.* 2001) this has happened on at least three occasions in the last ten years.

Accordingly, abandonment for a single season should not be seen as confirmation that a site has been abandoned temporarily; a site may be re-occupied if, for example, a source of disturbance which caused abandonment is no longer present in a subsequent breeding season.

13.5.4.6 Reptiles

Appendix 13.4 provides a summary of records from this and previous studies, and details of data collected during field surveys for this study.

Only four species of reptile were recorded in KTN by Maunsell (2003), three by Mott MacDonald (2012), while 15 are listed in the AFCD Biodiversity database and 23 species were reported for Long Valley by Hung and Pang (2008) and Wan (2010).

A total of 14 reptile species were recorded in the KTN NDA during surveys conducted under the current study of which four are considered to be of conservation significance (see **Appendix 13.4**). These comprised a dead Indo-Chinese Rat Snake found in the channelised Ho Sheung Heung Watercourse, a Banded Krait found near a pond to the east of Ho Sheung Heung village, a Chinese Soft-shelled Turtle recorded along the edge of the Ng Tung River and, of greatest significance, a Three-banded Box Terrapin in a stream at Ma Tso Lung, in the north-west of the KTN NDA (note that this is not mapped in Figure 13.6 for reasons of wildlife protection).

Hong Kong may be one of the last sites globally to support wild populations of Three-banded Box Terrapin (KFBG 2009), which favour clean streams but also wander into adjacent habitats, especially riparian woodland, and can be found several hundred metres from streams (Karsen *et al.* 1998, Paul Crow pers. comm.). Parts of the Ma Tso Lung Stream are of low water quality, but the section in which the terrapin was recorded is relatively clean and is bordered by riparian woodland and plantation. All reptiles of conservation significance recorded in this and previous studies are listed in **Table 13.10**, together with the various conservation status listings and areas/habitats where these species were found. In this regard, Indo-chinese Rat Snake is not listed from Ho Sheung Heung Watercourse in this table, as listing of a dead specimen from an unsuitable habitat is considered unrepresentative and potentially misleading.

Two areas in KTN are of significance for reptiles of conservation importance: the Long Valley and Ma Tso Lung areas. Whilst the number of observations in Long Valley is no doubt partly a consequence of the relatively intense survey effort there, it is also likely that the combination of open wetland and dryland habitats leads to food (amphibians, rodents and small birds) for snakes being relatively abundant.

The significance of Ma Tso Lung is likely to be a consequence of the mix of habitats and limited human activity. Habitat linkages between wetland habitats, especially the relatively unpolluted Ma Tso Lung Stream with

woodland cover and Ma Tso Lung marsh, are likely to be important in maintaining reptile populations in KT.

In FLN, two species were recorded by Maunsell (2003), including Chinese Cobra in active agricultural land in FLN, while ten were reported by the AFCD Biodiversity database. During fieldwork for this study, eleven reptile species were recorded during surveys (**Appendix 13.4**). All species recorded are common and widespread in Hong Kong (Karsen *et al.* 1998).

A total of 16 species have been recorded in FLN by this and previous studies (**Appendix 13.4**), of which Burmese Python and Indo-chinese *Ptyas korros* and Common Rat Snakes are of conservation significance; the latter two were recorded in FLN during this study. The location of the first of these observations is unknown, but Common Rat Snake was found in mitigation woodland on the north side of the Ng Tung River and in the riparian zone of the Kau Lung Hang Streams. The locations of all records of species of conservation significance are mapped (where known) in **Figure 13.6**.

Of the species of reptile that have been recorded in or near the Study Area during this and previous studies (see **Appendix 13.4**), those that are assessed as of conservation significance by one or more authorities are listed in **Table 13.10** together with the habitats or areas in which they are present in the Study Area.

Table 13.10 - Reptile Species of Conservation Significance Recorded in the Study Area during the Current and Previous Studies.

Species	Conservation and Protection Status	Areas/Habitats
Reeve's Terrapin <i>Scincella reevesii</i>	Global Concern ¹ , Endangered ² , Conservation Dependant ³ .	Long Valley.
Three-banded Box Terrapin <i>Cuora trifasciata</i>	Global Concern ¹ , Critically Endangered ^{2,3} .	Stream and wooded riparian zone at Ma Tso Lung (single record).
Chinese Soft-shelled Turtle <i>Mauremys mutica</i>	Global Concern ¹ , Vulnerable ^{2,3} .	Ng Tung River and adjacent wetland areas including Long Valley.
Tokay Gecko <i>Gekko gekko</i>	Regional Concern ³ , Endangered ⁵ .	Long Valley, but doubt over origins.
Common Water Monitor <i>Varanus salvator</i>	Regional Concern ¹ , Critically Endangered ³ .	Occasionally in Long Valley, though wild population now presumed extinct.
Five-striped Blue-tailed Skink <i>Plestiodon elegans</i>	Local Concern ¹	Ma Shi Po area, FLN (habitat uncertain, an anecdotal report by local naturalists).
Indian Forest Skink <i>Sphenomorphus indicus</i>	Local Concern ¹ .	Tong Hang Tung Chuen, FLN, wooded habitats.

Species	Conservation and Protection Status	Areas/Habitats
Burmese Python <i>Python bivittatus</i>	Potential Regional Concern ¹ , Vulnerable ² , Critically Endangered ³ .	Long Valley and Fanling North area; occurs in variety of open country habitats.
Buff-striped Keelback <i>Amphiesma stolatum</i>	Local Concern ¹ .	Long Valley, Ma Shi Po area, FLN (anecdotal report by local naturalists).
Copperhead Racer <i>Elaphe radiata</i>	Potential Regional Concern ¹ , Endangered ³ .	Secondary woodland near Tong Hang Tung Cheun in FLN,
Indo-Chinese Rat Snake <i>Ptyas korros</i>	Potential Regional Concern ¹ , Endangered ³ .	Mitigation plantation on the north side of the Ng Tung River and near Kau Lung Hang Stream in FLN, found in diverse open country habitats, widespread in HK.
Common Rat Snake <i>Ptyas mucosus</i>	Potential Regional Concern ³ , Endangered ⁵ .	Diverse open country habitats, widespread in HK, including Ma Tso Lung,
Banded Krait <i>Bungarus fasciatus</i>	Regional Concern ¹ , Endangered ³ .	Lowland wetland habitats, fairly widespread in HK.
Many-banded Krait <i>Bungarus multicinctus</i>	Potential Regional Concern ¹ , Vulnerable ³ .	Long Valley.
Chinese Cobra <i>Naja atra</i>	Potential Regional Concern ¹ , Vulnerable ³ .	Long Valley, Ma Tso Lung, agricultural land in FLN (Maunsell 2003).
King Cobra <i>Ophiophagus hannah</i>	Appendix II CITES ² , Potential Regional Concern ¹ , Vulnerable ² , Critically Endangered ³ .	Long Valley.

Notes

1. Fellowes *et al.* (2002)
2. IUCN (2013)
3. China Red Data Book (Zhao 1998)

13.5.4.7 Amphibians

Maunsell (2003) recorded nine species of amphibians, of which Chinese Bullfrog is of conservation significance; no amphibian species of conservation significance were recorded in KTN by Mott MacDonald (2012). The AFCD database for KTN and FLN recorded the same range of species plus Butler's Pigmy Frog and, at KTN, Greenhouse Frog; the latter is an invasive, exotic species. Surveys as part of the MAs for Long Valley and Ho Sheung Heung have recorded 12 species (Hung and Pang 2008), including two not recorded elsewhere in the Study Area: Three-striped Grass Frog and Two-striped Grass Frog, the latter of which is of conservation significance. There is, therefore, broad consistency in historical data regarding the amphibian community in lowland wetlands in the Study Area (see **Appendix 13.5**).

Ten amphibian species were recorded in KTN during surveys conducted under the current study. The abundance and diversity of amphibians was highest in wet agriculture, and ponds, especially around Long Valley (see **Appendix 13.5**). The only species of conservation importance recorded,

Chinese Bullfrog, was recorded in a variety of habitats in KTN NDA, in small numbers, including in village habitat; however, individuals in such habitat may relate to ex-captive individuals. Although of conservation significance, this species is regarded as common in Hong Kong.

Maunsell (2003) recorded four species in FLN, including Chinese Bullfrog, which is also reported for the area in the AFCD Biodiversity database for 2002-12, as well as another nine common and widespread species.

Ten amphibian species were recorded during initial surveys for this study in FLN, matching exactly the species reported in the AFCD Biodiversity database. The highest diversity of species was recorded in wet and dry agricultural land, with rather few in natural and channelised stream courses. The moderate numbers of vocalizing amphibians in wet agricultural land suggest that this habitat may be of some importance as a breeding and nursery ground for amphibian species. The species present included Chinese Bullfrog, which was found to be relatively abundant in riparian plantation and grassland at Kan Lung Tsuen (northeast of Leung Yeuk Tau) and in agricultural land at Siu Hang San Tsuen. Spotted Narrow-mouthed Frog was particularly abundant in seasonally wet grassland. The latter species is not regarded as a species of conservation significance, however.

Two further species of conservation significance were recorded in the Study Area in wet season 2013, both in plantation habitat near Wo Hop Shek Cemetery, in the southeast of FLN. These were Lesser Spiny Frog and Brown Wood Frog.

Very similar patterns of occurrence were recorded by previous studies, (**Appendix 13.5**) though Hyder (2008) recorded Short-legged Toad in the Wo Hop Shek area in plantation or secondary woodland, either within or just outside the Study area for the current project; this species is listed as Endangered by IUCN and of Potential Global Concern by Fellowes *et al.* (2002). Thus, three anuran species of conservation significance, two of which (Brown Wood Frog and Short-legged Toad) are woodland-dependant, have been found in woodland near Wo Hop Shek Crematorium, suggesting that this area may be of some significance for anuran species.

Table 13.11 lists amphibians of conservation significance that have been recorded in the Study Area.

Table 13.11 - Amphibian Species of Conservation Significance Recorded in the Study Area during the Current and Previous Studies.

Species	Conservation and Protection Status	Areas/ Habitats
---------	------------------------------------	-----------------

Species	Conservation and Protection Status	Areas/ Habitats
Short-legged Toad <i>Xenophrys brachykolos</i>	Potential Global Concern ¹ , Endangered ² .	Plantation/secondary woodland near Wo Hop Shek Crematorium, possibly in Study Area.
Chinese Bullfrog <i>Hoplobatrachus chinensis</i>	Potential Regional Concern ¹ .	Variety of agricultural and marsh habitats in Study Area, including irrigation ponds in dry agriculture, and at Ma Tso Lung.
Lesser Spiny Frog <i>Paa exilispinosa</i>	Potential Global Concern ¹ , Vulnerable ²	Plantation habitat near Wo Hop Shek Crematorium.
Brown Wood Frog <i>Rana latouchii</i>	Local Concern ¹	Plantation habitat near Wo Hop Shek Crematorium.
Two-striped Grass Frog <i>Rana taipehensis</i>	Local Concern ¹	Long Valley though scarce.

Notes

1. Fellowes *et al.* (2002)
2. IUCN (2013)

13.5.4.8 Fish

All species recorded in or near the Study Area are listed in **Appendix 13.6**, while those of conservation significance recorded in this or previous studies are listed in Table **13.12**.

The current study recorded nine species in KTN, of which those native to Hong Kong are Goldfish, Chinese Barb and Swampy Eel. The only species of potential conservation importance was Climbing Perch, up to five individuals of which were recorded in natural and channelised stream habitats. Climbing Perch appears to have colonised Hong Kong recently; the species is native to South China but it is unclear whether the colonisation of Hong Kong has occurred naturally or by human introduction. In view of uncertainty regarding the conservation status of this species in China and the fact it is regarded as 'Data Deficient' by IUCN, it is not treated here as a species of conservation significance.

The native species were recorded from natural streams; this suggests these streams are relatively clean, but these fish communities have been influenced by the introduction of exotic species.

Common aquaculture species were observed in fish ponds in the KTN NDA, including Grass Carp and Nile Tilapia; these are not considered to be of ecological importance. Previous studies have recorded Common Carp in KTN (AFCD HK Biodiversity database). These are not considered to refer to naturally-occurring individuals, and thus the species is not regarded as of conservation importance. In addition, Small Snakehead was recorded in the Ma Tso Lung San Tsuen Stream during field surveys for the LMC Loop Study.

Fish surveys in FLN for the current study recorded twelve species, several of which are not native to Hong Kong. The native species recorded were *Acrossocheilus parallens*, Predaceous Chub, Freshwater Minnow, Oriental Weatherfish, White-spotted Walking Catfish, Freshwater Goby and Barcheek Goby. The first of these, *Acrossocheilus parallens*, listed as of Global Concern by Fellowes *et al.* (2002), was recorded in the Kau Lung Hang Stream; while Predaceous Chub, listed as Vulnerable in the CRDB, was found in an upstream section of the Siu Hang San Tsuen Stream.

Most streams in the area are heavily impacted by human activity and are unlikely to support significant populations of stream-dependent fauna (including fish), especially species of conservation importance. Fish diversity observed in the stream at Siu Hang San Tsuen was relatively high, however and also included one species of conservation significance, as is noted above.

Common Carp and Small Snakehead were reported in the Ma Wat River by Mott MacDonald (2010); however, the first of these had most probably been introduced by human activity to the watercourse concerned; both of these records are believed to refer to the AFCD Biodiversity Database records discussed below. Biodiversity Database records collected by AFCD during 2002 to June 2012 recorded an additional seven species of fish (**Appendix 13.6.1**), none of which meet the criteria of conservation significance followed in this study; Broken-band Hillstream Loach, listed as Data Deficient by IUCN (2013) is widespread in Hong Kong and is considered to be common (AFCD Biodiversity Database).

Both of the species of conservation significance listed in the Biodiversity Database, *Acrossocheilus parallens* and Small Snakehead, were reported by this or other studies. However, the Biodiversity Database records provide a fuller picture of the distribution of these species in the Study Area: *Acrossocheilus parallens* has been found in many locations in the Kau Lung Hang Lo Wai Watercourse, the Kau Lung Hang San Wai Watercourse, the Ma Wat River south of Nam Wa Po and at the confluence of the Ma Wat River and the Tai Wo Watercourse; while Small Snakehead has been recorded from the Kau Lung Hang Lo Wai Watercourse, at the confluence of the Ma Wat River and the Tai Wo Watercourse and in an upstream location in the Tai Wo Watercourse.

Table 13.12 - Fish Species of Conservation Significance Recorded in the Study Area during the Current and Previous Studies.

Species	Conservation Status	Areas/ Habitats
<i>Acrossocheilus parallens</i>	Global Concern ¹	Channelised and natural streams in the Kau Lung Hang Streams EIS (including a section of the Ma Wat River).
Predaceous Chub <i>Parazacco spilurus</i>	Data Deficient ² , Vulnerable ³	Channelised stream with banks and bed of natural materials and of good water quality at Siu Hang San Tsuen.

Species	Conservation Status	Areas/ Habitats
Small Snakehead <i>Channa asiatica</i>	Local Concern ¹ .	Channelised and natural streams in the Kau Lung Hang Streams EIS (including a section of the Ma Wat River) and in Ma Tso Lung San Tsuen Stream.

Notes

1. Fellowes *et al.* (2002).
2. IUCN (2009).
3. China Red Data Book (Wang 1998).

13.5.4.9 Butterflies

Surveys carried out in the early 1990s in the KTN area by M. Bascombe recorded a total of 110 butterfly species within the Study Area (Maunsell 1997, Dudgeon & Corlett 2001, Maunsell 2003) (see **Appendix 13.7.1**). Species recorded by Bascombe that have not been recorded in field surveys for the current study or in surveys conducted under other subsequent studies are listed in **Appendix 13.7.13**. Further, only 36 butterfly species were recorded by the NENT Study in KTN (Maunsell 2003), and it was suggested in that study that habitat had been lost for many of the species recorded previously by Bascombe. However, it should be noted that Maunsell (2003) appears to have wrongly attributed a number of Bascombe's records to the NENT Study Area including two species of conservation significance, Vagrant and Common Birdwing, not otherwise known from the current Study Area. The lack of recent records suggests that some of these species may, indeed, have been lost from the area. Based on **Appendix 13.7.13**, the habitats potentially affected are bamboo groves and woodland or woodland edge areas.

A relatively high total of 86 butterfly species was recorded for KTN in surveys for this study, including seven species (including one identified as *Potanthus* sp. of Local Concern (Fellowes *et al.* 2002) (**Table 13.13**). Shrubland and *fung shui* woodland around Crest Hill and Ho Sheung Heung were found to be of particularly diverse (**Appendix 13.7.2**), though *Potanthus* sp. and Danaid Egg-fly were the only species of conservation significance found in these habitats in this study.

Field work for the LMC Loop study recorded 52 species in the lowland mix of marsh, seasonally wet grassland, village edge, woodland, shrubland and grassland at Ma Tso Lung in the north of the Study Area or in adjacent areas. Findings from this and other surveys in this area included four species of conservation significance: Pale Palm Dart, Spotted Angle (from two locations), Danaid Egg-fly and Small Three-ring (also from two locations). All of these species were recorded in open country habitats, either in hillside grassland or in wet grassland in and around Ma Tso Lung marsh. The presence of these four species of conservation importance, together with the diversity of species present, suggests that the mix of habitats in this area combine to make it relatively significant for butterflies.

Although there may have been some long-term loss in butterfly habitat, the butterfly community in the KTN NDA area remains diverse. This is supported by findings from AFCD surveys, which have recorded 57 species in KTN, 11 of which are additional to those recorded in the present study, albeit none of these are of conservation significance. This diversity is associated largely with the woodland and shrubland habitats around Ho Sheung Heung and Crest Hill, which support species that are uncommon in the northwest New Territories. These habitats may be important for the recolonisation and spread of butterfly species as woodland matures.

In FLN a total of 52 butterfly species (including one unidentified swift) were recorded within the Study Area during faunal surveys for this study (**Appendix 13.7.3**). This is a relatively low total, and suggests that habitats around the FLN NDA are of relatively lower quality for butterflies, probably due to a relatively low diversity of larval food plant species. Two butterfly species recorded are of Local Concern in Hong Kong (Pale Palm Dart and Commander).

Of 15 additional species listed in the AFCD Biodiversity Database from the FLN during the period from 2002 to June 2012, none are of conservation significance. None of the 26 species recorded in this area by Maunsell (2003) were of conservation significance.

Butterfly species of conservation significance recorded in the Study Area during the current and previous studies are listed in **Table 13.13**. *Potanthus* sp. is not included in this table, as a certainly identified *Potanthus*, Common Dart *P. pseudomaesa*, is listed. Species status in Hong Kong as defined by Chan *et al.* (2011) is listed in **Table 13.13** and **Appendix 13.7.2** to **13.7.13**, has been given due consideration, but has not been used as a primary criterion for determining conservation significance in **Table 13.13** and hence has not been utilised in the evaluation of habitats or assessment of impacts, except where stated.

**Table 13.13 - Butterfly Species of Conservation Significance
Recorded in the Study Area during the Current and Previous Studies.**

Species	Conservation Status / Rarity	Areas/ Habitats
Dark Brown Ace <i>Halpe porus</i>	Local Concern ¹ , Very Rare ²	Ho Sheung Heung and Tsung Pak Long (Bascombe)/ Bamboo groves.
Common Dart <i>Potanthus pseudomaesa</i>	Local Concern ¹ , Rare ² .	Ho Sheung Heung (Bascombe)/ Abandoned agricultural lands, grassland.
Hainan Palm Dart <i>Telicota besta</i>	Local Concern ¹ , Very Rare ² .	Lo Wu area (Bascombe)/ Abandoned exposed grassland, shrubland.
Pale Palm Dart <i>Telicota colon</i>	Local Concern ¹ , Rare ² .	Edge of marsh at Ma Tso Lung, waste ground near Ma Wat Tsuen, in FLN/ abandoned agricultural land, grassland.
Spotted Angle <i>Caprona alida</i>	Local Concern ¹ , Very Rare ²	Ma Tso Lung/ Grassland.
Lesser Forest Blue <i>Taraka hamada</i>	Local Concern ¹ , Rare ²	Tsung Pak Long (Bascombe)/ Bamboo groves.

Species	Conservation Status / Rarity	Areas/ Habitats
Pale Hedge Blue <i>Udara dilecta</i>	Local Concern ¹ , Very Rare ²	Dry agriculture at Long Valley.
Brown Onyx <i>Horaga albimacula</i>	Local Concern ¹ , Very Rare ²	Tsung Pak Long and Ho Sheung Heung (Bascombe)/ Forest.
Peacock Royal <i>Tajuria cippus</i>	Local Concern ¹ , Rare ²	Plantation near Fung Kong Shan in KTN and secondary woodland near Tong Hang Tung Chuen, FLN.
Common Pierrot <i>Castalius rosimon</i>	Local Concern ¹ , No verified sightings in recent years ²	Ho Sheung Heung, Tsung Pak Long and near Lo Wu (Bascombe)/ Coastal shrubland, wasteland.
Danaid Egg-fly <i>Hypolimnas misippus</i>	Local Concern ¹ , Uncommon ²	Wet agriculture in Long Valley, hillside grassland at Ma Tso Lung, shrubland at Crest Hill in KTN.
Commander <i>Moduza procris</i>	Local Concern ¹ , Very Rare ²	Channelised watercourse in Long Valley, dry agriculture near Ma Shi Po in FLN.
Painted Lady <i>Vanessa cardui</i>	Local Concern ¹ , Rare ² , non-breeding migrant in Hong Kong.	Wet agriculture in Long Valley.
Small Three-ring <i>Ypthima norma</i>	Local Concern ¹ , Very Rare ²	Crest Hill and Ma Tso Lung areas/ upland grassland on hillsides and seasonally wet grassland.
Small Grass Yellow <i>Eurema brigitta</i>	Local Concern ¹ , Rare ²	Ho Sheung Heung (Bascombe)/ Shrubland, abandoned agricultural lands.

Notes

1. Fellowes *et al.* (2002).
2. Chan *et al.* (2011).

13.5.4.10 Dragonflies

A total of 30 odonate species were recorded on surveys in KTN for this study. Only two species of conservation interest were recorded, both of which are listed by Fellowes *et al.* (2002) as of Local Concern. The first was Scarlet Basker (also recorded in the area by Mott MacDonald (2012)), which has, however, increased in recent years and is now relatively common in lowland areas in Hong Kong, especially around fish ponds (Wilson 2004). The second was Ruby Darter, which is also now considered to be common in Hong Kong.

Only one odonate species, Common Evening Hawker, was recorded for the area in the HKU biodiversity database (Dudgeon & Corlett 2001). This species is usually active during the evening and can be difficult to record during the day; it is likely to still be present in the area, despite not being recorded during surveys for this study.

The AFCD Biodiversity Database lists 34 dragonfly species in as having been recorded in KTN during 2002 to 2012, of which six were not recorded in the present study. Of these six, Orange-backed Threadtail and Blue Chaser are considered to be of Local Concern by Fellowes *et al.* (2002).

Fieldwork for the LMC Loop study recorded one species of conservation significance at Ma Tso Lung: Ruby Darter; this species is now are considered to be common in Hong Kong.

A total of 32 species was recorded in FLN during field work for this study. Most are common and widespread in Hong Kong, but Fellowes *et al.* (2002) consider Ruby Darter, Blue Sprite and Dingy Dusk-hawker to be of Local Concern, and Emerald Cascader to be of Potential Global Concern. However, like Common Evening Hawker, Dingy Dusk-hawker is active at dusk (as its common name suggests), and thus tends to be under-recorded in general dragonfly surveys, which are usually undertaken at other times of day (as was the case in surveys for the present study). Recent surveys have confirmed that this species is common and widespread in Hong Kong and this is reflected in its current categorisation as 'Common' on the AFCD Biodiversity Database. Accordingly, whilst included in **Table 13.14** for consistency, the current status has been taken into account in evaluation of habitats and assessment of the ecological impacts of the Project.

Seven additional species are listed in the AFCD Biodiversity Database as having been recorded in FLN b during 2002 to June 2012, with only Scarlet Basker of conservation significance; as noted above, this is now relatively common in lowland areas.

Although Maunsell (2003) did not record any species of conservation significance, Mott Macdonald (2010) reported three such species in the Study Area: Eastern Lilysquatter was recorded in the Kau Lung Hang area, Ruby Darter was seen near the Ma Wat River to the north of Kiu Tau, while Emerald Cascader was reported from near Tong Hang Tung Chuen, apparently in secondary woodland (**Appendix 13.8** and **Figure 13.6c**). All dragonfly species of conservation significance recorded in the present and previous studies, together with conservation status assessment and occurrence in the Study Area, are listed in **Table 13.14**.

Table 13.14 - Dragonfly Species of Conservation Significance Recorded in the Study Area during the Current and Previous Studies.

Species	Conservation Status	Areas/ Habitats
Eastern Lilysquatter <i>Paracercion melanotum</i>	Local Concern ¹ , Uncommon ²	Kau Lung Hang Streams near Ma Wat River.
Blue Sprite <i>Pseudagrion microcephalum</i>	Local Concern ¹ , Common ²	Natural watercourse in FLN.
Orange-backed Threadtail <i>Prodasineura croconota</i>	Local Concern ¹ , Common ²	Wooded stream in Kwu Tung North.
Dingy Dusk-hawker <i>Gynacantha subinterrupta</i>	Local Concern ¹ , Widespread and common ³	Mitigation wetland in FLN.

Species	Conservation Status	Areas/ Habitats
Blue Chaser <i>Potamarcha congener</i>	Local Concern ¹ , Common ²	Small ponds and marshes, Kwu Tung North.
Ruby Darter <i>Rhodothermis rufa</i>	Local Concern ¹ , Common ²	Ma Tso Lung, near Ma Wat River in the Kiu Hang area,, Kau Lung Hang Streams.
Scarlet Basker <i>Urothemis signata</i>	Local Concern ¹ , Common ²	Pond and mitigation wetland in KTN, also in FLN.
Emerald Cascader <i>Zygonyx iris</i>	Potential Global Concern ¹ Abundant ²	Natural watercourse in FLN near Tong Hang Tung Chuen, apparently in secondary woodland Kau Lung Hang Streams.

Notes

1. Fellowes *et al.* (2002).
2. Tam *et al.* (2011).
3. AFCD Biodiversity Database (2012).

13.5.4.11 Aquatic Invertebrates

Surveys of aquatic invertebrates in streams in KTN identified the presence of 21 taxa. Most (19 taxa) were found in semi-natural streams, especially those within the catchment of Ma Tso Lung Stream, suggesting that water quality in these streams is relatively good. In lowland habitats, such as mitigation wetlands and lowland streams, macroinvertebrate communities were dominated by freshwater snails, which are usually very abundant in suitable habitats and can tolerate disturbed and moderately polluted environments.

The freshwater crab *Somanniathelphusa zanklon*, considered to be of Global Concern and listed as endangered by IUCN (2013), was the only species of conservation significance recorded. This species is listed by IUCN (2013) as endemic to Hong Kong. This species was recorded in the Ma Tso Lung San Tsuen Stream. The species was also recorded from the Tung Fong Watercourse, a moderately polluted artificial channel, which is not considered to be suitable habitat. The individual present in this habitat may have been transported downstream by water currents.

According to IUCN (2013), *Somanniathelphusa zanklon* occurs in a variety of lotic and lentic lowland habitats, and is fairly tolerant of organic pollution, although it prefers unpolluted riverine habitats and slow-flowing low-gradient streams where the substratum might be muddy. It also inhabits irrigation ditches and flooded furrows, and has been found among the roots of floating plants such as the exotic *Eichhornia crassipes* or the trailing roots and stems of riparian grasses and other plants.

Surveys for the LMC Loop Study in the Ma Tso Lung San Tsuen Stream also found *Somanniathelphusa zanklon*. It was also found in a polluted watercourse near Chau Tau village in surveys conducted under the LMC Loop Study.

Surveys of aquatic invertebrates in FLN recorded 24 taxa in the Study Area. Diversity was reasonably high in both the channelised and natural streams (14 and 18 taxa, respectively), compared with only three species recorded in the mitigation wetlands. As in KTN, one species of Global Concern was recorded, the freshwater crab *Somanniathelphusa zanklon*. The stream at Siu Hang San Tsuen was found to be a good habitat for aquatic macroinvertebrates, including the uncommon freshwater bivalve *Corbicula fluminea*, atyid shrimp, aquatic moth larvae and fishfly larvae. These indicate that this stream may not be highly disturbed. A lowland stream located within the agricultural land to the north of Tin Ping Shan Tsuen was also found to support a diversity of aquatic invertebrates, including *C. fluminea* and various odonate larvae, but this stream seems to be dependent upon irrigation from a pumping station constructed by AFCD to provide irrigation water for adjacent agricultural land.

Somanniathelphusa zanklon was recorded in channelised watercourses at Sheung Shui Wa Shan, Tin Ping Shan Tsuen and Ma Wat Wai. The first of these is a concrete channel, those at Tin Ping Shan Tsuen and Ma Wat Wai have been informally channelised where they flow through village areas but include sections with semi-natural stream beds.

Details of aquatic invertebrates recorded in surveys for the current study are included in **Appendix 13.9**.

Table 13.15 - Aquatic Invertebrate Species of Conservation Significance Recorded in the Study Area during the Current and Previous Studies.

Species	Conservation Status	Areas/ Habitats
<i>Somanniathelphusa zanklon</i>	Global Concern ¹ , Endangered ²	Natural and channelised watercourses at Ma Tso Lung, Chau Tau, Tung Fong, Tin Ping Shan Tsuen, Sheung Shui Wa Shan and Ma Wat Wai

Notes

1. Fellowes *et al.* (2002).

2. IUCN (2013).

13.6 Description and Ecological Evaluation of Habitats and Species

In this Section, ecological characteristics of each habitat type present in the Study Area are described in accordance with the requirements of Section 13.4.14.4(iv)(c) of the Study Brief. Maps for the NDAs showing the types and locations of habitats are provided in **Figures 13.6a-v**; representative photographs of the habitat types and important ecological features are presented in **Appendix 13.11**. In interpreting the habitat maps, it should be noted that differences in the assessment criteria required under Section 3.14.4 (Ecological Impact) and Section 3.4.13 (Landscape and Visual Impact) of the Study Brief result in not all habitat

areas being mapped identically in these two sections of this report. Significant differences, and reasons for them, are noted below:

- Grassland, grassland/shrubland and shrubland have been mapped (and evaluated) as different habitats in the ecological impact assessment as their ecological characteristics differ, however they have been treated as a single habitat (shrubland/grassland mosaic) in the landscape and visual assessment, where they are considered to have similar landscape and visual characteristics;
- Different types of wooded habitat (fung shui wood, secondary woodland, plantation, mitigation plantation and orchard) have been mapped (and evaluated) as different habitats in the ecological impact assessment as their ecological characteristics differ, however they have been treated as a single habitat (hillside/lowland woodland) in the landscape and visual assessment, where they are considered to have similar landscape and visual characteristics;
- Wet and dry agricultural land have been mapped (and evaluated) as different habitats in the ecological impact assessment as their ecological characteristics differ, however they have been treated as a single habitat (agricultural land) in the landscape and visual assessment, where they are considered to have similar landscape and visual characteristics. In addition, small areas which have been mapped as other habitats in the ecological impact assessment (such as orchard, grassland and plantation) have not always been regarded as significant in the landscape and visual assessment and have been subsumed within the area mapped as agricultural land;
- In a number of parts of the Study Area habitats which have been mapped as a mosaic of developed areas, farmland and natural and semi-natural habitats in the ecological impact assessment have been regarded as a single habitat type (rural development area) for the purposes of the landscape and visual assessment and mapped accordingly.

In accordance with the approach throughout this study, where there are significant differences in the ecological characteristics of habitats in KTN and FLN, habitats in KTN are described first.

The complex habitat mosaic of Long Valley, where there are important linkages between habitats, and where many fauna species may be dependent on, or associated with, more than one of these habitats is described and evaluated in this Section as one habitat unit.

13.6.1 Habitats

13.6.1.1 Long Valley

Long Valley, comprising areas both north and south of Sheung Yue River, contains a highly complex mosaic of microhabitats. The principal habitats present are wet and dry agricultural land, ponds and grassland, some of which is seasonally wet. In addition, mitigation woodland plantation is present along the Ng Tung, Sheung Yue and Shek Sheung Rivers, and there are also smaller areas of mitigation wetland (former Sheung Yue River meanders), plantation (largely of fruit trees) and small developed areas.

The area included in the Long Valley habitat evaluation includes all the areas described in the previous paragraph. However, there is no universally agreed definition of the boundaries of Long Valley. Whilst the boundaries are clear in the east (where the Ng Tung and Shek Sheung Rivers form an obvious boundary), and are relatively clear in the southeast (where there is a topographical change, as is discussed below), they are more diffuse in the southwest and, especially, in the northwest in the area to the east of Ho Sheung Heung River. The approach followed in this report has been to include all areas of more or less continuous and contiguous wetland in Long Valley, as is described here, but to exclude more fragmented wetland areas on the periphery, especially where inclusion of such areas would lead to inclusion of significant areas of non-wetland habitats and developed areas. Except for the plantations, these areas either currently contain wetland habitats or are topographically similar (hence could easily be flooded by gravitational flow) but are currently occupied by dryland habitats.

As noted above, the dry agricultural fields to the south of Long Valley (near Yin Kong village) are raised approximately 1.5 - 2 m above the level of the land closer to the Sheung Yue River; thus, they cannot be easily flooded in this way. In addition, these fields are highly fragmented by developed areas, grassland and wooded habitats. These agricultural areas are described and evaluated in **Section 13.6.1.2** below.

In addition, the Sheung Yue River, whilst contained within the area shown as Long Valley in **Figure 13.6** for the purposes of ascribing faunal observations to location (as observations from this river are often attributed to observers as from Long Valley), has been described and evaluated as a different habitat in **Section 13.6.1.6** below.

The wetland conditions in Long Valley are maintained by water from a number of sources, including rainfall (both directly and by retaining wet season rainfall in ponds for subsequent dry season use) and wells. In addition, Long Valley south of the Sheung Yue River receives water which is abstracted from the Sheung Yue River above a fabric dam on the river located to the west of the Fanling Highway and delivered by gravity

via the Long Valley Watercourse. The area north of the Sheung Yue River also receives some water from the Tsung Yuen Watercourse and one mitigation meander receives water via the Ho Sheung Heung Watercourse.

The mix of habitats in Long Valley is similar on the north and south sides of the Sheung Yue River, but whereas the ponds on the south side of the river are managed, either for production and/or with conservation objectives, many of the ponds on the north side of the river were abandoned for many years and became partially or wholly overgrown, often with invasive or ruderal facultative wetland herbs. This process of habitat degradation has been partially reversed in recent years, through the MA mechanism, but several ponds near to Ho Sheung Heung village remain in a poor condition. Similarly, many grassland areas on the north side of the river have developed by vegetational succession from abandoned farmland, or have been colonised by ruderal herbs and grass species after ponds have been filled. On the south side of the river most such areas have been deliberately left fallow for short periods for agricultural and/or conservation management reasons, as is discussed below.

As was noted in **Section 13.3.2**, Long Valley MAs managed by the CA and HKBWS, with the participation of farmers in adjusting their farming practices to meet conservation objectives, have been in place since 2005. MAs currently cover approximately 12ha in Long Valley. This is subject to change, both in the total and individual areas involved, as participation in the MA scheme is voluntary. Partly as a consequence of MA objectives, but also in accordance with the individual preferences of farmers, and the growth stage of the crops involved, conditions in Long Valley vary both seasonally and within seasons. Such changes apply, especially, in the areas of wet and dry agricultural land and in the ponds to the south of the Sheung Yue River.

The wet agricultural fields comprise a complex mosaic of active and inactive fields. Common wet agricultural crops include Water Spinach *Ipomoea aquatica* and Water Cress *Nasturtium officinale*, while some fields (mostly those under the MAs) are cultivated with Water Chestnut *Eleocharis dulcis*, Rice *Oryza sativa*, Chinese Arrow-head *Sagittaria sagittifolia* subsp. *leucopetala* and Water Caltrop *Trapa natans*. Water levels in individual fields are variable. Most inactive fields in the area are seasonally wet, retaining water through the wet season, while active fields may be managed for wet or dry crops. Water levels are therefore dependent upon the actions of the farmers and the MA objectives.

Inactive fields are quickly colonised by common and widespread pioneer herb species such as grasses *Brachiaria mutica*, *Panicum maximum* and herbs *Ipomoea aquatica*, *Mikania micrantha*, *Bidens alba*, *Commelina diffusa*, *Cyclosorus interruptus* and *Ludwigia perennis*. Other common herbaceous plants are present in lower abundance, including *Kyllinga*

monocephala, *Kyllinga aromatica*, *Polygonum glabrum*, *Polygonum lapathifolium* and sedge *Cyperus* spp.

Some fields are used for cultivation of dry crops (including Chinese Aloe *Aloe vera* var. *chinensis*, Chinese Chives *Allium tuberosum*, Chinese White Cabbage *Brassica chinensis*, Lettuce *Lactuca sativa*, Matrimony Vine *Lycium chinense* and Egg-plant *Solanum melongena*) in certain seasons. The use of fields for dry agricultural crops is often temporary and these fields may be flooded in other seasons according to the preferences of the farmer and the MA objectives. Vegetation around cultivated fields is relatively poorly developed due to regular management by farmers to control non-crop species. Plant species present along field bunds include grasses *Eleusine indica* and *Panicum paludosum*, sedges *Cyperus iria* and *Kyllinga monocephala*, and fruit trees *Musa x paradisiaca*, *Dimocarpus longan*, *Litchi chinensis* and *Mangifera indica*.

As noted above, many ponds in Long Valley to the north of the Sheung Yue River are former fish ponds that are now abandoned and overgrown. These ponds are close to Ho Sheung Heung Village and are somewhat disturbed by human activities. Ponds to the south of the river include a group of ponds surrounded by high bunds in the centre of this area which have long been managed for the cultivation of invertebrate food to be supplied to aquarists. Other shallow ponds, which may be temporary, are also used for this purpose, the cultivation of lily and lotus or left fallow: management of such ponds is largely driven by MA objectives.

Small areas of marsh habitat are also present in Long Valley. These largely comprise areas where wet agricultural land has been left fallow (either passively or as an MA objective) and have been colonised by wetland herbs of agricultural land as well as crop species. A slightly larger area of marsh is present in the extreme north of Long Valley near the Lo Wu Correctional Institution. This has formed from a former pond that was temporarily filled as a works area and then restored topographically but not returned to fishery use. Plant species diversity is moderate and dominated by exotic wetland species such as *Brachiaria mutica* and *Sesbania cannabina* and the invasive exotic tree species *Leucaena leucocephala*, but also includes some native wetland herb species including *Polygonum japonicum*, *Commelina diffusa* and *Ludwigia octovalvis*.

Mitigation wetlands, created to compensate for ecological impacts of the channelisation of the Ng Tung, Sheung Yue and Shek Sheung Rivers, and now maintained by AFCD, are located along the Sheung Yue River. Habitats in the meanders are ponds (including lotus ponds) and marsh with wetland plant species, such as *Commelina diffusa*, *Cyperus flabelliformis*, *Cyperus malaccensis*, *Hedychium coronarium* and *Ludwigia perennis* and *Nelumbo nucifera*.

Small areas of grassland, plantation and developed area are also present in the habitat mosaic, and though individually these are of lower ecological value than the wetland areas, they add to the species diversity of the site and the habitats are utilised opportunistically by species that generally use the open country habitats.

The mitigation plantations, managed by AFCD as mitigation for the ecological impacts arising from channelisation of the rivers, largely comprise exotic tree species, though some native tree species such as *Ficus microcarpa*, *Ficus virens* and bamboo clumps are present, and relatively young (the trees are approximately 15 years old). Both factors result in their being assessed as of relatively low ecological value. However, though of limited intrinsic value in themselves, the plantations are of significant value in screening wildlife in Long Valley from disturbance arising from human activities on the tracks alongside the rivers. In addition, as with the other non-wetland habitats present, these plantations add to the habitat diversity, and hence the associated faunal diversity, of the area.

The complex mix of microhabitats (especially that of permanently and seasonally wet agricultural land, mitigation wetlands, marsh and ponds) provides conditions suitable for a wide diversity of wetland fauna species. There are strong ecological links not only between habitats present within Long Valley but also further afield to the Deep Bay wetland areas. The mixture of habitats present, with strong ecological linkage between them, is responsible for the high ecological value of the site and it is for this reason that ecological evaluation and impact assessments consider the site as a whole rather than breaking it into its constituent habitats. Furthermore, many individual animals and species may be dependent upon the presence of more than one microhabitat for different needs at different times.

In this regard, it should be noted that in the NENT Study, which pre-dated the implementation of MAs in Long Valley, Maunsell (2003) evaluated the active wet agricultural land in Long Valley as of High Ecological Value with potential for enhancement; active dry agricultural land was considered to be of Moderate Ecological Value, again with potential for enhancement; and inactive wet and dry agricultural land were considered to be of High Ecological Value with potential for enhancement. Maunsell (2003) also considered ponds in Long Valley to be of High Ecological Value with enhancement potential, and both marsh and mitigation meanders in Long Valley were considered to be of High Ecological Value.

Long Valley is well known as an important site for wetland fauna, especially birds (**Appendix 13.4**). The site is recognised internationally as part of the Inner Deep Bay and Shenzhen River Catchment Important Bird Area (IBA), although this does not confer any legal protection on the site. The bird community includes a variety of species associated with freshwater wetland habitats, many of which have a relatively restricted

distribution in Hong Kong. A total of 278 bird species have been recorded at Long Valley since December 2005, including surveys as part of the regular monitoring conducted by Hong Kong Bird Watching Society (HKBWS 2012 and HKBWS *in litt.*). Overall, from all sources, a total of 93 species listed by Fellowes *et al.* (2002) as species of conservation concern in Hong Kong or listed by BirdLife International as globally threatened have been recorded in Long Valley. While many of the species recorded during the HKBWS surveys (spanning more than seven years of weekly surveys, with the addition of observations from other bird watchers) are irregular in occurrence at Long Valley, the high number of species recorded reflects the importance of this site for birds.

Many of the wetland bird species are present in numbers that are significant from a Hong Kong perspective, especially those species associated primarily with wet agricultural land. As elsewhere, active dry fields generally support fewer species than wet fields, but this is affected by location and ecological linkages. Many seasonally or permanently dry agricultural fields close to wetland areas are used regularly by species generally considered to be at least wetland-associated, especially Little Ringed Plover, Yellow Wagtail and Red-throated Pipit.

Much of the ecological significance of Long Valley for bird species is a function of the high numbers and diversity of species present, and both of these criteria are higher outside the breeding season. However, Long Valley also provides a breeding/nursery ground for some bird species. Greater Painted-snipe has been proven to breed (e.g. Maunsell (2003)) and probably does so regularly as this species is present in Long Valley throughout the year (e.g. Binnie, Black & Veatch (2002)). It is likely that Long Valley supports a significant proportion of the breeding population of this species in Hong Kong. Other species of conservation significance which may breed (or for which habitat conditions are suitable for breeding) include Little Grebe, Yellow Bittern, Cinnamon Bittern, Slaty-breasted Rail, Little Ringed Plover, Zitting Cisticola and White-shouldered Starling (the last of these in man-made structures).

Observations during 2009 flight-line surveys suggest that Long Valley is also used as a foraging site by ardeids breeding in the egretries at Ho Sheung Heung and Man Kam To Road. Approximately 34% of birds observed leaving Ho Sheung Heung were seen to fly directly towards Long Valley, both north and south of Sheung Yue River. Little Egrets and Eastern Cattle Egrets seemed to be particularly dependent upon this area (58% and 74% of individuals, respectively), whereas only 45% of Chinese Pond Herons from this egretty flew in this direction. Approximately 68% of Chinese Pond Herons leaving Man Kam To Road egretty were heading in the general direction of Long Valley. During the breeding season (April – July), bird surveys at Long Valley recorded up to 39 Little Egrets, 13 Eastern Cattle Egrets and 12 Chinese Pond Herons, indicating that many birds from the egretries were indeed foraging at this site.

As shown in **Sections 13.5.5.6 and 13.5.5.9** and **Appendices 13.2, 13.4 to 13.6 and 13.8**, in addition to birds, other wetland or wetland-associated fauna, especially amphibians and dragonflies, are also diverse and some species occur in high numbers in Long Valley.

Most species recorded are widespread in Hong Kong, but mammal species recorded include Greater Bandicoot Rat, East Asian Porcupine, Masked Palm Civet and Leopard Cat, all of which are of conservation significance. Herpetofauna species of conservation significance include Reeve's Terrapin, Burmese Python, Buff-striped Keelback, Many-banded Krait, Chinese Cobra, King Cobra, Chinese Bullfrog and Two-striped Grass Frog. In addition, Red Muntjac, Tokay Gecko and Water Monitor would be of conservation significance if these species were found to be still present and/or of natural origin.

Four butterfly species of conservation significance were recorded during surveys conducted under the current study: Pale Hedge Blue, Painted Lady, Danaid Egg-fly and Commander. In addition to these species, the following additional butterfly species of conservation significance have been recorded in other surveys and studies: Dark Brown Ace, Small Grass Yellow, Lesser Forest Blue, Brown Onyx and Common Pierrot have been seen in the Ho Sheung Heung area and hence may occur in Long Valley. Of these species, Dark Brown Ace and Lesser Forest Blue are associated with bamboo groves. Bamboo groves form an element of areas of mitigation plantation in Long Valley, accordingly Long Valley habitats may be of significance for these species. Similarly, Danaid Egg-fly is associated with agricultural land and wetland as well as shrubland, so Long Valley may be of significance for this species. The other species are more typically associated with habitats not present in Long Valley (uplands for Pale Hedge Blue and the migrant Painted Lady; shrubland and/or woodland for Commander and Brown Onyx), whilst Common Pierrot has not been seen in Hong Kong for many years (Lo and Hui 2010) so Long Valley is not likely to be of significance for these species.

One dragonfly species of listed as being of conservation significance by Fellowes *et al.* (2002), Scarlet Basker, has been recorded, though this species is common in fishpond areas in Hong Kong (AFCD Biodiversity Database (2012).

Table 13.16 - Ecological evaluation of Long Valley

Criteria	Assessment
Naturalness	All habitats are anthropogenic and most are actively managed. Some areas, including inactive agricultural land, marsh, ponds, grassland and plantation show some natural succession through colonisation and habitat maturation, but succession is maintained at an early stage by management.

Criteria	Assessment
Size	The overall area (57.61ha) is large and is one of the largest freshwater wetland areas in Hong Kong. The area of wet agricultural land (19.11ha, but this fluctuates) is also large in a Hong Kong context. The area of ponds (7.92ha) is small in a Hong Kong context but large in the Study Area. The areas of marsh (5.58ha), mitigation wetland (1.02ha), dry agricultural land (8.80ha), grassland (3.80ha), seasonally wet grassland (1.26ha), plantation (2.68ha), mitigation plantation (3.81ha), watercourse (0.16ha) and developed area (3.47ha) are small in the context of the Study Area except for the area of marsh which is of a moderate size.
Diversity	A diverse mixture of microhabitats supporting moderate floral diversity but a highly diverse community of wetland fauna species, especially birds.
Rarity	The shallow freshwater wetland habitats (wet agricultural land, shallow ponds and freshwater marsh) forming a sizeable and varied mosaic of linked microhabitats that are rare and declining in Hong Kong. Dry agricultural land is fairly common in Hong Kong, but rarely shows such ecological connection to wetland habitats. Other dryland habitats are common. The habitats support a high number of rare bird species and also rare species of other fauna including mammals, reptiles, amphibians, dragonflies and butterflies, some of which are wholly or largely restricted to Long Valley habitats in the Study Area.
Re-creatability	Could be re-created in areas with suitable soil conditions and hydrology.
Fragmentation	A single mosaic of ecologically linked microhabitats. Fragmented by the Sheung Yue River for most terrestrial fauna, but not for wetland bird species.
Ecological linkage	Strong ecological linkage between the constituent habitats. Ecological linkage also to main river channels, especially the Sheung Yue River, for wetland birds, to Ho Sheung Heung Egretty for ardeids and to Deep Bay wetland ecosystem for some wetland bird species.
Potential value	Currently of high value but with potential for further enhancement with appropriate management.
Nursery/ breeding ground	Known to be a breeding ground for Greater Painted-snipe and various amphibian and dragonfly species, some of which are of conservation significance. Suitable conditions exist for a number of other bird species of conservation significance and some of these may breed. Used for foraging by birds breeding in Ho Sheung Heung Egretty.
Age	Agricultural use of the area presumably dates back a long time but habitats maintained at an early successional stage. Plantation habitats are young (age approximately 15 years).
Abundance/ Richness of wildlife	Known to support an abundant and diverse community of wetland species, especially birds. Considered to be of significance for a number of wildlife species including mammal, bird, reptile, amphibian, dragonfly, and butterfly species.
Ecological value	Area to the south of the Sheung Yue River of High to Very High Ecological Value . Area to the north of the Sheung Yue River of High Ecological Value due to smaller size, lower habitat diversity and relatively low value of pond areas.

13.6.1.2 Agricultural land (excluding Long Valley)

Away from Long Valley, most agricultural land in the Study Area is found to the north and east of Sheung Shui/Fanling, primarily around Ma Shi Po, with smaller areas scattered through other lowland areas. Individual farmed areas are small and most are highly fragmented by developed areas, though there are some larger areas around Ma Shi Po.

Most of this agricultural land is utilised for dryland crops, but some areas; (notably around Chau Tau Tsuen in the west of KTN and near the Ng Tung River in FLN); are, at least, seasonally wet and are utilised for wet agricultural crops.

Floral species diversity in agricultural land in the Study Area away from Long Valley is low and a few common and widespread species are dominant. Species cultivated include *Aloe vera* var. *chinensis*, *Allium tuberosum*, *Brassica chinensis*, *Lactuca sativa*, *Lycium chinense*, *Solanum melongena*, *Ipomoea aquatica*, *Ipomoea batatas* and *Nasturtium officinale*. Common species found on field bunds include grasses *Eleusine indica* and *Panicum paludosum* and sedges *Cyperus iria* and *Kyllinga monocephala*. Fruit trees such as *Dimocarpus longan*, *Litchi chinensis* and *Mangifera indica* are also often present along field edges and around village areas.

Faunal diversity in agricultural land in KTN away from Long Valley is constrained by the small areas present, their fragmentation and, in most areas, limited linkages with adjacent habitats; although at Chau Tau an area of wet agricultural land does have linkages with adjacent marsh and seasonally wet grassland.

Surveys conducted under the present study found wet agricultural land in KTN away from Long Valley to be utilised by small numbers of wetland bird species of conservation significance, with Red-billed Starling present in moderate numbers in some areas. High numbers and moderate diversity of amphibians were also found, including one species of conservation significance, Chinese Bullfrog. Dry agricultural land in KTN is of limited significance for fauna of conservation significance with occasional records of species that occur in larger numbers in other habitats, primarily wetlands. Other than incidental records of wetland-dependent or associated birds, only one bird species of conservation significance, Zitting Cisticola, was found in dry agricultural land during the present study. This species is not dependent on this habitat and occurs in larger numbers in grassland and wetland habitats. Similarly, a record of Chinese Bullfrog is of limited significance as this species is dependent on wetland habitats. Wet agricultural land in FLN supports moderate diversity but low numbers of wetland bird species of conservation significance. However, both wet and dry agricultural land areas in FLN support high numbers and moderate diversity of amphibian species. Most species are not of conservation significance, but Chinese Bullfrog is

present in small numbers and anecdotal evidence suggests that Two-striped Grass Frog may have occurred, at least in the past.

Two reptile species of conservation significance have been reported from the Ma Shi Po area by naturalists, Five-striped Blue-tailed Skink and Buff-striped Keelback, and it is reasonable to anticipate that these and some other snake species of conservation significance reported from the Study Area may occur in agricultural land in FLN in small numbers, given their habitat requirements. In addition, Maunsell (2003) reported a sighting of Chinese Cobra in active agricultural land in FLN, but the location was not stated.

Amongst invertebrates, one butterfly species, Commander, was found in surveys for the current study, but as this is primarily a woodland and shrubland species its occurrence in agricultural land is of low significance.

The status of agricultural land in the Study Area changes frequently between active and inactive; both within seasons and between years due to the preferences of individual farmers and the decision of landowners as to whether to make land available to farming tenants. Some areas are farmed more or less continuously, while other areas may be utilised more sporadically. In addition, the area of active agricultural land in the Study Area has declined, since the time of the NENT Study (Maunsell 2003) and during the course of the current Study, especially in FLN.

The change in status of agricultural land is of relevance to the ecological assessment process: active agricultural land may provide conditions suitable for different fauna species than inactive areas; further, the conditions in inactive areas change over time as vegetational succession proceeds.

Thus, Maunsell (2003) considered active wet agricultural land to be of Moderate Ecological Value in both KTN away from Long Valley and in FLN; active dry agricultural land was considered to be of Low to Moderate Ecological Value in both areas; while inactive agricultural land (both wet and dry) was considered to be of Low Ecological Value in KTN and of Moderate Ecological Value in FLN. The reasons for the higher evaluation in FLN included the larger areas present, significantly greater functional linkages with adjacent habitats, and significantly greater numbers and diversity of fauna (especially dragonflies, amphibians and birds), and the presence of rare species. The higher evaluation of inactive dry agricultural land relative to active dry agricultural land in FLN reflected the observation that the inactive dry agricultural land provided suitable nursery and breeding conditions for 'a wide array of wildlife including rare residents' and the higher abundance of dragonflies and amphibians.

The consequences of this change over time - with wet agricultural land tending to decline in value if it is left inactive but the value of dry agricultural land tending to increase - need not affect the overall ecological assessment process, so long as there is no overall trend in the relative proportions of agricultural land which is active and inactive.

However, in the present study), the decline in the area of active agricultural land, (especially in FLN, during the course of the study period, may affect the assessment if this only takes into account current conditions. Accordingly, in the current study, while wet and dry agricultural land areas have been evaluated separately, active and inactive areas have been combined for the purposes of assessment and evaluation. The higher value of active wet agricultural land and the higher value of inactive dry agricultural land has been utilised in the evaluation process, where relevant, on a precautionary basis.

Table 13.17 - Ecological evaluation of Agricultural Land (excluding Long Valley)

Criteria	Wet Agricultural Land – KTN (excluding Long Valley)	Wet Agricultural Land - FLN	Dry Agricultural Land - KTN	Dry Agricultural Land FLN
Natural-ness	An artificial habitat created and managed for the cultivation of various crop species and subject to regular human activity.			
Size	Small patches are present and total area is small (4.16ha).	Small patches are present and total area is small (3.53ha).	Small patches are present and total area is small (6.11ha).	Small patches; but the overall area is moderate (15.87ha).
Diversity	A low diversity of plant species due to typical crop cultivation practices. Low to moderate diversity of fauna.	Low diversity of flora and fauna.	Flora diversity is low but fauna diversity is low to moderate. Most species are generalists that occur in several habitats common in the Study Area and/or are species common in the Study Area. In addition, many of the species, notably birds, are associated with wetland habitats and use this habitat on an incidental basis.	Low floral diversity but fauna diversity is low to moderate. Most species are generalists that occur in several habitats common in the Study Area and/or are species common in the Study Area. In addition, many of the species, notably birds, are associated with wetland habitats and use this habitat on an incidental basis.

Criteria	Wet Agricultural Land – KTN (excluding Long Valley)	Wet Agricultural Land - FLN	Dry Agricultural Land - KTN	Dry Agricultural Land FLN
Rarity	Such small and fragmented areas of wet agricultural habitat are common in Hong Kong, but area is declining. Wetland bird species of conservation significance present in small numbers. Of these, seven species (Watercock, Pintail Snipe, Swinhoe’s Snipe, Citrine Wagtail, Pallas’s Grasshopper Warbler and Oriental Reed Warbler) are largely restricted to wet agricultural land and Long Valley habitats in the Study Area, while one species (Bull-headed Shrike) is largely restricted to these habitats and dry agricultural land in the Study Area. One butterfly species, Danaid Egg-fly, may be largely restricted to wet agricultural land and Long Valley habitats in the Study Area. Other rare species are not restricted to wet agricultural land or a small number or area of habitats.		A common habitat type in Hong Kong, but area is declining. Supports a small number but few individuals of rare fauna species. One bird species, Bull-headed Shrike, is largely restricted to dry agricultural land, wet agricultural land and Long Valley habitats in the Study Area. Other rare fauna species are not restricted to dry agricultural land or a small number or area of habitats.	
Re-creatability	Easily re-creatable if suitable hydrological conditions are present.		Easily re-creatable.	
Fragmentation	Highly fragmented.			
Ecological linkage	That at Chau Tau has some linkages with nearby seasonally wet grassland and marsh. Otherwise, only very limited linkages.	Some linkages for wetland birds with the Ng Tung River and Long Valley.	Area to the east of Yin Kong has some linkages to Long Valley. Other areas have few linkages.	That in the Ma Shi Po area has some linkages with nearby lowland grassland, much of which is former agricultural land. Other areas have few linkages.
Potential value	Limited potential for enhancement due to small size and, especially, fragmentation.		Some potential for enhancement but constrained by fragmentation.	
Nursery/ breeding ground	Number of vocalising amphibians suggests that moderate numbers breed in the area.		None known.	
Age	Unknown but maintained at an early successional stage by regular management.			

Criteria	Wet Agricultural Land – KTN (excluding Long Valley)	Wet Agricultural Land - FLN	Dry Agricultural Land - KTN	Dry Agricultural Land FLN
Abundance/ Richness of wildlife	Low to moderate abundance and diversity of amphibians. Low abundance and diversity of other fauna.	Low to moderate abundance and diversity of amphibians. Low abundance and diversity of other fauna	Low abundance but low to moderate diversity of wildlife; however, many of the species recorded (notably wetland birds) are more associated with other habitats and utilise dry agricultural land only occasionally and/or opportunistically. This habitat is largely occupied by generalist species for which it is not of significance at a population level.	
Ecological value	Low to Moderate Ecological Value , primarily due to importance for a number of bird species largely restricted to this and Long Valley habitats in the Study Area.		Low Ecological Value.	

13.6.1.3 Ponds (excluding Long Valley)

Away from Long Valley, there are two main areas of ponds in the Study Area; both these areas are adjacent to the Ng Tung River. Ponds on each side of the tidal Ng Tung River are inactive or are abandoned and are largely overgrown. Floral diversity is low, with those ponds on the west side of the river largely covered by Water Hyacinth *Eichhornia crassipes*. Faunal diversity is low to moderate, but small numbers of wetland birds, including breeding ardeids, amphibians and dragonflies use these ponds. The most significant observation was a sighting of Eurasian Otter in the pond areas on the east side of the river during surveys conducted for the FCA Study. This is the only confirmed sighting of this Globally Near-threatened species in the Study Area.

Also of significance, however, is the role of these ponds in maintaining the linkage between Long Valley and the Deep Bay wetland ecosystem. Ardeids, including ardeids breeding at Ho Sheung Heung Egretty, use this corridor in significant numbers.

Ponds on the north side of the Ng Tung River in the west of FLN are also inactive or abandoned and largely overgrown with invasive floating vegetation. The ponds are largely surrounded by woodland habitat (orchard and plantation). Again, however, these ponds are of significance for their role in maintaining a flight-line corridor, in this case that between Long Valley and the tidal Ng Tung River and between the Ng Tung River in FLN and Man Kam To Road Egretty.

A single inactive pond straddling the Study Area boundary and located at Tse Koo Hang lies at the edge of the Hoo Hok Wai wetland area. This pond is a part of the much larger fishpond area present in the Deep Bay wetland ecosystem. As such, it is evaluated separately in **Table 13.18** below.

An active pond (utilised for rearing fish fry) of 0.95ha is present at Fung Kong. Bunds of this pond are kept clear of herbaceous vegetation, though it is largely surrounded by fruit trees. Measures to minimise loss of fish are in place; nevertheless, small numbers of ardeids are regularly present around this pond. A single inactive pond of moderate size is present south of Ho Sheung Heung. This pond has some linkages with Long Valley and regularly supports small numbers of waterbirds. Neither of these ponds is conveniently evaluated as a part of a larger area of pond or wetland habitats; accordingly these are also evaluated separately below.

Finally, a few isolated, inactive or abandoned ponds are scattered through the Study Area. These ponds are too small in size, too isolated from other wetland habitats and/or too disturbed to support wetland fauna in significant numbers or to be of significance for species of conservation importance (**Table 13.18**).

Maunsell (2003) categorised ponds as active fish ponds, inactive fish ponds and other ponds, with the latter category covering the aquaculture production ponds in Long Valley, water storage ponds and other unmanaged ponds. A total of 12.7ha of ponds were found, of which approximately 3ha were in Long Valley, and of which 3.4ha were active fish ponds. Allowing for the different Study Areas, the area of ponds has not, therefore, changed significantly in recent years. In Maunsell (2003) ponds away from Long Valley were considered to have a Moderate Ecological Value.

Table 13.18 - Ecological evaluation of Ponds (excluding Long Valley)

Criteria	Ponds along the Ng Tung River	Pond at Tse Koo Hang	Larger Ponds in KTN away from Long Valley	Small Ponds scattered through the Study Area
Naturalness	Man-made.			
Size	Small area in total (8.69ha).	Small within the Study Area (0.43ha) but forms a part of the Deep Bay wetland ecosystem (total area between LMC and Ng Tung River approx. 184ha).	Small (the active pond at Fung Kong is 0.95ha, while the area of inactive ponds south of Ho Sheung Heung is 1.18ha).	Small individually and in total (2.96ha).
Diversity	Low floral diversity and low to moderate faunal diversity.	Low floral and faunal diversity due to small size, but the larger area has moderate to high faunal diversity.	Low floral and faunal diversity.	
Rarity	A moderately common habitat, especially in the north-west New Territories. Some fauna of conservation significance, including wetland dependent species, utilise this habitat but numbers are small and/or use is irregular.			
Re-creatability	Can be re-created in suitable low-lying locations with appropriate hydrological conditions.			
Fragmentation	Moderately fragmented by developed areas and non-wetland habitats.	Not fragmented.	Highly fragmented.	
Ecological linkage	Linked to other wetland habitats by the Ng Tung River. Ponds along the tidal Ng Tung River form part of the flight-line corridor between Long Valley and Ho Sheung Heung Egrettry and the Deep Bay wetland ecosystem; ponds along the Ng Tung	An integral part of the Deep Bay wetland ecosystem and has significant linkages with adjacent wetland habitats.	Some linkages with Long Valley for areids.	No significant linkages.

Criteria	Ponds along the Ng Tung River	Pond at Tse Koo Hang	Larger Ponds in KTN away from Long Valley	Small Ponds scattered through the Study Area
	River in FLN form part of the corridor linking wetlands along the River with Long Valley			
Potential value	Value could be improved with dedicated management for wildlife.		Value could be improved with dedicated management for wildlife but constrained by size.	
Nursery/ breeding ground	Not known to be a significant breeding ground, but ponds are utilised as foraging areas by breeding ardeids from Ho Sheung Heung Man Kam To Egrettries.	Not known to be a significant nursery/ breeding ground.		
Age	Unknown.			
Abundance/ Richness of wildlife	Low to moderate abundance and diversity of wetland birds, herpetofauna and dragonflies.	Probably low due to small size, but moderate abundance and diversity of wetland birds, herpetofauna and dragonflies in the wider area.	Low.	
Ecological value	Moderate to High for ponds along the tidal Ng Tung River due to their role in maintaining linkages. Moderate for ponds to the north of the Ng Tung River in FLN for the same reason but linkages are less important.	High as an element of the wider area.	Low to Moderate , primarily due to providing foraging areas for ardeids.	Low.

13.6.1.4 Marsh

Away from Long Valley, marsh habitat in the Study Area is limited to an area in the extreme north-west, near Ma Tso Lung village (outside the boundaries of the proposed NDA) and an area to the west of Chau Tau village in the extreme south-west of the Study Area. Both of these marshes were surveyed and evaluated under the LMC Loop Study. There is no marsh habitat in FLN.

Faunal diversity of both of these marsh areas is limited by lack of microhabitat diversity. However, the marsh at Ma Tso Lung has linkages with adjacent seasonally wet grassland and the Ma Tso Lung Stream system, while that at Chau Tau has linkages with nearby wet agricultural land and seasonally wet grassland.

Despite this, a number of fauna species of conservation significance have been found in the Ma Tso Lung marsh and linked wetland habitats in surveys conducted under the present study, the FCA Study and the LMC Loop Study. While some of these fauna species are not wetland-dependent or wetland-associated, the following observations are of significance in the assessment and evaluation of the marsh habitat.

Common Rat Snake appears to be reasonably common in the Ma Tso Lung area based on field surveys carried out for the LMC Loop and FCA Studies. Many-banded Krait was recorded in the LMC Loop study in village area habitat at Ma Tso Lung, while Chinese Cobra was recorded in shrubland near Tse Koo Hang (at the edge of the Ma Tso Lung area). While none of these species are wetland-dependent, it is probable that the combination of streams, marsh, seasonally wet grasslands and adjacent non-wetland habitats, together with limited human presence are of some importance for these species.

Chinese Bullfrog was recorded in the Ma Tso Lung Stream and in marsh in several nearby locations in surveys conducted for the current study and the LMC Loop Study.

Two butterfly species of conservation significance, Pale Palm Dart and Small Three-ring, have been found in Ma Tso Lung marsh. The larval food plants of both of these species are common grasses: larvae of Pale Palm Dart feed on *Miscanthus sinensis* and *Pennisetum purpureum*, while those of Small Three-ring feed on *Ischaemum barbatum* (AFCD Biodiversity Database, Lo & Hui 2010, Xing *et al.* 2000, Young and Yiu 2002, Young and Yiu. 2011). None of these grasses are obligate wetland species, but both *Pennisetum purpureum* and *Ischaemum barbatum* are often present in wetlands. The edges of the marsh may, therefore, be used by these butterfly species but it is unlikely to be of high importance as grassland is abundant in the area. Indeed, as well as being recorded in marsh, Small Three-ring has also been found in seasonally-wet grassland and hillside grassland in the area.

One dragonfly species of conservation significance, Ruby Darter, was found in the Ma Tso Lung marsh in surveys for the current study. This is a marsh and pond-dependent species.

One dragonfly species of conservation significance, Scarlet Basker, which is also a marsh and pond-dependent species, was found in Chau Tau marsh in surveys conducted for the Loop Study and Chinese Bullfrog was found in wetland habitat nearby, also in surveys conducted for the Loop Study.

In terms of avifauna, the lack of structural diversity of these marsh areas restricts opportunities severely for the type of bird species that occur more numerous at Long Valley. However, species able to utilise closed-marsh such as Ruddy-breasted Crake, *Gallinago* snipe and Greater Painted-snipe, or the edges of such areas (e.g. White-throated Kingfisher) do occur.

Table 13.19 - Ecological evaluation of Marsh

Criteria	Ma Tso Lung Marsh	Chau Tau Marsh
Naturalness	Semi-natural.	
Size	Moderate in size in a HK context (3.93ha).	Moderate in size in a HK context (1.65ha inside Study Area boundary, total area 3.50ha).
Diversity	Low floral diversity but low to moderate faunal diversity.	Low floral and faunal diversity.
Rarity	Lowland freshwater marsh is a relatively scarce and declining habitat in HK; three reptile; one amphibian; two butterfly and one dragonfly of conservation significance recorded in or near the marsh (though reptiles not wetland-dependent).	Lowland freshwater marsh is a relatively scarce and declining habitat in HK; one amphibian and one dragonfly species of conservation significance recorded in or near the marsh. Very small numbers of wetland-dependent bird species.
Re-creatability	Could be re-created where land has suitable hydrological conditions.	
Fragmentation	Fragmented by roads and non-wetland habitats.	Largely fragmented by developed areas.
Ecological linkage	Ecological and hydrological linkages to ponds, streams, grassland and shrubland nearby.	Some linkages to nearby wet agricultural and seasonally-wet grassland habitats.
Potential value	Potential for increase under appropriate management regime.	Potential for increase under appropriate management regime; but constrained by developed area nearby and fragmentation.
Nursery/breeding ground	Suitable breeding area for amphibians and dragonflies. May be utilised by Chinese Bullfrog, Small Three-ring and Ruby Darter as a nursery/breeding area.	Suitable breeding area for amphibians and dragonflies. May be utilised by Chinese Bullfrog, and Scarlet Basker as a nursery/breeding area.
Age	Unknown.	
Abundance/Richness of wildlife	Low to moderate.	Low.

Criteria	Ma Tso Lung Marsh	Chau Tau Marsh
Ecological value	Low to Moderate taking into account linkages with other wetland and semi-natural habitats.	Low.

13.6.1.5 Mitigation wetland

In addition to the mitigation wetlands along the Sheung Yue River, which form an element of the Long Valley habitat complex described in **Section 13.6.1.1**, three further meanders to the southwest of Long Valley, along the Sheung Yue River, and eight meanders of the Ng Tung River (all in FLN) have also been retained as wetland habitat to provide mitigation for the ecological impacts of channelisation. These have been managed by AFCD as ponds or marshes, in which habitat management has included the planting of wetland plants and riparian vegetation (Chik & Lam 2007). These mitigation meanders are described and evaluated below.

The wetlands are planted with common wetland plants such as *Cyperus flabelliformis*, *Cyperus malaccensis* and *Hedychium coronarium*. Herbaceous vegetation, including grasses *Brachiaria mutica*, *Panicum maximum* and *Imperata koenigii* and herbs *Bidens alba*, *Mimosa pudica*, *Ludwigia octovalvis*, *Polygonum barbatum* and *Polygonum lapathifolium*, is common on the bunds, which are also planted with a few trees including *Acacia confusa*, *Cinnamomum camphora*, *Ficus virens* var. *sublanceolata* and *Sapium sebiferum*.

Faunal species diversity in the mitigation wetlands was generally low to moderate, probably because of their small size and regular disturbance by people, including, in some cases, regular utilisation by anglers. However, the 17 species of dragonfly recorded in surveys conducted for the current study included a single Dingy Dusk-hawker, which is of Local Concern, in one of the Ng Tung River meanders. This species is, however, now considered to be widespread and common in Hong Kong, hence observation of a single individual is not of significance. Wetland birds were mostly common species, but also included Eastern Water Rail, which is an uncommon winter visitor to Hong Kong. The wetlands may also provide foraging areas for ardeids breeding at Ho Sheung Heung and Man Kam To Road Egrettries.

These mitigation wetlands were under construction/to be constructed at the time of the NENT Study, but were predicted to be of High Ecological Value by Maunsell (2003) when established. However, it is uncertain if the high level of disturbance which they now experience, following the opening of the maintenance access roads along the river channels for public enjoyment, was anticipated or taken into account in reaching this conclusion.

Table 13.20 - Ecological evaluation of mitigation wetlands along the Ng Tung and Sheung Yue Rivers

Criteria	Ng Tung River Meanders	Sheung Yue River Meanders
Naturalness	Former semi-natural meanders of the adjacent river, but modified and artificially isolated by channelisation of the river.	
Size	Eight small, isolated patches of wetland. Total 1.57ha.	Two small, isolated wetland areas constituting 2.66ha.
Diversity	Low to Moderate floral and faunal diversity.	
Rarity	Semi-natural wetland habitats are not uncommon in Hong Kong, but are rarely managed for ecological mitigation. Some wetland bird species of conservation significance.	Semi-natural wetland habitats are not uncommon in Hong Kong, but are rarely managed for ecological mitigation. Some wetland bird species of conservation significance.
Re-creatability	Could be readily re-created if suitable hydrological conditions present.	
Fragmentation	Wetlands are somewhat fragmented but show some connectivity via the Ng Tung River.	Wetlands are somewhat fragmented but show some connectivity via the Sheung Yue River
Ecological linkage	Some ecological linkages to the Ng Tung River and probable linkages for ardeids with egrettries at Ho Sheung Heung and Man Kam To Road.	Some ecological linkages to the Sheung Yue River and probable linkages for ardeids with egrettries at Ho Sheung Heung and, probably to a lesser extent, Man Kam To Road.
Potential value	Currently subject to human disturbance following the opening of the maintenance access roads along the river channels for public enjoyment. Value could be increased by reducing disturbance and additional management measures, but constrained by the small size of the habitat patches.	
Nursery/ breeding ground	No significant breeding grounds known.	
Age	Mitigation wetlands are comparatively new but based on old river meanders.	
Abundance/ Richness of wildlife	Low to moderate diversity and abundance of wildlife but moderate diversity of dragonflies.	
Ecological value	Low to Moderate	Low to Moderate

13.6.1.6 Major Channelised Watercourses

Three large channelised watercourses, the Ng Tung River, the Shek Sheung River and the Sheung Yue River in which the banks and/or stream bed have been modified to enhance water flow and limit flooding risk are present in the Study Area. Locations of these channelised watercourses are shown in **Figure 13.9** and are assessed and evaluated below.

The watercourses are similar in physical characteristics: all were channelised during the 1990s (Maunsell 1997) and have grasscrete sides; the Shek Sheung and Sheung Yue Rivers have a concrete substrate. The Ng Tung and Sheung Yue Rivers and the section of the Shek Sheung River on the east side of Long Valley are subject to tidal influences. The Ng Tung River in FLN upstream as far as its confluence

with the Ma Wat River is maintained at a permanently high level by dams, as is the Sheung Yue River above a point just to the south of where it is crossed by the Fanling Highway. All the rivers are spanned by a number of bridges (vehicular and pedestrian) of a similar conventional concrete design with piers in the channels (**Figure 3.4** and **Plates 61, 63 and 64** in **Appendix 13.11**).

All bridges are low structures with no significant elements projecting above the carriageway level. There is no evidence that the bridges have any fragmentation impact on flight-lines; most ardeids appear to fly over them at approximately 5m to 10m above the carriageway level of the bridges without making significant horizontal or vertical adjustments to their flight paths. A possible exception is the Fanling Highway Bridge over the Sheung Yue River. Relatively few waterbirds appear to fly over this bridge; however this may be because there are few foraging areas present along the section of river south of the highway, rather than the bridge acting as a barrier to movement. However, those that do fly over the bridge do so at typical heights, suggesting that the birds are habituated to the bridges, as was found during flight-line surveys at the Ho Sheung Heung egretty conducted under this study (see **Section 13.5.4.4**), and avoidance of the structure and traffic is not a major constraint to their flight paths.

Due to the artificial substrate and regular management by DSD, plant species diversity on the banks of these watercourses is low. Common herbaceous herbs and grasses are dominant, including *Bidens alba*, *Brachiaria mutica*, *Mimosa pudica*, *Panicum maximum*, *Sesbania cannabina* and *Wedelia trilobata*.

Thus, as a consequence of their design and operational requirements, the rivers are highly uniform and lack structural and microhabitat diversity. Their use by fauna is highly constrained by these limitations and their hydrological regimes. As a consequence, they are only utilised by a limited number of bird species and only as feeding areas. Essentially, they are only used for foraging by bird species which can forage in open wetland habitats and, at least for a part of the time, by bird species which are not highly sensitive to disturbance. In addition, foraging opportunities are constrained by water depths in tidal sections and in sections where water levels are permanently high.

The bird species using the Sheung Yue River in the most significant numbers are Little Egret, Little Ringed Plover and Green Sandpiper (see **Appendix 13.3**). Flight-line surveys at Ho Sheung Heung Egretty showed that this river was a potential destination for birds flying south from the egretty and this is supported by the numbers of species (especially Little Egret) foraging in the river during the breeding season. A peak count of 66 Little Egrets foraging in the river during the breeding season was made during surveys conducted for the current study. The Ng Tung River is also regularly used by wetland-dependent birds,

especially in the intertidal downstream area and the exposed concrete channel near Ma Shi Po. Of the eleven wetland bird species recorded from the river, most were present in relatively low abundance, but counts included up to 43 Little Egrets and up to 51 Little Ringed Plover. Flight-line surveys also showed that the Ng Tung River north of Ho Sheung Heung Egretty is an important movement corridor for breeding egrets; some of these may forage in the river while others may use the river as a movement corridor to other foraging areas along the Shenzhen River.

Other than Great Cormorant, for which the tidal section of the Ng Tung River is the only regular site in the Study Area (albeit it occurs in very small numbers relative to the Hong Kong population), all bird species of conservation significance regularly utilising the rivers also occur regularly in other wetland habitats in the Study Area, and only two (Black-winged Stilt and Pied Avocet) are restricted to the rivers and a limited number of other habitats. Neither Black-winged Stilt nor Pied Avocet was recorded on the rivers during systematic surveys undertaken in 2008-09; however both species now occur there regularly, especially the former (M.R. Leven pers. obs.). The status of both species in Hong Kong and in Long Valley has changed in recent years: Black-winged Stilt, which was formerly a non-breeding migrant to Hong Kong now breeds regularly, while Pied Avocet, which was formerly largely restricted to inter-tidal mudflats, now regularly forages in fishponds and is regularly present in moderate numbers in Long Valley (Hong Kong Bird Reports, HKBWS 2012). These two species regularly occur only on the rivers and in Long Valley, but numbers in the river are not high and are insignificant in a Hong Kong context, and both species, especially Pied Avocet, use Long Valley on a more regular basis (Study Team pers. obs.).

Flight-line surveys conducted at the Man Kam To Road Egretty showed that the western section of Ng Tung River is an important movement corridor for Chinese Pond Herons breeding at this egretty. Most birds were observed to fly west (downstream). This suggests that their destination was the Ng Tung River itself, Long Valley or the Sheung Yue River. All of these areas are within two kilometres of the egretty so are well within the foraging range of breeding Chinese Pond Herons.

A Chinese Softshell Turtle *Pelodiscus sinensis* (listed as of global conservation concern by Fellowes *et al.* (2002)) was recorded in an amenity planting strip between the tidal channel of the Ng Tung River and the service road during surveys conducted under the current study. On being disturbed by the observer it retreated into the Ng Tung River. The river would provide suitable habitat for this species, though the grasscrete channel banks are unlikely to be suitable for nesting.

Table 13.21 - Ecological evaluation of Major Channelised Watercourses

Criteria	Ng Tung River	Sheung Yue River	Shek Sheung River
Naturalness	Artificial habitat created by modification of streams courses.		

Criteria	Ng Tung River	Sheung Yue River	Shek Sheung River
Size	Large (approx. 4700m in length).	Large (approx. 3300m in length).	Moderately large (approx. 2300m in length).
Diversity	Highly uniform habitat, with very limited structural diversity. Floral diversity low; faunal diversity also low but includes several bird species of conservation significance.	Highly uniform habitat, with very limited structural diversity. Floral diversity low; faunal diversity low for most groups but moderate for wetland birds, including species of conservation significance. However, all but two of these species use a variety of wetland habitats in the Study Area; the two species restricted to the rivers and Long Valley habitats occur more regularly and in larger numbers in Long Valley.	Highly uniform habitat, with very limited structural diversity. Floral and faunal diversity low but including some bird species of conservation significance. However, all but two of these species use a variety of wetland habitats in the Study Area; the two species restricted to the rivers and Long Valley habitats occur more regularly and in larger numbers in Long Valley.
Rarity	Channelised watercourses are very common in Hong Kong; but rivers of this size are few. The tidal downstream section is particularly rare in a Hong Kong context. Several wetland bird species and Chinese Soft-shelled Turtle are of conservation significance. However, bird species of conservation significance using this habitat are relatively common in the Study Area. Further, all but two of these species use a variety of wetland habitats in the Study Area; the two species restricted to the rivers and Long Valley habitats occur more regularly and in larger numbers in Long Valley.	Channelised watercourses are very common in Hong Kong; but rivers of this size are few. Several wetland bird species are of conservation significance. However, bird species of conservation significance using this habitat are relatively common in the Study Area. Further, all but two of these species use a variety of wetland habitats in the Study Area; the two species restricted to the rivers and Long Valley habitats occur more regularly and in larger numbers in Long Valley.	

Criteria	Ng Tung River	Sheung Yue River	Shek Sheung River
	more regularly and in larger numbers in Long Valley.		
Re-creatability	Could be re-created where suitable hydrological conditions present.		
Fragmentation	Habitat is somewhat fragmented by roads/bridges (except tidal section which is not fragmented). Non-tidal section is fragmented for aquatic fauna by dams; avoidance of structures and disturbance from people may deter some disturbance sensitive bird species from utilising as a movement corridor.	Habitat is somewhat fragmented by roads/bridges. Significantly fragmented for aquatic fauna by dam upstream from the Fanling Highway Bridge. The movement corridor for large waterbirds from Ho Sheung Heung Egret and to Long Valley is currently not fragmented.	Tidal section is slightly fragmented by a bridge. Non-tidal section is fragmented for aquatic fauna by dams; avoidance of structures and disturbance from people may deter some disturbance sensitive bird species from utilising as a movement corridor.
Ecological linkage	Tidal section has significant linkages to Deep Bay wetland ecosystem, linkages to Long Valley wetland habitats and Ho Sheung Heung Egret. Tidal section also has linkages to linkages to other major channelised watercourses. Non-tidal section has linkages to Man Kam To Road Egret and some linkages to other habitats in FLN.	Significant linkages to Long Valley wetland habitats and Ho Sheung Heung Egret and to Ng Tung River.	Significant linkages to Long Valley wetland habitats.
Potential value	Limited potential to increase value of riparian vegetation due to operational constraints, as vegetation must be managed such that it does not impede water flow and increase flood risk. No potential to increase value in other ways due to operational constraints.		
Nursery/ breeding ground	Not known to be a breeding ground for species of conservation significance (and highly unlikely to be so due to physical characteristics), but provides a foraging site for egrets from Ho Sheung Heung Egret (especially Little Egret).	Not known to be a breeding ground for species of conservation significance (and highly unlikely to be so due to physical characteristics), but provides a foraging site for egrets from Ho Sheung Heung Egret (especially Little Egret).	Not known to be a breeding ground present for species of conservation significance (and highly unlikely to be so due to physical characteristics).

Criteria	Ng Tung River	Sheung Yue River	Shek Sheung River
Age	Watercourses have been fairly recently channelised (about 10-15 years).		
Abundance/ Richness of wildlife	Moderate abundance but low diversity of wetland birds including species of conservation significance. Only able to be utilised by a small number of species due to uniformity of habitat; low abundance and diversity for other fauna of conservation significance.	Moderate abundance and diversity of wetland birds including species of conservation significance. Only able to be utilised by a small number of species due to uniformity of habitat; low abundance and diversity of other fauna of conservation significance.	Low abundance and diversity of wildlife but used by small numbers of some bird species of conservation significance.
Ecological value	Tidal section of Moderate Ecological Value due to importance in maintaining linkages between Long Valley and the Deep Bay wetland ecosystem and as a foraging area for waterbirds of conservation significance. Non-tidal section of Low to Moderate Ecological Value due to importance in maintaining ecological linkages and use as a foraging area by small numbers of waterbirds of conservation significance.	Moderate Ecological Value due to its importance as a foraging area for moderate to high numbers waterbirds of conservation significance, albeit the species diversity is relatively low and all species occur in a variety of wetland habitats and/or larger numbers elsewhere in the Study Area.	Low to Moderate Ecological Value due to some utilisation by waterbirds of conservation significance.

13.6.1.7 Minor Watercourses/Stream

Minor watercourses/streams are distributed throughout the Study Area (**Figure 13.9**). None of these watercourses are entirely natural throughout their entire length, though some are largely natural in their upper reaches. In the following section, a broadly geographical approach has been taken to presentation, beginning in the northwest of KTN and proceeding eastwards and southwards. In addition to the watercourses described below, a few small, largely seasonal, watercourses in upland areas which lack a defined riparian corridor are shown on **Figure 13.10** and are considered, where relevant, in the evaluation of the adjacent habitats.

Ma Tso Lung Stream and tributaries

The upper and middle reaches of the Ma Tso Lung Stream and its tributaries are largely natural, with only limited anthropogenic influences from adjacent and nearby development. Vegetation around the stream in these sections is largely plantation, containing a closed canopy of fruit trees (such as *Dimocarpus longan* and *Litchi chinensis*) which has been naturally colonized by native understorey species (such as the herbs *Alocasia odora* and *Lophatherum gracile* and the tree *Schefflera heptaphylla*).

In the lower reaches where it lies in the north of the Project Area, the channel consists of natural materials, but it is maintained and shaped by regular management. Vegetation in this section is grassland, which may be seasonally wet, but is cut periodically. Downstream of this section, to the edge of the Study Area, the stream is partially channelised, but the streambed is largely natural. Adjacent vegetation in this section of the stream is seasonally wet grassland and marsh.

The potential ecological value of some sections of the stream may be limited by upstream pollution sources (largely village areas), but it appears that the water is cleaned naturally to some extent as it progresses, and it is able to support a moderately diverse invertebrate community in the middle reaches.

Fauna species of conservation significance recorded in the middle and upper reaches of the Ma Tso Lung Stream include the globally critically endangered Three-banded Box Terrapin, recorded in surveys conducted as a part of the current study. Surveys conducted under the current study and surveys for the LMC Loop Study also logged the presence of Chinese Bullfrog in several locations along and near to these sections of the stream.

In the lower reaches of Ma Tso Lung Stream and the adjacent and closely ecologically linked Ma Tso Lung Marsh, three reptiles and one amphibian of conservation significance have been found in recent surveys: Chinese Cobra and Common Rat Snake were found in surveys for the Loop Study, and Many-banded Krait was found in surveys for the FCA Study. While none of these species are wetland-dependent, it is probable that the combination of streams, marsh, seasonally wet grasslands and adjacent non-wetland habitats, together with limited human presence are of some importance for these species. Chinese Bullfrog was recorded in the marsh area and in several nearby locations in surveys conducted for the current study and the Loop Study.

Also present in Ma Tso Lung Marsh and hence potentially dependent upon Ma Tso Lung Stream is one dragonfly species of conservation significance, Ruby Darter which is associated with marsh and pond habitats (see **Section 13.6.1.4**). Pale Palm Dart and Small Three-ring,

both butterfly species of conservation significance, were also found in wetland at Ma Tso Lung, these species is unlikely to be dependent on the wetland habitats in the area as their larval food plants are common grasses which are not obligate wetland species.

Though it is slightly disturbed by domestic pollution and anthropogenic structure, Ma Tso Lung San Tsuen Stream also supports fauna species of conservation significance. Species found in surveys conducted for the current study and the LMC Loop Study included Small Snakehead, Chinese Bullfrog, the crab *Somanniathelphusa zanklon* (in two locations) and Ruby Darter.

Table 13.22 - Ecological evaluation of Ma Tso Lung Stream

Criteria	North: Ma Tso Lung Stream	Ma Tso Lung San Tsuen Stream
Naturalness	Largely natural in the upstream and midstream sections; partially channelised but with natural stream bottom and largely natural banks in the lower reaches. Some pollution but water quality largely good.	Largely natural, but some disturbance from adjacent structures and pollution.
Size	Ma Tso Lung stream is narrow (<5m) but moderate in length (5600m including upper tributaries).	Ma Tso Lung San Tsuen Watercourse is narrow and relatively short (1000m).
Diversity	Moderate diversity of riparian vegetation; especially in the middle and upper reaches. Moderate diversity of fauna in stream and riparian corridor.	Low diversity of riparian vegetation. Moderate diversity of fauna in stream and riparian corridor.
Rarity	Streams with this limited level of human activity are uncommon in Hong Kong and declining due to channelisation. Three-banded Box Terrapin is globally critically endangered; several other species of conservation importance are present in and near the stream and ecologically and hydrologically linked habitats.	Streams with this limited level of human activity are uncommon in Hong Kong and declining due to channelisation. Three species, including two stream specialists (Small Snakehead and <i>Somanniathelphusa zanklon</i>) were recorded in and along the stream; several other species of conservation importance are present in ecologically and hydrologically linked habitats.
Re-creatability	Middle and upper sections are not easily re-creatable; partially channelised lower section could be re-created.	Not easily re-creatable.
Fragmentation	Some fragmentation due to roads, structures and pollution but riparian corridor largely unfragmented.	Slightly fragmented by structures and pollution.

Criteria	North: Ma Tso Lung Stream	Ma Tso Lung San Tsuen Stream
Ecological linkage	Significant ecological and hydrological linkages to adjacent and downstream habitats: plantation in upper and middle sections; marsh, seasonally wet grassland and shrubland in lower sections. Riparian corridor of Ma Tso Lung Stream is a significant ecological corridor.	Significant ecological and hydrological linkages to and downstream habitats: marsh and seasonally wet grassland.
Potential value	Some potential for enhancement, especially in Ma Tso Lung Stream, by preventing pollution or by improvement to riparian vegetation.	Some potential for enhancement by preventing pollution or by improvement to riparian vegetation.
Nursery/ breeding ground	Stream fauna of conservation significance presumably breeds in the stream or marsh.	Stream fauna of conservation significance presumably breeds in the stream or marsh or downstream marsh or stream habitats.
Age	Not known, but modified by past human activity, especially to riparian vegetation.	Not known, but modified by past human activity, especially to riparian vegetation.
Abundance/ Richness of wildlife	Moderate abundance and diversity of riparian and stream fauna with several species of conservation significance present including Three-banded Box Terrapin.	Low to moderate abundance and diversity of riparian and stream fauna with several species of conservation significance present.
Ecological value	Upper and midstream section of Ma Tso Lung Stream of High Ecological Value because of presence of Three-banded Box Terrapin; lower section of Moderate to High Ecological Value because of presence of several species of conservation significance and importance of riparian corridor.	Ma Tso Lung San Tsuen Stream of Moderate to High Ecological Value due to presence species of conservation importance.

Pak Shek Au Watercourse and Chau Tau Village Watercourses

Pak Shek Au Watercourse comprises two concrete-lined 'v-shaped' drainage ditches bordering the Castle Peak Road (Chau Tau section) empty into a roadside culvert. They only flow after rain and do not support any stream fauna.

The Chau Tau Village Watercourses comprise two minor and polluted channels in the east of the village. They were surveyed for the LMC Loop Study and were found to support a small number of the crab species *Somanniathelphusa zanklon* which is of conservation significance. These streams were evaluated as of low ecological value under that study.

Tung Fong/Shek Tsai Ling Watercourse and Kwu Tung Watercourse

These watercourses are the upper and lower sections of the same river basin respectively. They are largely channelised with vertical concrete sides and bottom and are polluted by grey water run-off from nearby open storage and Ho Sheung Heung Road. However, part of the upstream section of the Tung Fong Watercourse is not channelised and has a rocky, semi-natural streamcourse. This section of the watercourse only flows seasonally and is highly degraded and polluted by human activities. The species complexity and abundance of fauna and flora species on both watercourses is low.

The only fish species recorded in surveys conducted under the current study was the exotic Mosquito Fish. However, the endangered crab *Somanniathelphusa zanklon* was recorded in the concrete-lined channel of the Tung Fong Watercourse. This species occurs in a variety of lotic and lentic lowland habitats, including irrigation ditches, and is fairly tolerant of organic pollution, but generally favours a muddy substrate, so the individual recorded may have been displaced from habitat upstream. Surveys conducted under the current and LMC Loop studies have found this species in a number of streams in the area of varying ecological value. Thus, while of relevance to the assessment process, in view of the habitat preferences of this species, the presence of this species is considered to be of limited relevance to the assessment of the ecological value of the watercourse habitat as a whole.

No flora or other fauna of conservation significance has been recorded from this stream.

Table 13.23 - Ecological evaluation of Tung Fong/Shek Tsai Ling Watercourse and Kwu Tung Watercourse

Criteria	Assessment
Naturalness	Largely channelised with 'u-shaped' concrete channel, upper section of Tung Fong Watercourse is a natural rocky channel, but this section is highly disturbed by anthropogenic activity and is seasonal.
Size	Small.
Diversity	Low faunal and floral diversity.
Rarity	A common habitat type in urban and village areas in HK; however one crab species of conservation significance, <i>Somanniathelphusa zanklon</i> , was found, albeit in atypical and probably unsuitable habitat.
Re-creatability	Readily re-created.
Fragmentation	Connected hydrologically, but fragmented ecologically by urban/village development.
Ecological linkage	No significant linkages.
Potential value	Very little potential for enhancement without complete re-engineering of channels.
Nursery/ breeding ground	Not known to be an important nursery or breeding ground and most unlikely due to small size, artificial nature and pollution. However, presence of <i>Somanniathelphusa zanklon</i> suggests that this species may breed, perhaps in the upstream section.
Age	Unknown.

Criteria	Assessment
Abundance/ Richness of wildlife	Low abundance and diversity of fauna.
Ecological value	Low Ecological Value.

Fung Kong and Ho Sheung Heung Watercourses

These watercourses are the upper and lower sections of the same catchment, respectively, and are situated to the west of Ho Sheung Heung village. Most sections of these watercourses lie in vertical-walled concrete channels; some sections of the Fung Kong Watercourse have been channelised by villagers and are not lined with concrete. However, these sections are highly disturbed by anthropogenic structures and pollution while vegetation is dominated by the aggressive exotic climber *Mikania micrantha* and common herb species such as *Panicum maximum* and *Bidens alba*. Other than a dead Indo-Chinese Rat Snake *Ptyas korros* found in a vertical-walled section of Ho Sheung Heung Watercourse (which may have fallen in and cannot be considered as an individual utilising the habitat), only very limited pollution-tolerant fish and invertebrate stream fauna species were recorded during surveys conducted under the present study.

This watercourse does, however, supply water to a mitigation meander on the Sheung Yue River; in view of the polluted state of the watercourse it is not clear if this hydrological linkage is beneficial.

Table 13.24 - Ecological evaluation of Fung Kong and Ho Sheung Heung Watercourses

Criteria	Assessment
Naturalness	Largely channelised with 'u-shaped' concrete channel, part of Fung Kong Watercourse has been 'informally' channelised and is not lined with concrete. Highly disturbed by anthropogenic activity.
Size	Small.
Diversity	Low faunal and floral diversity.
Rarity	A common habitat type in urban and village areas in HK; one reptile of conservation significance (Indo-chinese Rat Snake) was found in surveys, however the individual was dead and in unsuitable habitat.
Re-creatability	Readily re-created.
Fragmentation	Connected hydrologically, but fragmented ecologically by urban/village development.
Ecological linkage	No significant ecological linkages, but linked hydrologically to a mitigation meander downstream on the Sheung Yue River.
Potential value	Very little potential for enhancement without complete re-engineering of channels.
Nursery/ breeding ground	Not known to be an important nursery or breeding ground and most unlikely due to small size, artificial nature and pollution.
Age	Unknown.

Criteria	Assessment
Abundance/ Richness of wildlife	Low abundance and diversity of fauna.
Ecological value	Low Ecological Value.

Tsung Yuen Watercourse

This small watercourse passes through Ho Sheung Heung San Tsuen and agricultural land in the north of Long Valley. The watercourse is partly channelised, but part of the channel is semi-natural, albeit highly polluted by domestic discharge from the village. Riparian vegetation is dominated by disturbance-tolerant exotic species such as *Brachiaria mutica* and *Kyllingo polyphylla*. Only pollution-tolerant fish and stream invertebrate species were found in this channel during surveys conducted under the current study. However, these included one fish species, Climbing Perch, which is listed as Data Deficient by IUCN. This species appears to have colonized Hong Kong in recent years, but it is uncertain if the population has reached Hong Kong naturally.

The unchannelised section of this stream is programmed to be channelised during 2013 - 2016.

Table 13.25 - Ecological evaluation of Tsung Yuen Watercourse

Criteria	Assessment
Naturalness	Partly channelised but largely semi-natural sides and stream bottom. Highly disturbed by anthropogenic activity.
Size	Small.
Diversity	Low faunal and floral diversity.
Rarity	A common habitat type in urban and village areas in HK. One fish species, Climbing Perch, present but origin uncertain.
Re-creatability	Readily re-created.
Fragmentation	Fragmented by urban/village development.
Ecological linkage	No significant ecological linkages.
Potential value	Could be enhanced by sensitive channelisation and control of pollution.
Nursery/ breeding ground	Not known to be an important nursery or breeding ground and most unlikely due to small size, artificial nature and pollution.
Age	Unknown.
Abundance/ Richness of wildlife	Low abundance and diversity of fauna.
Ecological value	Low Ecological Value.

Lo Wu Correctional Institution Watercourse

This 'watercourse' is a vertical concrete-lined drainage ditch and only flows after rain and is not of ecological significance. No fish were found and the only invertebrates present in a heavily polluted pool were exotic gastropods during surveys conducted under the current study.

Ngam Pin Watercourse

This small watercourse is located in the north of the Study Area, rising on the east side of Crest Hill and flowing into ponds adjacent to the Ng Tung River. The lower portion of the watercourse borders storage yards and other anthropogenic structures but the natural stream bed is retained. As the watercourse is highly disturbed by human activities in the lower section, riparian vegetation here largely comprises ruderal species such as *Bidens alba*, *Alocasia macrorrhizos* and *Praxelis clematidea*. However, a clump of the protected riparian fern species *Cibotium barometz* was found beside the watercourse. This species is listed as a Category II nationally protected species in China (CSIS 2013) and is protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). It is, however, very common in forest and shrubland in Hong Kong (Xing *et al.* 2000).

The upper section of this stream is largely natural but its ecological value is constrained by its small size and low flow, with the upper reaches being seasonal.

No fish or stream invertebrates were found in the stream during surveys conducted under the current study.

Table 13.26 - Ecological evaluation of Ngam Pin Watercourse

Criteria	Assessment
Naturalness	Largely natural but disturbed by anthropogenic activity in the lower section which is polluted.
Size	Small and narrow (700m in length) with limited flow in the dry season.
Diversity	Low faunal diversity, but riparian vegetation moderately diverse along its upper reaches.
Rarity	Small natural streams are moderately common in Hong Kong but declining. One fern, <i>Cibotium barometz</i> , of conservation significance found, but this species is common in Hong Kong.
Re-creatability	Not easily re-creatable.
Fragmentation	Somewhat fragmented in its lower reaches by developed areas.
Ecological linkage	Limited ecological linkage to surrounding habitats but hydrological linkage to ponds west of Ng Tung River.
Potential value	Some potential for enhancement by preventing pollution or by improvement to riparian vegetation in lower reaches.
Nursery/ breeding ground	No breeding grounds known and unlikely due to small size and pollution.
Age	A long-established habitat but with past human activity, especially to riparian vegetation.
Abundance/ Richness of wildlife	Low diversity and low abundance of wildlife.

Criteria	Assessment
Ecological value	Low to Moderate Ecological Value due to natural condition of upstream section.

Long Valley Watercourse

The Long Valley Watercourse is an irrigation channel that delivers water from the Sheung Yue River to Long Valley. Water is abstracted above a fabridam on the river upstream from the Fanling Highway. The upstream section is a concrete-lined channel; water quality is relatively high but the concrete lining severely limits its ecological function.

The middle and downstream sections comprise a network of manually created ditches, largely with earth sides and bottom, which are frequently modified by farmers for irrigation and other agricultural purposes.

Fish and stream invertebrate species found in stream surveys conducted under the current study found one fish species, Climbing Perch, in the downstream section of the watercourse within Long Valley. This species is not considered to be of conservation significance.

Table 13.27 - Ecological evaluation of the Long Valley Watercourse

Criteria	Assessment
Naturalness	Man-made habitat.
Size	Small.
Diversity	Low habitat diversity; low diversity of stream fauna.
Rarity	A common habitat type in Hong Kong. No rare species of conservation significance recorded in the stream.
Re-creatability	Could be re-created where suitable hydrological conditions present.
Fragmentation	Upper reaches fragmented by roads and developed area but not hydrologically fragmented.
Ecological linkage	Ecologically linked to other wetland habitats in Long Valley.
Potential value	Significant potential for enhancement within Long Valley.
Nursery/ breeding ground	Not known to be an important nursery or breeding ground but likely to be utilised by wetland-dependent fauna in Long Valley.
Age	Unknown but upstream section modified during river channelisation works and downstream sections regularly modified by farming activities.
Abundance/ Richness of wildlife	Moderate abundance but relatively low diversity of stream fauna due to anthropogenic activity.
Ecological value	Low to Moderate Ecological Value largely due to its ecological linkages to other wetland habitats in Long Valley.

Cheung Po Tau Stream

This and the Fu Tei Au Watercourse comprise one catchment area which drains into the Ng Tung River in the northwest of FLN, but are fragmented by the village of Hung Kiu San Tsuen. The Cheung Po Tau

Stream is a natural watercourse in its upper reaches but the lower section is a concrete-lined channel. The entire watercourse is seasonal. It is somewhat disturbed by human activity, including hillfire, in its upper reaches, and highly disturbed close to Hung Kiu San Tsuen.

The upper section of Cheung Po Tau Stream is located under the plantation woodland. The plantation is dominated by the exotic tree *Melaleuca quinquenervia* but native shrub species such as *Rhus chinensis* are found below the tree canopy. Two wild orchid species were recorded on the roadside close to the upper section of the stream; two individuals of *Spathoglottis pubescens* and 57 individuals of *Pecteilis susannae* were identified. All wild native orchid species are protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and the Forestry Regulations (Cap. 96A) in Hong Kong. The population of *Pecteilis susannae* has undergone a dramatic decline due to extensive collection and hill fire, hence it is listed as infrequent and restricted by Barretto *et al.* (2011). The other orchid species *Spathoglottis pubescens* is regarded as abundant and widespread (Barretto *et al.* 2011).

Being seasonal, no fish species were found during surveys conducted in the Cheung Po Tau Stream under the current study. However, water quality was found to be fair and a moderate diversity, but low numbers of stream fauna species was found. Though not of conservation significance, an uncommon dragonfly species Elusive Adjutant *Aethriamanta brevipennis* was found near the lower section of watercourse in surveys conducted under the current study. This species is considered as uncommon by Tam *et al.* (2011). In addition, Bush Hopper *Ampittia dioscorides*, a wetland-dependent butterfly species which is considered to be uncommon in Hong Kong (AFCD Biodiversity Database 2012), was also recorded near the stream in surveys conducted under the current study.

Table 13.28 - Ecological evaluation of Cheung Po Tau Stream

Criteria	Cheung Po Tau Stream
Naturalness	Semi-natural habitat in its upstream section but with human impacts to riparian habitats; lower section channelised and highly disturbed. Relatively unpolluted in its upstream section, but lower section polluted.
Size	Small.
Diversity	Habitat, floral and faunal diversity low to moderate.
Rarity	Natural streams are common but declining in Hong Kong. Two protected orchid species present in riparian corridor.
Re-creatability	Not easy to re-create.
Fragmentation	Fragmented by developed area in its lower reaches.
Ecological linkage	Some ecological linkages with adjacent woodland and shrubland habitats.
Potential value	Potential for improvement if riparian corridor protected from fire and other anthropogenic impacts.

Criteria	Cheung Po Tau Stream
Nursery/ breeding ground	Not known to support important breeding grounds.
Age	A relatively long-established habitat but with some human influence.
Abundance/ Richness of wildlife	Moderate diversity but low numbers of riparian and stream fauna.
Ecological value	Low to Moderate due to rarity of habitat and protected and uncommon species in riparian corridor.

Fu Tei Au Watercourse

This seasonal watercourse is channelised with vertical concrete sides and floor. Thus, its ecological value is severely limited and this is exacerbated by pollution from the nearby developed area and storage yard. As the stream is channelised, plant diversity and coverage were found to be very low. Species such as *Ipomea carica*, *Mikania micrantha*, *Wedelia trilobata* and *Panicum maximum* were recorded. No fish or aquatic invertebrates were found in surveys of Fu Tei Au Watercourse conducted under the current study and no fauna of conservation significance is present.

Table 13.28a - Ecological evaluation of Fu Tei Au Watercourse

Criteria	Fu Tei Au Watercourse
Naturalness	Man-made habitat. Polluted.
Size	Small.
Diversity	Low diversity of fauna and flora.
Rarity	A common habitat in Hong Kong.
Re-creatability	Easy to re-create.
Fragmentation	Fragmented by developed areas.
Ecological linkage	Little ecological linkage between these and other habitats.
Potential value	Little potential for improvement of value without significant engineering works.
Nursery/ breeding ground	Not known to support important breeding grounds.
Age	Created relatively recently during the Ng Tung River channelisation.
Abundance/ Richness of wildlife	Low.
Ecological value	Low Ecological Value.

Sheung Shui Wa Shan Watercourses

These twin watercourses pass through Sheung Shui Wa Shan Village. They are channelised in 'u-shaped' concrete channels below the villages, but the upper sections in the villages are 'informally' channelised. Though somewhat polluted, water quality was found to be fair in both channels in stream surveys conducted under the present study.

Only exotic fish species were recorded in these surveys, but a single individual of a crab species of conservation significance, *Somanniathelphusa zanklon* was recorded in the eastern channel. This species occurs in a variety of lotic and lentic lowland habitats, including irrigation ditches, and is fairly tolerant of organic pollution. Surveys conducted under the current and LMC Loop studies have found this species in a number of streams of varying ecological value in the area.

No flora or other fauna of conservation significance has been recorded from these streams.

Table 13.29 - Ecological evaluation of Sheung Shui Wa Shan Watercourses

Criteria	Assessment
Naturalness	Man-made habitat.
Size	Small.
Diversity	Low habitat diversity; low diversity of stream fauna.
Rarity	A common habitat type in Hong Kong. The crab species <i>Somanniathelphusa zanklon</i> of conservation significance was recorded in the eastern channel. However, only a single individual was found, suggesting that the population of this species in this stream is small.
Re-creatability	Easily re-created.
Fragmentation	Fragmented by developed areas.
Ecological linkage	No significant ecological linkages.
Potential value	Very little potential for enhancement without complete re-engineering of channels.
Nursery/ breeding ground	Not known to be an important nursery or breeding ground. However, presence of <i>Somanniathelphusa zanklon</i> suggests that this species may breed in the eastern watercourse.
Age	Unknown but modified during river channelisation works.
Abundance/ Richness of wildlife	Low abundance and diversity of wildlife.
Ecological value	Low to Moderate Ecological Value due to presence of <i>Somanniathelphusa zanklon</i> on a precautionary basis as this species is listed as of Global Concern, albeit it appears to be quite widespread in the Study Area and in Hong Kong.

Siu Hang San Tsuen

This stream is a tributary of the Ng Tung River; the downstream section passes through a mitigation wetland maintained by AFCD, while the upstream section flows through agricultural land. The downstream section is in a concrete-lined channel; the upstream section is semi-natural but has been excavated to improve flow. Floral diversity along the riparian corridor is typical of agricultural land in the upstream section and of mitigation wetland in the downstream section.

However, the aquatic faunal community is moderately diverse including the native fish Predaceous Chub *Parazacco spilurus*, which is common in

Hong Kong but is listed as ‘Vulnerable’ in the Chinese Red Data Book. The dragonfly community of the stream is also diverse, with 19 species recorded including Blue Sprite (of Local Concern) and Emerald Cascader (of Potential Global Concern). However, despite these species being listed as of respectively local and international conservation significance, Blue Sprite is common in Hong Kong and Emerald Cascader is abundant (AFCD Biodiversity Database 2012).

Table 13.30 - Ecological evaluation of Siu Hang San Tsuen Stream

Criteria	Assessment
Naturalness	Man-made habitat, but upstream section has banks and stream floor of natural materials; some human impacts to riparian habitats.
Size	Small in size (<5m in width and 1200m in length).
Diversity	A moderate diversity of fish and invertebrates.
Rarity	Upstream section is a relatively common stream type in Hong Kong; channelised downstream section is common. Stream fauna includes one fish species and two dragonfly species of conservation significance (Predaceous Chub, Blue Sprite and Emerald Cascader). However, all of these species are considered to be common or abundant in Hong Kong. None of these rare species have been found in the lower section of stream.
Re-creatability	Could be re-created relatively readily.
Fragmentation	Rather fragmented in this area.
Ecological linkage	Upstream section has ecological linkage with adjacent agricultural habitats; downstream section has linkages with mitigation wetland which it flows through.
Potential value	Value could be increased by enhancement of vegetation in riparian corridor.
Nursery/ breeding ground	Predaceous Chub and other stream fish species must breed in the stream.
Age	A relatively long-established habitat but with some human influence.
Abundance/ Richness of wildlife	Moderate abundance and diversity of stream fauna.
Ecological value	Upstream section of Moderate Value due to stream fauna; downstream channelised section of Low to Moderate Ecological Value , largely due to linkages with adjacent mitigation wetland.

Man Kok Village, Tin Ping Shan Tsuen, Shek Wu San Tsuen and Ma Shi Po Watercourses

These four small watercourses are located to the south of the Ng Tung River in FLN. All are channelised: Man Kok Village and Shek Wu San Tsuen Watercourses are concrete drainage channels, Tin Ping Shan Tsuen Watercourse is also a concrete channel in its upstream and downstream sections, but part of the midstream, which passes through agricultural land, has sides and bed of natural materials. Finally, Ma Shi Po Watercourse is a seasonal ditch, partly hand dug and partly concrete-lined where it passes through the village; this stream is heavily polluted by grey water.

Stream surveys undertaken under the current study in the Tin Ping San Tsuen Watercourse found no fish species of conservation significance and one individual of the crab species, *Somanniathelphusa zanklon*, which is of conservation significance. As discussed elsewhere in this Report, surveys conducted under the current and LMC Loop studies have found this species in a number of streams of varying ecological value in the area. Thus, while of relevance to the assessment process, the presence of this species is considered to be of limited relevance to the assessment of the ecological value of the watercourse habitat as a whole.

Table 13.31 - Ecological evaluation of Man Kok Village, Tin Ping Shan Tsuen, Shek Wu San Tsuen and Ma Shi Po Watercourses

Criteria	Assessment
Naturalness	Man-made habitat, largely concrete-lined channel but the midstream section of Tin Ping San Tsuen Watercourse, and sections of Ma Shi Po Watercourse, have banks and floor of natural materials. All are highly disturbed by adjacent developed and village areas and are moderately to highly polluted.
Size	All are small in size; Mai Shi Po Watercourse is very small.
Diversity	Low diversity of fish and invertebrates.
Rarity	Streams of this type are common in Hong Kong; crab species <i>Somanniathelphusa zanklon</i> found in a channelised section of the Tin Ping Shan Tsuen Watercourse is of conservation significance but is present in several streams in the Study Area.
Re-creatability	Could be re-created relatively readily.
Fragmentation	Fragmented by developed areas.
Ecological linkage	Some linkages with adjacent agricultural habitats.
Potential value	Limited potential for enhancement without significant re-engineering works; Ma Shi Po Watercourse could be enhanced by eliminating pollution but potential limited by size, seasonality and adjacent developments.
Nursery/ breeding ground	<i>Somanniathelphusa zanklon</i> may breed in Tin Pan Shan Tsuen Watercourse.
Age	Age unknown but all modified in recent years by river channelisation works.
Abundance/ Richness of wildlife	Low abundance and diversity of stream fauna.
Ecological value	Low Ecological Value.

Ma Wat River

This watercourse, which drains into the Ng Tung River in the east of Fanling, is much the largest of the smaller watercourses in the Study Area, at least in its lower reaches. These lower reaches, north of the point where the MTRC East Rail Line crosses the river, have been channelised by creation of a trapezoidal channel with concrete/masonry-

lined sides and a concrete floor with a low flow channel (**Figure 13.9b** illustrates the different sections of the river).

Upstream from this this point to the crossing point of the Fanling Highway the river has been channelised by creation of a trapezoidal grassed concrete channel with cellular paving on the sides and a rock and gravel floor.

South (and upstream) from this point to the southern limit of the Study Area, the channel has gabion sides and a rocky floor and the channel is sufficiently wide to allow establishment of semi-natural herbaceous riparian vegetation in many places. A short length of the upstream section, to the south of Nam Wa Po, is included in the Kau Lung Hang Streams EIS, which was designated due to the presence of *Acrossocheilus parallens*, a fish species of conservation significance. Another fish species of conservation significance, Small Snakehead, has also been recorded in this stream section (AFCD Biodiversity Database). Common Carp has also been recorded in the EIS. This species is listed as Vulnerable globally by IUCN (2013), but its presence in this location may not be natural.

Table 13.32 - Ecological evaluation of Ma Wat River

Criteria	Assessment
Naturalness	Man-made habitat, largely concrete-lined channel in lower reaches, midstream section with an engineered trapezoidal section and rock/gravel floor; upstream section an engineered channel with gabion sides, rock/gravel floor and areas with semi-natural riparian vegetation.
Size	Moderate width but relatively long (length approx. 5.1km).
Diversity	Low diversity of fish and invertebrates.
Rarity	Two fish species of conservation significance, Small Snakehead and <i>Acrossocheilus parallens</i> , have been recorded, the latter species is of global conservation concern.
Re-creatability	Could be re-created.
Fragmentation	Fragmented by developed areas, roads and railway.
Ecological linkage	Downstream linkage with Ng Tung River, upstream linkages to tributaries; limited linkages to adjacent habitats.
Potential value	Limited potential for enhancement without significant re-engineering works.
Nursery/ breeding ground	None known, but the fish species of conservation significance, <i>Acrossocheilus parallens</i> and Small Snakehead, may breed in the upstream section where suitable habitat appears to be present.
Age	Age unknown but midstream and upstream sections significantly modified in recent years by river channelisation works.
Abundance/ Richness of wildlife	Moderate abundance and diversity of stream fauna in mid and upstream sections but fish community dominated by exotic species.
Ecological value	Downstream and midstream sections of Low Ecological Value ; upstream section of Moderate Ecological Value due to presence of fauna species of conservation significance.

San Uk Tsuen, Ma Wat Wai and Tong Hang Watercourses

These small watercourses all drain into the Ma Wat River. All are concrete-lined channels in their lower reaches within the Study Area and all are located within developed areas. Water quality in the San Uk Tsuen Watercourse was found to be poor in stream surveys conducted under the current study, but the water quality in the other channels was fair. No fish or invertebrate species of conservation significance were found in two of the streams during surveys conducted under the current study, while in Ma Wat Wai Stream the crab *Sommaniathelphusa zanklon* was recorded. This species is listed as of global conservation concern, but has been found in several watercourses in the Study Area.

Table 13.33 - Ecological evaluation of San Uk Tsuen, Ma Wat Wai and Tong Hang Watercourses

Criteria	Assessment
Naturalness	Man-made habitat but with semi-natural sections, especially upstream; all influenced by human activity.
Size	All are small in size.
Diversity	Low diversity of fish and invertebrates.
Rarity	Streams of this type are common in Hong Kong. <i>Sommaniathelphusa zanklon</i> , recorded in the Ma Wat Wai Watercourse, is of conservation significance.
Re-creatability	Could be re-created relatively readily.
Fragmentation	Fragmented by developed areas.
Ecological linkage	No significant ecological linkages.
Potential value	Limited potential for enhancement without significant re-engineering works; constrained by adjacent developments.
Nursery/ breeding ground	None known.
Age	Age unknown but all modified in recent years by river channelisation works.
Abundance/ Richness of wildlife	Low abundance and diversity of stream fauna; fish community dominated by exotic species.
Ecological value	San Uk Tsuen and Tong Hang Watercourses are of Low Ecological Value . Ma Wat Wai Watercourse Low to Moderate Ecological Value due to presence of <i>Somanniathelphusa zanklon</i> on a precautionary basis as this species is listed as of Global Concern, albeit it appears to be quite widespread in the Study Area and in Hong Kong.

Kau Lung Hang Watercourses

The Kau Lung Hang Lo Wai, Kau Lung San Wai, Yuen Leng and Tai Wo Watercourses are, together with a short section of the Ma Wat River discussed above, designated as an EIS due to the presence of *Acrossocheilus parallens*. The Kau Lung Hang Watercourses meet just south of Kiu Tau and the combined stream joins the Ma Wat River slightly to the east of the Fanling Highway.

During surveys conducted under the current study the combined channels at Kiu Hang were found to be channelised and polluted and no fish or invertebrate species of conservation significance were found. The lower section of the Kau Lung Hang Watercourses was also channelised at the time of surveys and somewhat polluted. Despite this, *Acrossocheilus parallens* was found to be common. The marsh-associated dragonfly species, Ruby Darter, was found in this area during surveys conducted under the current study but is probably not dependent upon the streams. Another dragonfly species of conservation significance, Eastern Lilysquatter, was reported in this area by Mott MacDonald (2010). One additional fish species of conservation significance, Small Snakehead, is listed for the EIS and the dragonfly species, Emerald Cascader, is listed for the stream system in the AFCD Biodiversity Database.

In addition, a Common Rat Snake, a species of Potential Regional Concern was found in the riparian zone of the Kau Lung Hang Stream in surveys conducted for this study, albeit this species occurs in a variety of habitats and is not wetland-dependent.

These streams are currently all being channelised under the DSD Project 4148CD/A 'Drainage Improvement Works in Ping Kong, Kau Lung Hang, Yuen Leng, Nam Wa Po and Tai Hang areas'; the evaluation below assumes completion of these works.

Table 13.34 - Ecological evaluation of Kau Lung Hang Watercourses

Criteria	Assessment
Naturalness	Channelisation works are in progress, when these are completed the lower sections will be man-made habitat but the upstream sections will remain natural.
Size	Small.
Diversity	Moderate diversity of fish and invertebrates.
Rarity	A common habitat in Hong Kong; <i>Acrossocheilus parallens</i> is of global conservation concern; Small Snakehead, found in the watercourses, and three dragonfly species, Eastern Lilysquatter, Ruby Darter and Emerald Cascader, found in the riparian area, are also of conservation significance. Common Rat Snake also found, but this species is not wetland-dependent.
Re-creatability	Could be re-created.
Fragmentation	Slightly fragmented in the lower sections.
Ecological linkage	Downstream linkage with Ma Wat River; upstream sections may have some linkages to adjacent habitats.
Potential value	Limited potential for enhancement.
Nursery/ breeding ground	<i>Acrossocheilus parallens</i> must breed in the streams; the other species of conservation significance present may also breed.
Age	Age unknown but recently modified by river channelisation works.
Abundance/ Richness of wildlife	Assumed to be moderate following channelisation.

Criteria	Assessment
Ecological value	Moderate Ecological Value as habitat will be highly modified, but several species of conservation significance are present including <i>Acrossocheilus parallens</i> which is of global conservation concern.

Nam Wa Po Watercourses

These seasonal tributaries of the Ma Wat River flow from the ridge of Wo Hop Shek. All are heavily shaded by a tree canopy of common plantation species. No fauna species of conservation concern were recorded.

Table 13.35 - Ecological evaluation of Nam Wa Po Watercourses

Criteria	Assessment
Naturalness	Semi-natural but modified in lower sections.
Size	Small and seasonal.
Diversity	Low due to small size and seasonality and surrounding plantation.
Rarity	A common habitat in Hong Kong.
Re-creatability	Could be re-created.
Fragmentation	Slightly fragmented in the lower sections.
Ecological linkage	Some linkages to adjacent habitats.
Potential value	Limited potential for enhancement.
Nursery/ breeding ground	None known.
Age	Unknown.
Abundance/ Richness of wildlife	Low
Ecological value	Low

13.6.1.8 Grassland, Grassland/Shrubland and Shrubland

Natural succession of vegetation from grassland to grassland/shrubland and eventually shrubland occurs when land on hillsides, abandoned agricultural land, filled ponds or wasteground is left undisturbed. The condition of microhabitats present and speed of succession to shrubland depends upon relief, the soil and hydrological conditions present at the site. Within the Study Area, most of the hillside area is covered by grassland, which is maintained by periodic fire. Hillside shrubland is present around Mat Tso Lung, on the east side of Crest Hill and at Ki Lun Shan in KTN; with smaller areas in the north of FLN and in other scattered locations through the Study Area.

Grassland, grassland/shrubland and shrubland habitats support similar plant species but the diversity and relative abundance of shrubs and small trees increases as the habitat matures. Common species in these habitats within the NDA Study Area include the grasses *Imperata koenigii*, *Miscanthus sinensis*, *Neyraudia reynaudiana* and *Panicum maximum*, fern *Dicranopteris pedata*, herbs *Conyza sumatrensis*, *Crotalaria pallida*, *Mimosa pudica*, *Spilanthes paniculata*, *Tridax*

procumbens and shrubs *Baeckea frutescens*, *Breynia fruticosa*, *Eurya chinensis*, *Litsea rotundifolia* var. *oblongifolia*, *Rhaphiolepis indica*, *Rhus chinensis*, *Rhus succedanea* and *Wikstroemia indica*. Isolated trees were often recorded in shrubland; common species include *Acacia confusa*, *Aporosa dioica*, *Celtis sinensis*, *Ilex rotunda*, *Litsea glutinosa* and *Pinus massoniana*.

Faunal communities in the grassland and shrubland habitats are fairly species-poor, with the exception of butterflies. The butterfly community of shrubland around Crest Hill was found to be diverse, including a number of woodland-associated species that are uncommon in the north-west New Territories. Species recorded included Danaid Egg-fly of Local Concern. However, this species also occurs around ponds and lowland wetlands, so this habitat is unlikely to be of particular significance for this species. Small Three-ring, also of Local Concern, was recorded in hillside grassland on Crest Hill close to Ho Sheung Heung and near Ma Tso Lung. As this species is not dependent on this habitat and also occurs in shrubland, lowland and coastal grassland and wetland fringes, the presence of this species in this location is not considered to be of particular conservation significance.

Few species of conservation significance are present in, or dependent upon, upland grassland and shrubland habitats in the Study Area. One bird species of conservation importance, Eurasian Hobby, was noted over shrubland on Crest Hill. This species is considered to be of local conservation concern as a breeding species. Eurasian Hobbies typically utilise abandoned corvid nests for breeding, and a pair is thought to have bred on Crest Hill on a pylon in such a location in the past (Carey *et al.* 2001). Golden-headed Cisticola was also recorded in upland grassland on Crest Hill. This species is considered to be of Local Concern by Fellowes *et al.* (2001); however it is fairly widespread as a passage migrant and winter visitor in grassland habitat in the northern New Territories. The observation at Crest Hill, which was of three birds outside the breeding season, is not, therefore, considered to be of conservation significance.

Eurasian Eagle Owl has not definitely been recorded from the Study Area but has occurred in the Chau Tau area in the past (Carey *et al.* 2001). Grey Nightjar was recorded calling over upland grassland at Cheung Po Tau and Wa Shan in FLN in surveys conducted under the current study. Only one breeding record of this species in Hong Kong is listed by Carey *et al.* (2001), but this species is now considered by members of the study team to breed in upland grassland/shrubland areas in a number of locations in the New Territories. The species is not associated with grassland of higher ecological value, even occurring in recently burnt areas. Shrubland in the Ma Tso Lung area is a part of the habitat complex in this area, which is of significance for a number of fauna species of conservation significance, including butterfly and reptile species. While none of these species may be primarily dependent on the shrubland

element of the habitat complex, shrubland probably forms a significant habitat element for some of them.

Much of the lowland habitats close to the Ng Tung River (especially to the south of the river) comprise grassland and grassland/shrubland derived from vegetative succession on long-abandoned agricultural land. Such habitats generally support relatively low plant diversity, dominated by widespread and weedy vegetation including exotic grasses *Panicum maximum* and *Brachiaria mutica*.

Smaller areas of lowland grassland with similar ecological characteristics are found elsewhere in the Study Area, notably around Ho Sheung Heung.

Fauna species found in lowland grassland tend to be habitat generalists and this habitat is not qualitatively of significance for any species regularly occurring in the Study Area. However, seasonally wet lowland grassland may be utilised by amphibian and wetland bird species which also use other lowland wetland habitats.

Table 13.36 - Ecological evaluation of upland grassland, grassland/shrubland and shrubland

Criteria	Upland Grassland	Grassland/Shrubland	Shrubland
Naturalness	Semi-natural habitat on hill slopes.	Semi-natural habitat as part of succession from grassland to shrubland.	A semi-natural habitat derived from succession on grassland habitats.
Size	Extensive in the Study Area (311.60ha).	Moderate areas present in the Study Area (50.21ha).	A moderately large area in the north of the Study Area on Crest Hill, small areas elsewhere (62.66ha in total).
Diversity	Low diversity of flora and fauna species.	Low diversity of flora and fauna species.	Moderate diversity of flora and butterflies, low to moderate diversity of birds, low diversity of other fauna.
Rarity	A common habitat type in Hong Kong. Grey Nightjar recorded at Cheung Po Tau and Wa Shan and Small Three-ring recorded on hillside adjacent to Ma Tso Lung and at Crest Hill.	A common habitat type in Hong Kong.	A common habitat type in Hong Kong. Eurasian Hobby is of conservation significance as a breeding species.

Criteria	Upland Grassland	Grassland/ Shrubland	Shrubland
Re-creatability	Could be re-created if suitable land present.	Easily re-created on suitable land.	Could be re-created by planting of shrub species but takes several years to mature.
Fragmentation	Largely fragmented.	Fragmented.	Not fragmented on slopes of Crest Hill. Moderately fragmented elsewhere.
Ecological linkage	Some ecological linkage to shrubland.	Ecological linkages to nearby grassland and shrubland.	Ecological linkage to grassland and woodland habitats.
Potential value	May be improved by preventing fire on hills.	Value will increase if allowed to mature into shrubland.	Value could be enhanced by natural succession and colonization of more species (especially fauna).
Nursery/ breeding ground	Not known to support significant breeding grounds; but Eagle Owl may breed at Chau Tau and Grey Nightjar at Cheung Po Tau.	Not known to be a significant nursery ground.	Pylon in shrubland at Crest Hill has been utilised by breeding Eurasian Hobby (of local conservation significance as a breeding habitat).
Age	Maintained at an early successional stage.	A fairly early successional habitat.	A mid-succession habitat undergoing succession to woodland.
Abundance/ Richness of wildlife	Relatively low abundance and diversity of wildlife present.	Low abundance and diversity of wildlife.	Generally low abundance and diversity but may be low to moderate for birds and a diverse community of butterflies present in shrubland on Crest Hill.
Ecological value	Upland grassland generally of Low Ecological Value , but that at Chau Tau, Cheung Po Tau, and Wa Shan of Low to Moderate Ecological Value due to possible presence of Eurasian Eagle	Grassland/shrubland in this area of Low Ecological Value .	Shrubland on Crest Hill of Moderate Ecological Value due to presence of breeding Eurasian Hobby and diverse butterfly community. Shrubland around Ma Tso Lung of Low to Moderate Ecological Value due to its role in a habitat complex of importance to

Criteria	Upland Grassland	Grassland/ Shrubland	Shrubland
	Owl and Grey Nightjar.		several species of conservation significance. Small patches elsewhere of Low Ecological Value.

Table 13.37 - Ecological evaluation of lowland grassland,

Criteria	Assessment
Naturalness	Semi-natural habitat derived from succession on abandoned agricultural land.
Size	A relatively large area is present within the Study Area (132.21ha).
Diversity	Low diversity of flora and fauna.
Rarity	A common habitat type in Hong Kong.
Re-creatability	Could be re-created on suitable land.
Fragmentation	Somewhat fragmented by developed areas.
Ecological linkage	Ecological linkage to seasonally wet grassland and some linkages to agricultural land.
Potential value	Limited potential.
Nursery/ breeding ground	None of significance known.
Age	Maintained at an early successional stage.
Abundance/ Richness of wildlife	Low abundance and diversity.
Ecological value	Low Ecological Value.

13.6.1.9 Seasonally Wet Grassland

Some of the lowland grassland, close to Ma Tso Lung village, is seasonally wet. This habitat is derived from poorly-drained abandoned agricultural land that is flooded during the wet season, permitting the establishment of wetland plant species. A moderately diverse plant community is present, but this is dominated by common herbaceous vegetation such as grass *Brachiaria mutica*, *Panicum maximum* and herbs *Ipomoea aquatica*, *Mikania micrantha*, *Commelina diffusa*, *Cyclosorus interruptus* and *Ludwigia perennis*. Other common herbaceous plants (such as *Kyllinga monocephala*, *Kyllinga aromatica*, *Polygonum glabrum*, *Polygonum lapathifolium* and sedge *Cyperus* spp.) and a few isolated trees (mostly *Macaranga tanarius*, *Ficus hispida* and *Trema tomentosa*) are also present. Chinese Bullfrog was recorded in this habitat at Ma Tso Lung during field work for the LMC Loop study, and it is connected with marsh and riparian areas along Ma Tso Lung Stream. In view of these factors, it is of higher ecological value than other areas of the same habitat in the Study Area.

Small areas of seasonally wet grassland are also present near Chau Tau and along the Ng Tung River in FLN. Vegetation in these areas differs little from the adjacent lowland grassland, and is dominated by ruderal grassland herb species, though the proportion of facultative wetland species may be higher.

Though it may be utilised by wetland bird and amphibian species, all bird and amphibian species found in this habitat occur in several habitat types, and are not restricted to this habitat, or to this habitat and a small number of other habitat types (see **Appendix 13.3.1**, **Appendix 13.5.2** and **Appendix 13.5.3**). Small Three-ring, found in this habitat at Ma Tso Lung was also found in hillside grassland and marsh habitat nearby. The distribution of this butterfly is related to that of its larval foodplant, the very common grass species *Ischaemum barbatum* which also grows on dry hillslopes so it too is highly unlikely to be dependent upon this habitat.

Table 13.38 - Ecological evaluation of seasonally wet grassland

Criteria	Ma Tso Lung	Near Chau Tau	Along the Ng Tung River
Naturalness	Semi-natural and has developed through natural succession.		
Size	Moderate (8.99ha).	Small (1.68).	Small (1.80ha).
Diversity	Vegetation low in floristic diversity, lacking structural complexity.		Vegetation largely ruderal herbs and grasses, diversity low.
Rarity	Not uncommon in Hong Kong. Utilised by some wetland bird and amphibian species of conservation significance and one such butterfly species at Ma Tso Lung (Small Three-ring) but none of these species are restricted to this habitat or this and a small number of other habitats or areas. All bird species of conservation significance recorded in this habitat occur in larger numbers in other wetland habitats.		
Re-creatability	Readily re-created given suitable hydrology.		
Fragmentation	Little fragmentation.	Somewhat fragmented by developed areas.	
Ecological linkage	Linkage with adjacent marsh and stream habitats.	Linkage with marsh and wet agricultural land nearby.	Linkage with adjacent wetland and grassland habitats.
Potential value	Enhancement as marsh possible.		
Nursery/ breeding ground	None of significance known.		
Age	Unknown.		
Abundance/ Richness of wildlife	Low.		Generally low but may be used by moderate numbers of common amphibians.

Ecological value	Low to Moderate due to moderate size and utilisation by fauna species of conservation significance.	Low due to small size and low numbers of fauna of conservation significance, none of which are restricted to this habitat.	Low due to small size and low numbers of fauna of conservation significance, none of which are restricted to this habitat.
------------------	--	---	---

13.6.1.10 *Fung Shui Wood*

Fung shui woods were identified at Ho Sheung Heung, Tsung Pak Long and Kam Tsin. The *fung shui* woods at Ho Sheung Heung and Tsung Pak Long are located within the boundary of the Project Area, while that at Kam Tsin is outside this boundary but within the Study Area. No *fung shui* woodland was identified in FLN.

The *fung shui* wood at Ho Sheung Heung formerly contained a closed and continuous woodland canopy, but was damaged by a fire in 2006, which divided the wood into two halves. Seedlings/saplings of native tree species typical of *fung shui* woodland, including *Aquilaria sinensis*, *Garcinia oblongifolia* and *Sterculia lanceolata*, were planted to help connect and restore the woodland area and these, together with natural regeneration, have now partially restored the linkages between the *fung shui* woodland areas. The structural integrity of the remaining woodland habitat is moderate. The overstorey of this wood is dominated by *Cinnamomum camphora*, *Machilus pauhoi*, *Litsea glutinosa*, *Microcos paniculatus* and *Schefflera heptaphylla*. The understorey and sub-canopy contains a diverse collection of common shrubs and trees, including *Acronychia pedunculata*, *Aporosa dioica*, *Bridelia tomentosa*, *Canthium dicoccum*, *Celtis sinensis*, *Desmos chinensis*, *Litsea cubeba*, *Litsea rotundifolia* var. *oblongifolia*, *Maesa perlaris*, *Psychotria asiatica* and *Uvaria macrophylla*. Climbers such as *Gnetum luofuense* (listed as near-threatened by IUCN), *Embelia laeta* and *Rourea minor* are common. Two saplings of *Aquilaria sinensis* were found in surveys conducted under the current Study. In surveys for the NENT study, as well as *Aquilaria sinensis*, two other plant species of conservation significance were recorded, *Alianthus fordii* and *Pavetta hongkongensis*, but it is not clear if they were found in the *fung shui* wood or the adjoining secondary woodland (Maunsell 2003).

The grassland resulting from the hill fire is generally covered by *Miscanthus sinensis* and the fern *Dicranopteris pedata*, with a small number of shrubs such as *Glochidion eriocarpum*, *Melastoma dodecandrum*, *Rhodomyrtus tomentosa* and *Rhus chinensis*.

The Ho Sheung Heung *fung shui* woodland was found to support a diverse butterfly community (42 species) in surveys conducted under the current study. No species of conservation significance were recorded, but

several species are woodland-associated and unusual in this part of Hong Kong. Butterfly species of conservation significance have previously been recorded in the area by Bascombe (Maunsell 2003); a list of such species is provided at **Appendix 13.7.4**, from which it is possible to determine those not recorded in the current study or in other subsequent studies (see **Appendix 13.7.13**).

Some woodland bird species recorded in the Ho Sheung Heung *fung shui* wood are uncommon in this part of the New Territories, including Black-naped Monarch, Mountain Tailorbird and Greenish Warbler. In terms of mammals, two mammal species of conservation significance, Masked Palm Civet and Leopard Cat, have been recorded in the woodland.

Kam Tsin *fung shui* wood is a small remnant highly degraded woodland patch embraced by the village. It receives frequent human disturbance and supports a poor plant diversity and simple vegetation structure with no understorey. The overstorey includes several large *Cinnamomum camphora* and *Dimocarpus longan*. Faunal surveys were not carried out in this area under the current study; other surveys or studies have not identified this wood as being of conservation significance for fauna or flora species.

Tsung Pak Long *fung shui* wood is a small woodland patch near the village. The woodland is mainly dominated by the typical *fung shui* woodland species of *Cinnamomum camphora* and *Sterculia lanceolata*. As the woodland is highly disturbed, some other common ruderal species such as *Leucaena leucocephala*, *Eleusine indica* and *Bidens alba* were also commonly recorded at the edge of the woodland. Faunal surveys were not carried out in this area under the current study; other surveys or studies have not identified this wood as being of conservation significance for fauna or flora species.

Table 13.39 - Ecological evaluation of *fung shui* woods

Criteria	Ho Sheung Heung <i>Fung Shui</i> wood	Kam Tsin <i>Fung Shui</i> wood	Tsung Pak Long <i>Fung Shui</i> wood
Naturalness	Semi-natural woodland, initially created by human action but since allowed to develop naturally.	Now highly-modified habitat created by human planting and subject to intense human disturbance.	Semi-natural habitat created by human planting and subject to human disturbance.
Size	Moderately sized, although reduced following fire in 2006; 4.57 ha of habitat present.	Small in size (0.66ha).	Small in size (0.72ha).
Diversity	Supports a moderate diversity of vegetation. Moderate diversity of fauna especially birds and	Vegetation species diversity is very low and largely restricted to a few large trees; most of understorey	Vegetation species diversity is low. Faunal diversity unknown but likely to be low in view of

Criteria	Ho Sheung Heung <i>Fung Shui</i> wood	Kam Tsin <i>Fung Shui</i> wood	Tsung Pak Long <i>Fung Shui</i> wood
	butterflies.	replaced by concrete car park. Faunal diversity unknown but likely to be low in view of degradation of habitat.	small size and high levels of human activity.
Rarity	<i>Fung shui</i> woodlands of this size are uncommon in Hong Kong. <i>Alianthus fordii</i> is rare in Hong Kong; other plant species of conservation significance (<i>Aquilaria sinensis</i> and <i>Gnetum luofuense</i>) also recorded, albeit only a few saplings of <i>A. sinensis</i> recorded; neither species rare in Hong Kong. Two mammal species of conservation significance (Masked Palm Civet and Leopard Cat) recorded and some historic records of butterfly species of conservation significance are likely to relate to this area (Maunsell 2003).	Similar <i>fung shui</i> woodland showing human disturbance is common in Hong Kong.	
Re-creatability	Could be re-created in the long term, although trees would take a long time to become mature.	Re-creation probably impractical due to surrounding village development.	Could be re-created although trees would take a long time to become mature.
Fragmentation	Somewhat fragmented; fragmentation increased by recent fire.	Highly fragmented by development.	Somewhat fragmented by development.
Ecological linkage	Ecological linkage to adjoining secondary woodland and nearby plantation and shrubland habitats.	No significant linkages.	Some ecological linkages to nearby plantations.
Potential value	Value will increase as replanted trees mature to replace damaged woodland.	Small in size and surrounded by developed land, so potential value is limited.	
Nursery/ breeding	Not known to support any significant nursery or breeding grounds.		

Criteria	Ho Sheung Heung <i>Fung Shui</i> wood	Kam Tsin <i>Fung</i> <i>Shui</i> wood	Tsung Pak Long <i>Fung Shui</i> wood
ground			
Age	Likely to be moderately old.		
Abundance/ Richness of wildlife	Good diversity of butterflies, including some species unusual in the north- west New Territories; moderate diversity and abundance of birds.	Likely to be low due to small size, lack of understorey, disturbance and fragmentation.	Likely to be relatively low due to small size, disturbance and fragmentation.
Ecological value	Moderate Ecological Value.	Low Ecological Value.	Low to Moderate Ecological Value

13.6.1.11 Secondary Woodland

Kwu Tung North

Four small to moderately-sized secondary woodland patches were identified at Tse Koo Hang near Ma Tso Lung, at Pun Uk Tsuen north of Chau Tau, south of Pak Shek Au on the north slope of Ki Lun Shan and at Ho Sheung Heung, either as regenerated woodland on hillsides or as remnants of old woodland patches behind villages or traditional graves. The plant species diversity in these woodlands is relatively rich, with closed and continuous canopy and reasonably complex structure. Native trees, such as *Cinnamomum camphora*, *Microcos paniculata*, *Celtis sinensis* and *Ficus variegata* var. *chlorocarpa*, dominate in the overstorey. The subcanopy and understorey support a variety of native climbers, shrubs and trees such as *Mallotus paniculata*, *Psychotria asiatica*, *Desmos chinensis*, *Aporosa dioica*, *Litsea glutinosa*, *Litsea rotundifolia* var. *oblongifolia*, *Phyllanthus emblica*, *Sarcandra glabra* and *Sapium sebiferum*.

The protected tree species *Aquilaria sinensis* was recorded in the woodland close to Ma Tso Lung, Ho Sheung Heung and south of Pak Shek Au. It was also recorded in woodland near Pun Uk Tsuen during the LMC Loop Study. Although this species is commonly found in lowland forest and *fung shui* woods in Hong Kong, it is regarded as Near Threatened in the China Plant Red Data Book. In Hong Kong, it is protected under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). In surveys for the NENT study, as well as *Aquilaria sinensis*, two other plant species of conservation significance were recorded in woodland at Ho Sheung Heung, *Alianthus fordii* and *Pavetta hongkongensis*, but it is not clear if they were found in the *fung shui* wood or the adjoining secondary woodland (Maunsell 2003).

Secondary woodlands in KTN were not found to be of importance for fauna species of conservation significance in surveys conducted under the current study. However, while the exact locations of some

observations of fauna of conservation significance in the Ho Sheung Heung area are not clear, it seems probable that some relate to the secondary woodland in this area.

Fanling North

In FLN a relatively large area of woodland was identified behind Siu Hang San Tsuen and Siu Hang Tsuen. This woodland comprises a mixture of areas which are in the process of evolving from plantation, and the overstorey of much of the woodland contains a significant proportion of plantation and orchard species, as well as colonizing native trees, including *Cinnamomum camphora*, *Dimocarpus longan*, *Microcos paniculata* and *Sterculia lanceolata*. The understorey supports richer floristic diversity, including herbs *Alocasia odora* and *Lophatherum gracile*, shrubs (such as *Litsea rotundifolia* var. *oblongifolia*, *Psychotria asiatica* and *Uvaria macrophylla*) and trees (*Archidendron clypearia*, *Celtis sinensis*, *Claoxylon indicum*, *Cratoxylum cochinchinense* and *Schefflera heptaphylla*). The climber *Gnetum luofuense* was found in this woodland; this species is listed as near-threatened by IUCN, but is common in Hong Kong.

Similar, but smaller patches of mixed secondary woodland and plantation are present elsewhere in the north of FLN.

A smaller secondary woodland patch is located to the north of Fu Tei Au Road. Dominant trees in this woodland include a mixture of native (*Celtis sinensis*, *Cinnamomum camphorum*, *Sapium sebiferum*, *Microcos paniculata*, *Tetradium glabrifolium* and *Liquidambar formosana*) and exotic (*Melia azedarach* and *Acacia auriculiformis*) tree species, forming a semi-closed canopy ranging from 5 to 15 m in height. The understorey is rich in common shrubs of native (such as *Psychotria asiatica*, *Bridelia tomentosa*, *Ligustrum sinense*, *Clerodendrum cyrtophyllum*) and exotic (such as *Lantana camara*) species. Native (*Tetracera asiatica*) and exotic (*Mikania micrantha*) climbers were also common in the woodland. This woodland patch appears to be derived from natural regeneration and colonisation of trees as a result of seed dispersal by birds and/or bats.

A number of woodland patches are present on hill slopes to the southeast of FLN. Again, these comprise a mixture of areas where plantation and orchard have been colonized by native tree and shrub species and areas where shrubland has matured into young secondary forest. *Aquilaria sinensis* was recorded in such habitat in surveys conducted under the Liantang/Heung Yuen Wai Study (Mott MacDonald 2010).

Secondary woodland in FLN was not found to be of importance for fauna species of conservation significance in surveys conducted under the current study. However, whilst the exact locations of some observations are unclear, it seems possible that secondary woodland to the east of

Kau Lung Hang in the Study Area may be utilised by some of the mammal species found during AFCD camera trapping surveys. One woodland-associated mammal species, Leopard Cat, two reptile species, Copperhead Racer and Indian Forest Skink, and one butterfly species, Peacock Royal of conservation significance were found in woodland in this area, near Tong Hang Tung Chuen and near Wo Hop Shek in surveys conducted under the Liantang/Heung Yuen Wai Study by Mott MacDonald (2010); however other species noted from this habitat in that study (Black Kite and Emerald Cascader) are not dependent or associated with woodland.

Table 13.40 - Ecological evaluation of secondary woodland in KTN

Criteria	Secondary Woodland – Ho Sheung Heung	Secondary Woodland – Tse Koo Hang	Secondary Woodland – Pun Uk Tsuen	Secondary Woodland – south of Pak Shek Au		
Naturalness	Derived from natural vegetation succession of suitable undisturbed habitat.					
Size	A fairly small area present, totalling 2.74ha.	A small to medium-sized area present, totalling 5.19ha.	A small to medium-sized area present, totalling 5.90ha.	A moderate to large area present totalling 17.62ha.		
Diversity	A fairly diverse vegetative community with diversity of microhabitats.	Moderate floral diversity and structural complexity.				
Rarity	Woodland habitat is common in Hong Kong, but is relatively uncommon in this part of the New Territories. <i>Alianthus fordii</i> , a near-threatened plant species found in woodland at Ho Sheung Heung woodland, is rare in Hong Kong.					
Re-creatability	Could be re-created in the long term, but trees would take a long time to mature.					
Fragmentation	Rather unfragmented.	Somewhat fragmented by road and marsh habitats.	Somewhat fragmented by village areas.	Somewhat fragmented by roads and developed areas.		
Ecological linkage	Closely linked to nearby plantation and <i>fung shui</i> Wood.	Some linkages with nearby grassland and grassland/shrubland habitat.	Linkage with adjacent hillside shrubland and grassland.	Linkage with adjacent plantation, hillside shrubland and grassland.		
Potential value	Potential for increase in value with maturation of nearby habitats, but limited in scope as woodland near climax stage.			Potential for increase with maturation.		
Nursery/breeding ground	Not known to support a significant breeding ground.					
Age	Unknown, but relatively long-established habitat.			Unknown but areas in south are probably		

Criteria	Secondary Woodland – Ho Sheung Heung	Secondary Woodland – Tse Koo Hang	Secondary Woodland – Pun Uk Tsuen	Secondary Woodland – south of Pak Shek Au
				recently formed by maturation of shrubland.
Abundance/ Richness of wildlife	Moderate, especially butterflies.	Low.		
Ecological value	Relatively good quality of habitat but not particularly large, so considered to be of Moderate Ecological Value.	Low to Moderate due to small size and isolation.	Moderate as relatively extensive woodland areas could provide suitable habitat for birds and mammals.	Low to Moderate due to disturbance and age.

Table 13.41 - Ecological evaluation of secondary woodland in FLN

Criteria	Secondary Woodland – Siu Hang Tsuen	Secondary Woodland - Fu Tei Au	Secondary Woodland – Hill slopes in the southeast of FLN (Tong Hang Tung Chuen, Kau Lung Hang and Wo Hop Shek)
Naturalness	Semi-natural habitat derived from vegetation succession on shrubland and plantation.		
Size	Moderately extensive area (28.91ha).	Small area (1.36ha).	Moderately extensive area (41.78ha).
Diversity	Relatively rich flora present, typical of secondary woodland habitats.	Low to moderate diversity of flora.	
Rarity	A common habitat type in Hong Kong. No species of conservation significance are known from these areas.		A common habitat type in Hong Kong; some woodland-dependent or associated fauna species of conservation significance present including Leopard Cat, Indian Forest Skink, Copperhead Racer and Peacock Royal. In addition, three such amphibian species; Lesser Spiny Frog, Brown Wood Frog and Short-legged Toad were found in area of plantation and secondary woodland near Wo Hop Shek.
Re-creatability	Can be re-created but maturation of trees would take a long time.		
Fragmentation	Somewhat fragmented.		
Ecological linkage	Linked to nearby plantation habitats.		
Potential value	Could be enhanced by plantation of trees in adjacent habitats to increase woodland size and by natural succession.		
Nursery/ breeding ground	No significant breeding grounds known.		
Age	Fairly mature so probably relatively old.		Mostly rather early successional stage woodland
Abundance/ Richness of wildlife	Moderate diversity but numbers relatively low.		

Ecological value	Woodland at Siu Hang and Wa Shan of Moderate Ecological Value because of size.	Small woodland patch by Fu Tei Au Road of Low to Moderate Ecological Value .	Moderate Ecological Value because of size and presence of some fauna of conservation significance.
------------------	---	---	---

13.6.1.12 Plantation

Plantation is one of the dominant habitat types within the Study Area, occurring in a variety of locations and with a variety of functions. Plantations within the Study Area include hillside plantation, roadside plantation and urban plantations associated with villages, playgrounds and public facilities.

The canopy of these plantations generally comprises exotic tree species, of which *Melia azedarach*, *Acacia confusa*, *Acacia mangium*, *Lophostemon confertus*, *Melaleuca quinquenervia*, *Leucaena leucocephala* and *Delonix regia* are particularly common in the Study Area. The overall plant species diversity may be moderately high, however, especially in hillside plantations where colonisation occurs from adjacent shrubland, and the habitat is subjected to lower levels of human disturbance or vegetation management. Vegetation management in other plantation habitats limits the natural colonisation of understorey species.

Tree mixes within the villages often contain the exotic tree *Dimocarpus longan* or native *Cinnomomum camphora*, *Ficus microcarpa* and *Celtis sinensis* as the overstorey, with an understorey containing a limited diversity of native shrubs and trees.

Upland plantation habitats in KTN are ecologically linked to shrubland on Crest Hill and the Ho Sheung Heung *fung shui* woodland as well as the mixture of semi-natural habitats in the Ma Tso Lung area. The habitats around Crest Hill and Ho Sheung Heung were found to support a moderate community of butterflies (30 species), and could be expected to attract more species if left undisturbed so that more plant species are able to colonise. Similarly, the plantation in the Ma Tso Lung area is likely to be of significance to some of the fauna species of conservation importance in this area.

Two saplings of the protected tree species, *Aquilaria sinensis* were found in plantation east of Wo Hop Shek; however this is not a rare species in Hong Kong, hence does not meet criteria of conservation significance for this study, particularly as only two saplings were found. Likewise, the protected orchid species *Spathoglottis pubescens* found near Cheung Po Tau Stream, Sha Ling is abundant and widespread in Hong Kong. However, another orchid species found *Pecteilis susannae*, which was considered to be 'Endangered' by Baretto *et al.* (2011) is of conservation significance.

Lesser Spiny Frog and Brown Wood Frog were found in plantation in the Wo Hop Shek area in surveys undertaken under the current study, and it is also likely that plantation in this area could be utilised by species found in secondary woodland in the area, including Indian Forest Skink, recorded by Mott MacDonald (2011). In addition, a third anuran species of conservation significance, Short-legged Toad, has also been found in the area (Hyder 2008) and may occur in plantation in the Study Area.

Roadside plantations and those in developed areas generally have lower diversity of plant species and structure, and are subject to moderate or high levels of human disturbance or intrusion. The surrounding urban land uses also typically isolates these plantations from other woodland habitats. Consequently, these plantations are generally of lower ecological value than the more naturalized hillside plantations.

Usage of lowland plantation in the Study Area by fauna of conservation significance is largely limited to occasional opportunistic use by fauna that is not dependent on this habitat such as waterbirds, herpetofauna and butterflies, but it may have some significance for Chinese Grosbeak and Red-billed Starling, albeit neither species is dependent on this habitat.

However, both Ho Sheung Heung and Man Kam To Road Egrettries are located in lowland plantation (the former also partly in orchard). These plantations are, therefore, of particular significance for the breeding ardeids. The plantation supporting Man Kam To Road Egrettry was slightly damaged in 2012, but, based on a check in April 2013, was still being used as an egrettry.

Three butterfly species were found in roadside and urban plantation or mitigation plantation, which were considered to be rare by Lo (2010). These were Grass Demon and Small Cabbage White in KTN and Conjoined Swift in FLN. Grass Demon is stated to be rare but widely distributed in agricultural fields in Hong Kong, while the other species are stated to be rare but no habitat requirements are in the AFCD Biodiversity Database (2012). The foodplant of Conjoined Swift is stated to be *Microstegium ciliatum*, a very common herb of wasteland and streamsides by Xing et al. (2000). Small Cabbage White is generally considered to be an invasive pest species of agricultural crops. Accordingly, since none of these species, or their larval host plants are dependent on, or highly associated with, plantation woodland, and none meet the criteria for conservation significance used in this assessment, they are not considered further in the habitat evaluation or ecological impact assessment processes.

Figure 13.11 indicates those areas where plantation largely comprises hillside plantation of higher ecological value, though to some extent there is a continuum between the characteristics and hence the ecological significance of the two plantation types.

Table 13.42 - Ecological evaluation of plantation

Criteria	Hillside Plantation	Roadside and Urban Plantation
Naturalness	An artificially-created habitat but some areas with natural colonisation of vegetation.	An artificially-created habitat but some areas with limited natural colonisation of vegetation.
Size	A large area (100.20ha in Study Area boundary).	A large area (299.48ha in Study Area boundary).
Diversity	Low to moderate floral diversity.	Low floral diversity with many exotic species.
Rarity	A common habitat type in Hong Kong. One rare orchid species, <i>Pecteilis susannae</i> was found in this habitat near Cheung Po Tau Stream, Sha Ling; two amphibian species of conservation significance, Lesser Spiny Frog and Brown Wood Frog near Wo Hop Shek Crematorium and two further herpetofauna species which have been recorded in the area (Indian Forest Skink and Short-legged Toad) may also occur. One butterfly species of conservation significance, Peacock Royal, found in this habitat near Fung Kong Shan, KTN.	A common habitat type in Hong Kong. No rare species that is considered to be of conservation significance or other rare species is restricted to this habitat, or this habitat and a small number of other habitats in the Study Area.
Re-creatability	Easily re-creatable although trees would take a long time to mature.	
Fragmentation	Moderately fragmented.	Highly fragmented.
Ecological linkage	Some ecological linkages to similar habitats nearby, especially shrubland and woodland.	Some ecological linkages to adjacent semi-natural habitats.
Potential value	Value would increase by natural vegetation succession if habitat left undisturbed.	Limited scope for increase in value due to fragmentation and disturbance.
Nursery/ breeding ground	None known.	Ho Sheung Heung and Man Kam To Road Egrettries are located in plantation.
Age	Judging by the size of trees present, some areas are moderately old.	
Abundance/ Richness of wildlife	Low to moderate abundance and diversity of wildlife; especially birds and butterflies.	Low to moderate numbers and low diversity of wildlife.

Ecological value	Low to Moderate Ecological Value.	Low Ecological Value except Ho Sheung Heung Egretty plantation of Moderate to High Ecological Value due to presence of a large egretty. The Man Kam To Road Egretty planation is considered to be of Low to Moderate ecological value as it is small, disturbed and has been damaged and the egretty is small in a Hong Kong context.
------------------	--	--

13.6.1.13 Mitigation Plantations

In addition to the mitigation plantations along the Sheung Yue River which were assessed as an element of the Long Valley habitat complex, other mitigation plantations are present elsewhere on the Ng Tung, Sheung Yue and Shek Sheung Rivers. All are managed by AFCD as mitigation for the ecological impacts arising from channelisation of the rivers. These largely mostly comprise corridors of plantation located along the channelised rivers, as well as some patches adjacent to agricultural land to the north and south of the rivers. Tree species planted are often exotic species and are consequently of relatively low ecological value, although some native species are also present within the plantation areas.

Though of limited value in themselves due to fragmentation and the predominance of exotic species, the plantations on the north and south sides of the Sheung Yue River, alongside wetlands at Ho Sheung Heung and the west side of the Shek Sheung River are of value in screening wildlife in Long Valley from disturbance arising from human activities on the tracks alongside the rivers.

As with other areas of lowland plantation in the Study Area, utilisation by fauna of conservation significance is largely limited to occasional opportunistic use by fauna not dependent on this habitat such as waterbirds, open country birds, herpetofauna and butterflies. An Indo-Chinese Rat Snake was found in surveys conducted under the current study in mitigation plantation to the north of the Ng Tung River, this species is listed as Endangered in the CRDB and of Potential Regional Concern by Fellowes *et al.* (2002).

Table 13.43 - Ecological evaluation of mitigation plantations

Criteria	Assessment
Naturalness	An artificially-created habitat but designed to provide some function similar to natural habitat.
Size	Total area is relatively small (19.89ha) and individual woodland patches small.
Diversity	A fairly low diversity of planted tree species with relatively limited colonisation by other plant species.

Rarity	Plantation woodland is a common habitat in Hong Kong. An Indo-Chinese Rat Snake was found in this habitat on the north side of the Ng Tung River. Whilst of conservation significance, this species is found in widespread open country habitats and is not considered to be restricted to one or a few habitats or small parts of the Study Area by virtue of its habitat requirements or other factors.
Re-creatability	Could easily be re-created in suitable locations.
Fragmentation	Highly fragmented into small patches.
Ecological linkage	Some ecological linkage with adjacent habitats.
Potential value	Some potential for an increase in value especially if managed to increase the proportion of native tree and shrub species.
Nursery/ breeding ground	None known.
Age	Planted fairly recently.
Abundance/ Richness of wildlife	Fairly low abundance and richness of wildlife.
Ecological value	Although planted for ecological mitigation, the value of these plantations is limited by the degree of fragmentation resulting in small-sized patches of habitat and the predominance of exotic species and hence of Low intrinsic ecological value. However, of Low to Moderate Value functionally, as a screen to reduce disturbance fauna using the adjacent river channels.

13.6.1.14 Orchard

A number of orchard areas are scattered through the Study Area; many of these are close to village and agricultural areas. These orchards are small in size and mainly cultivated with fruit crops, largely *Litchi chinensis* and *Dimocarpus longan*. This habitat is subject to regular vegetation management and human disturbance, and hence supports low plant and faunal diversity. The Ho Sheung Heung Egrettry is located partially in plantation and partially in orchard; this has been taken into account in the evaluation of the specific plantation area at Ho Sheung Heung which is occupied by the egrettry, the same criteria, and hence evaluation apply to the orchard area at Ho Sheung Heung occupied by the egrettry, however this is not reflected in Table 13.44, in order to avoid unnecessary duplication.

Table 13.44 - Ecological evaluation of orchards

Criteria	Assessment
Naturalness	An artificial habitat used for cultivation of fruit crops.
Size	A few small patches present, totalling 17.78ha.
Diversity	A low diversity of plant species due to ongoing management of vegetation for benefit of crop species.
Rarity	A common habitat type around Hong Kong villages.
Re-creatability	Easily re-creatable.
Fragmentation	Fragmented.
Ecological linkage	Some orchards have linkages to nearby farmland, plantation and shrubland.
Potential value	Ecological value would be increased by permitting establishment of understorey vegetation.

Criteria	Assessment
Nursery/ breeding ground	No nursery or breeding grounds known (other than Ho Sheung Heung Egrettry, considered under lowland plantation above.
Age	Varies, but most are moderately mature.
Abundance/ Richness of wildlife	Diversity and abundance are low.
Ecological value	Low Ecological Value.

13.6.1.15 Golf Course

Part of Fanling Golf Course is located in the south of the Study Area. Golf course is a highly modified landscape with high maintenance short grassland and tree patches, largely of exotic species; these are often managed to reduce or minimise understorey. Other than ground-truthing to check that this habitat was as shown in aerial photographs, field surveys were not undertaken in this habitat and the evaluation was based on a desktop review. This review found no evidence that golf course in the Study Area is significance for any flora or fauna species.

Table 13.45 - Ecological evaluation of golf course

Criteria	Assessment
Naturalness	An artificial habitat used for active recreation.
Size	A relatively large area occupying 30.72ha in the south of the Study Area.
Diversity	From aerial photographs and ground-truthing it was evident that plant species diversity was highly influenced by the management regime and hence likely to be low. Fauna diversity was not assessed.
Rarity	One of six golf courses in Hong Kong.
Re-creatability	Easily re-creatable.
Fragmentation	Not fragmented.
Ecological linkage	Few ecological linkages to other habitats.
Potential value	Ecological value would be increased by permitting establishment of understorey vegetation and by managing water features for wildlife.
Nursery/ breeding ground	No nursery or breeding grounds known and unlikely due to management regime and high level of human activity.
Age	Present for many years but succession arrested by management activities.
Abundance/ Richness of wildlife	Low.
Ecological value	Low Ecological Value.

13.6.1.16 Waste Ground

Waste ground is semi-natural habitat which has evolved on abandoned developed land following the early stages of vegetation succession. Plant species diversity is very low, supporting only common and widespread ruderal species such as *Bidens alba*, *Mimosa pudica*, *Brachiaria mutica*, *Rhynchelytrum repens* and *Leucaena leucocephala*. If left undisturbed, it can be expected that the land will gradually evolve towards more natural habitat as a result of vegetation succession, although the speed and nature of this succession depends upon the local conditions. No species of conservation significance in the Study Area are dependent on or associated with this habitat.

Table 13.46 - Ecological evaluation of waste ground

Criteria	Waste Ground
Naturalness	Anthropogenic habitat on unused developed land.
Size	Small area present within Study Area (9.99ha).
Diversity	Low.
Rarity	A common habitat in Hong Kong.
Re-creatability	Easily re-creatable.
Fragmentation	Fragmented.
Ecological linkage	None of significance.
Potential value	If left undisturbed potential for some improvement as more species colonise.
Nursery/ breeding ground	None known.
Age	An early successional habitat on recently abandoned land.

Abundance/ Richness of wildlife	Low.
Ecological value	Low Ecological Value.

13.6.1.17 Village Area and Urban/Residential Area

In the Study Area, these habitats include villages, urban areas and roads and other infrastructure. Vegetation in these habitats is dominated by a variety of exotic species planted for ornamental or screening purposes, including herbs, climbers and trees. Such areas are generally subject to regular and intensive vegetation management. Plantation trees such as *Aleurites moluccana*, *Bombax ceiba*, *Eucalyptus citriodora*, *Ficus microcarpa*, *Melia azedarach* and *Melaleuca quinquenervia* are commonly present along the roadside. Other plantation species are also often present in the vicinity of these habitats, as described in the previous section of this report.

The village and residential areas support a high diversity of planted species, of which many are exotic, fruit trees *Artocarpus macrocarpus*, *Averrhoa carambola*, *Clausena lansium*, *Dimocarpus longan*, *Litchi chinensis* and *Manilkara zapota* are often present in village areas. A number of *Cinnamomum camphora*, *Eucalyptus citriodora*, *Ficus microcarpa* and *Melaleuca quinquenervia* in the Study Area are registered as Old and Valuable Trees by Leisure and Cultural Services Department.

Faunal diversity is very low, and generally restricted to common and widespread commensal and disturbance-tolerant species. White-shouldered Starling, which appears to be restricted to man-made structures as breeding sites in Hong Kong, was recorded in the breeding season in Siu Hang Tsuen in FLN and may breed there. This species was considered to be a rare breeding species in Hong Kong by Carey *et al.* (2001) with a population of less than 50 pairs, and was evaluated as of local conservation concern as a breeding species by Fellowes *et al.* (2002). However, it has increased significantly in Hong Kong in recent years and is now considered to be a locally common breeding species, with the population increase attributed to use of nest boxes (Hong Kong Bird Report 2009-10).

Table 13.47 - Ecological evaluation of village and urban/residential area

Criteria	Assessment
Naturalness	Man-made artificial habitats.
Size	An extensive area present in the Study Area (875.18ha).
Diversity	Floral diversity low with many exotic species.

Criteria	Assessment
Rarity	A very common habitat in Hong Kong. Fauna largely comprises common and disturbance-tolerant species not restricted to one or a few habitats; White-shouldered Starling was recorded in the breeding season in Siu Hang Tsuen; this observation is not considered of significance in respect to the ecological evaluation of this habitat: this species is listed as of local conservation concern by Fellowes <i>et al.</i> (2002) but it is now considered to be a locally common breeding species.
Re-creatability	Easily re-creatable.
Fragmentation	Not particularly fragmented.
Ecological linkage	Limited ecological linkages.
Potential value	Potential value limited by high levels of human activity but suitable management of vegetation could lead to some ecological enhancement.
Nursery/ breeding ground	None known.
Age	Variable.
Abundance/ Richness of wildlife	Low diversity, abundance low in urban areas and low to moderate in village areas.
Ecological value	Low Ecological Value.

13.6.2 Species Evaluations

In the following Section the protection status of species (where this is relevant to the ecological assessment process), status in Hong Kong and conservation status (i.e. whether a species is considered to be of conservation significance in a Hong Kong, China or international context) are summarized, and an ecological value is ascribed to the species in the context of the Study Area, Hong Kong, China and internationally. This is not intended to substitute for the impact assessment process, but to provide an indication of the weight which has been attached to the presence of a species during the course of this process.

It should be noted that protection status in this context only applies to Hong Kong legislation to protect flora and fauna in respect of the ways it has been used in the evaluation and impact assessment processes; other protection status, for example that relating to trade under Cap. 586, is not relevant in this context and has not been considered.

13.6.2.1 Flora

Table 13.48 - Ecological evaluation of flora of conservation significance recorded in the Study Area

Species	Protection Status	Status in HK	Conservation Status	Ecological Value
---------	-------------------	--------------	---------------------	------------------

Species	Protection Status	Status in HK	Conservation Status	Ecological Value
<i>Ailanthus fordii</i>	Cap. 96A	Rare. Widely cultivated for roadside planting and ornamental purpose	Near Threatened ²	Low (because widely cultivated)
<i>Aquilaria sinensis</i>	-	Commonly found in lowland forest and <i>fung shui</i> wood	Vulnerable ¹ Near Threatened	Medium
<i>Cibotium barometz</i>	-	Very common and widely distributed	Vulnerable ¹	Medium
<i>Gnetum luofuense</i>	-	Very common	IUCN Near Threatened ¹	Low
<i>Pavetta hongkongensis</i>	Cap. 96A	Common	Nil	Low
<i>Pecteilis susannae</i>	Cap. 96A,	Infrequent and Restricted ³	Nil	Medium
<i>Rhododendron simsii</i>	Cap. 96A	Common, but often planted	Nil	Not Applicable as all specimens considered to have been planted
<i>Spathoglottis pubescens</i>	Cap. 96A, Cap. 586	Abundant and Widespread ³	Nil	Low

Notes

1. Sun, W. 1998. *Aquilaria sinensis*. In: IUCN 2010. IUCN Red List of Threatened Species Version 2010.4. <www.iucnredlist.org>. Downloaded on 19 January 2011.
2. South China Institute of Botany & Agriculture, Fisheries and Conservation Department 2003. *Rare and Precious Plants of Hong Kong*. AFCD, Hong Kong.
3. Barretto, G., Cribb, P. and Gale, S. 2011. *The Wild Orchids of Hong Kong*. Natural History Publications (Borneo) Kota Kinabalu: Kadoorie Farm & Botanic Garden. Hong Kong.

13.6.2.2 Mammals

One species, Pomona Leaf-nosed Bat, is only of possible occurrence. All bat species are protected by law in Hong Kong under the Wild Animals Protection Ordinance (Cap 170), and are not listed individually in **Table 13.49**.

Table 13.49 - Ecological evaluation of mammals of conservation significance recorded in the Study Area

Species	Protection Status	Conservation Status	Distribution in HK	Ecological Value
Pomona Leaf-nosed Bat*	Cap 170.	(Local Concern) ¹	Widespread	Medium
Brown Noctule	Cap 170.	Potential Regional Concern/(Regional Concern) ¹	Fairly widespread	Medium
Greater Bandicoot Rat	-	Local Concern ¹	Highly localised.	Medium

Species	Protection Status	Conservation Status	Distribution in HK	Ecological Value
East Asian Porcupine	Cap 170.	Potential Global Concern ¹	Widespread	Medium
Eurasian Otter	Cap 170.	Regional Concern ¹ , Near Threatened ² , Vulnerable ³	Restricted to northwest NT	High
Small-toothed Ferret Badger	Cap 170.	-	Widely distributed	Low
Masked Palm Civet	Cap 170.	Potential Regional Concern ¹	Fairly widely distributed.	Medium to High
Small Indian Civet	Cap 170.	-	Widely distributed	Low
Leopard Cat		Vulnerable ³	Widely distributed	Medium
Red Muntjac		Potential Regional Concern ¹	Widely distributed	Medium

Note:

1. Fellowes et al. (2002). Letters in brackets represents the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.

2. IUCN (2013).

3. China Red Data Book (Wang 1998).

*: species not recorded with certainty in Study Area.

13.6.2.3 Birds

A total of 121 species of conservation significance have been recorded in the Study Area. A full list is provided in **Appendix 13.3.1**, which includes their distribution and abundance in Hong Kong and their conservation status based on assessments by BirdLife International and Fellowes *et al.* (2002). This includes many species that are rare within the Study Area or for which the numbers occurring are not of conservation importance. A list of species of conservation importance that are considered to regularly occur in the Study Area is provided in **Table 13.7**. Rather than repeating the list of species in this section, however, it is more helpful to break it down into categories, and provide an assessment of ecological significance for each. The conservation status of individual species is provided in **Table 13.7** and in **Appendix 13.3.1**.

All bird species are protected by law in Hong Kong under the Wild Animals protection Ordinance (Cap 170), and hence are not listed individually as protected species in **Table 13.50**.

Table 13.50 - Ecological evaluation of birds of conservation significance recorded in the Study Area

Species	Conservation Status	Distribution in HK	Ecological Value
Ardeids	Many RC, some LC or (LC) ¹	Most confined to New Territories, in particular the northwest	High
Other wetland-	Most LC or (LC), some RC ¹	Most confined to	Medium to High

Species	Conservation Status	Distribution in HK	Ecological Value
dependent non-passerines (see Table 13.7 and Appendix 13.3.1)		New Territories, in particular the northwest	
Raptors	Black Kite is (RC) ¹ , while the remainder are (LC) ¹	Black Kite very widespread, others fairly widespread but localised	Medium
Eurasian Hobby	(LV)	Rare and localised in New Territories as a breeding species	High
Eurasian Eagle Owl	RC	Localised on open hillsides	High (but not of certain occurrence)
Grey Nightjar	LC	Localised on open hillsides	Medium
Yellow-breasted and Japanese Yellow Bunting	Both VU ² , former RC ¹ , Japanese Yellow Bunting is GC ¹	Lowland open-country areas of northwest NT	Medium to High
Red-billed Starling	GC ¹	Widespread in lowland open-country areas of New Territories	Low to Medium
Other wetland-dependent or wetland-associated passerines (see Table 13.7 and Appendix 13.31)	LC ¹	Fairly widespread in New Territories	Medium
Non wetland-associated species (see Table 13.7 and Appendix 13.31)	LC ¹	Fairly widespread in New Territories	Low to Medium

Notes

1: Fellowes *et al.* (2002).

2: IUCN (2013).

13.6.2.4 Reptiles

Table 13.51 - Ecological evaluation of reptiles of conservation significance recorded in the Study Area

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Reeves' Terrapin	Cap 170	Widespread. Common in the past but rarer in recent years.	Global Concern ¹ , Endangered ² , Conservation Dependent ³	High.
Three-banded Box Terrapin	Cap. 170,	HK has largest population in world. Widely distributed but rare.	Global Concern ¹ , Critically Endangered ² Critically Endangered in China ³ .	Very High.
Chinese Soft-shelled Turtle	Cap. 170	Highly restricted, only in northwest NT.	Global Concern ¹ , Vulnerable ^{2,3} .	Medium.

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Tokay Gecko	Nil	Restricted distribution	Regional Concern ¹ , Endangered ³ .	Low (records likely to be of released individuals).
Common Water Monitor	Cap 170	Extinct in the wild	Regional Concern ¹ , Critically Endangered/Extinct in Wild ³	Low (modern records attributed to escapes).
Five-striped Blue-tailed Skink	-	Woodlands in the New Territories	Local Concern ¹ .	Medium (but anecdotal record).
Indian Forest Skink	Nil	Present in eastern and central New Territories.	Local Concern ¹ .	Low.
Burmese Python	Cap. 170	Widely distributed	Potential Regional Concern ¹ , Lower Risk/Near Threatened ² , Critically Endangered ³ .	Medium to High.
Buff-striped Keelback	Nil	Uncommon but widely distributed in central New Territories and Lantau Island.	Local Concern ¹ .	Low.
Copperhead Racer	Nil	Widely distributed	Potential Regional Concern ¹ , Endangered ³ .	Medium.
Indo-Chinese Rat Snake	Nil	Widely distributed	Potential Regional Concern ¹ , Endangered ³	Medium.
Common Rat Snake	Nil	Widely distributed	Potential Regional Concern ¹ , Endangered ³ .	Medium.
Banded Krait	Nil	Locally distributed	Regional Concern ¹ , Endangered ³	Medium.
Many-banded Krait	Nil	Widely distributed	Potential Regional Concern ¹ , Vulnerable ³ ,	Medium.
Chinese Cobra	Nil	Widely distributed	Potential Regional Concern ¹ , Vulnerable ³ .	Medium.
King Cobra	Cap 170	Widely distributed	Potential Regional Concern ¹ , Vulnerable ² , Critically Endangered ³	High.

Notes

1. Fellowes *et al.* (2002).
2. IUCN (2013).
3. China Red Data Book (Zhao 1998).

13.6.2.5 Amphibians

Table 13.52 - Ecological evaluation of amphibians of conservation significance recorded in the Study Area

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Short-legged Toad	Nil	Widely distributed in upland forest streams	Potential Global Concern ¹ , Endangered ³	High (but not certain in Study Area)
Chinese Bull Frog	Nil	Quite widely distributed in HK.	Potential Regional Concern ¹	Medium.

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Lesser Spiny Frog	Nil	Widespread	Potential Global Concern ¹ , Vulnerable ³	Low to Medium
Brown Wood Frog	Nil	New Territories and Lantau	Local Concern ¹	Low to Medium
Two-striped Grass Frog	Nil.	Restricted in HK.	Local Concern ¹	Medium.

Notes

1. Fellowes *et al.* (2002).
2. IUCN (2013).
3. China Red Data Book (Zhao 1998).

13.6.2.6 Fish

Table 13.53 - Ecological evaluation of fish of conservation significance recorded in the Study Area

Species	Protection Status	Distribution and Status	Conservation Status	Ecological Value
<i>Acrossocheilus parallens</i>	Nil	Uncommon	Global Concern ¹	Medium
Predaceous Chub	Nil	Common and widespread in HK.	Vulnerable ²	Low.
Small Snakehead	Nil	Uncommon in the wild.	Local Concern ¹ .	Medium.

Notes

1. Fellowes *et al.* (2002).
2. China Red Data Book (Yue and Chen 1998).

13.6.2.7 Butterflies

Table 13.54 - Ecological evaluation of butterflies of conservation significance recorded in the Study Area

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Dark Brown Ace	Nil	Locally distributed	Local Concern ¹ , Very Rare ² .	Medium
Common Dart	Nil	Locally distributed	Local Concern ¹ , Rare ² .	Medium
Pale Palm Dart	Nil	Locally distributed	Local Concern ¹ , Rare ² .	Medium
Hainan Palm Dart	Nil	Locally distributed	Local Concern ¹ , Very Rare ² .	Medium
Small Grass Yellow	Nil	Locally distributed	Local Concern ¹ , Rare ² .	Medium
Lesser Forest Blue	Nil	Locally distributed	Local Concern ¹ , Rare ² .	Medium.
Brown Onyx	Nil	Distribution uncertain.	Local Concern ¹ , Very Rare ² .	Medium
Peacock Royal	Nil	Locally distributed	Local Concern ¹ , Rare ² .	Medium
Common Pierrot	Nil	Locally distributed	Local Concern ¹ , No verified sightings in recent years ² .	Low to Medium.
Pale Hedge Blue	Nil	Locally distributed	Local Concern ¹ , Very Rare ² .	Medium
Small Three-ring	Nil	Locally distributed	Local Concern ¹ , Very Rare ² .	Medium
Painted Lady	Nil	Locally distributed	Local Concern ¹ , Rare ² .	Medium
Danaid Egg-fly	Nil	Locally distributed	Local Concern ¹ , Uncommon ² .	Low to Medium
Commander	Nil	Locally distributed	Local Concern ¹ , Very Rare ² .	Medium
Spotted Angle	Nil	Locally distributed	Local Concern ¹ , Very Rare ² .	Medium

Notes

1. Fellowes *et al.* (2002).
2. Chan *et al.* (2011).

13.6.2.8 Dragonflies

Table 13.55 - Ecological evaluation of dragonflies of conservation significance recorded in the Study Area

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Eastern Lilysquatter	Nil	Widely distributed	Local Concern ¹ , Common ²	Low

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
Blue Sprite	Nil	Widely distributed	Local Concern ¹ , Common ²	Low
Orange-backed Threadtail	Nil	Largely restricted to northeast New Territories	Local Concern ¹ , Common ²	Low to Medium
Dingy Dusk-hawker	Nil	Widely distributed	Local Concern ¹ , Common ³	Low
Blue Chaser	Nil	Widely distributed	Local Concern ¹ , Common ²	Low
Ruby Darter	Nil	Widely distributed	Local Concern ¹ , Common ²	Low
Sapphire Flutterer	Nil	Widely distributed	Local Concern ¹ , Common ²	Low
Scarlet Basker	Nil	Largely restricted to northwest New Territories in HK.	Local Concern ¹ , Common ²	Low to Medium
Emerald Cascader	Nil	Widely distributed	Potential Global Concern ¹ , Abundant ²	Medium

Notes

1. Fellowes *et al.* (2002).
2. Tam *et al.* (2011).
3. AFCD Biodiversity Database (2012).

13.6.2.9 Aquatic Invertebrates

Table 13.56 - Ecological evaluation of aquatic invertebrates of conservation significance recorded in the Study Area

Species	Protection Status	Distribution in HK	Conservation Status	Ecological Value
<i>Somanniathelphusa zanklon</i>	Nil.	HK endemic, but quite widely distributed.	Global Concern ¹ , Endangered ² .	Medium.

Notes

1. Fellowes *et al.* (2002).
2. IUCN (2013).

13.7 Prediction and Evaluation of Ecological Impacts of the Proposed Development

13.7.1 Introduction

This section assesses significance of the potential direct and indirect, primary and secondary, on-site and off-site, and cumulative impacts of the Project. The approach adopted is to address impacts on habitats, species, those arising from fragmentation and, finally, the potential cumulative impacts. Within each of these categories a distinction is made between direct and indirect impacts, and these are further defined as to whether they are predicted at the construction or operational stage of the project.

The significance of ecological impacts has been evaluated based primarily on the criteria set out in Table 1 of Annex 8 of the TM-EIAO, using the following criteria: habitat quality, species impacted, size/abundance, duration, reversibility, magnitude and severity.

In addition to the project as a whole, the following Designated Projects (DPs) have been included in the ecological impact assessment.

- DP1 – San Tin Highway and Fanling Highway Kwu Tung Section Widening (between San Tin Interchange and Po Shek Wu Interchange) (Major Improvement) and associated new Kwu Tung Interchange (New Road) and Pak Shek Au Interchange Improvement (Major Improvement);
- DP2 – Castle Peak Road Diversion (Major Improvement);
- DP3 – KTN NDA Road P1 and P2 (New Road) and associated new Kwu Tung Interchange (New Road) and Pak Shek Au Interchange;
- DP4 – KTN NDA Road D1 to D5 (New Road);
- DP5 – New Sewage Pumping Stations (SPS) in KTN NDA;
- DP6 – Proposed railway station and associated facilities in KTN NDA (To be conducted under other separated studies);
- DP7 – Utilisation of Treated Sewage Effluent;
- DP8 – Po Shek Wu Interchange Improvement (Major Improvement);
- DP9 – Fanling Bypass Western Section (New Road);
- DP10 – Fanling Bypass Eastern Section (New Road);

- DP11 – Proposed expansion and upgrading of Shek Wu Hui Sewage Treatment Works at FLN NDA;
- DP11 – Reprovision of wholesale market in FLN NDA; and
- DP12 – New Sewage Pumping Stations in FLN NDA.

13.7.2 Baseline conditions

The current conditions of habitats in and around the Project area are used as the baseline against which impacts of the development are assessed. This is based on the expectation that ecological conditions in this area would remain largely unchanged in future in the absence of the Project.

Future conditions are difficult to predict, being dependent on changes to habitat conditions, human activity in and around the area and the population dynamics of species present. The potential ecological value of the area has been evaluated in **Section 13.6** to determine whether this may be expected to change in the absence of the Project. In most habitats conditions are expected to remain largely unchanged, albeit with the potential for enhancement in many habitats if active management measures were implemented or extended. This issue is of particular relevance in respect to habitats in the Long Valley and Ho Sheung Heung Priority Site, where a nature conservation MA is in place in parts of the area. The current MA is scheduled to be completed in February 2015, but for purposes of this assessment it is assumed that similar MAs (or a similar successor conservation mechanism) will continue beyond this date. Some other habitats may be expected to increase in value in future as a result of natural succession (for example from shrubland into woodland) and maturation (for example woodland). In such cases where a change in ecological conditions can be predicted the ecological value of the predicted future conditions is taken into account in the impact assessment for the relevant habitats.

13.7.3 Impacts on Habitats

In this section the types of direct and indirect impacts on habitats are described; potential direct and indirect impacts in the habitats in the assessment area are then predicted and evaluated in accordance with the requirements of Section 13.4.14.4(vii) of the Study Brief.

13.7.3.1 Habitat Loss

Direct habitat loss is caused by developments and their associated infrastructure, and includes temporary construction impacts and long-term (usually permanent) operational impacts. These are readily recognized as they take the form of habitat disappearance and are easy to define, and the magnitude is more easily assessed than some other

forms of impact. The ecological impact is generally a function of the scale of habitat loss and ecological value of the habitat.

The significance of temporary habitat loss depends to a degree on the type of habitat; late successional habitats (especially woodland) take longer and are more difficult to restore than early successional habitats. Some natural habitats (especially streams) may be difficult to restore to a natural state, even after completion of construction works.

The areas of habitats predicted to be lost as a consequence of the Project in the absence of mitigation are summarized in **Table 13.57** below. Because of the nature of the Project, the area of permanent direct habitat loss in the absence of mitigation of natural, semi-natural and other habitats of ecological value broadly corresponds to the areas of these habitats not excluded from development areas under the revised RODP (see **Figures 13.14a-c**).

This definition obviously does not extend to developed areas (village areas and, especially, urban/residential areas) where some areas, such as those in village (V) zones, will not be redeveloped. Accordingly, these habitats to be 'lost' are shown in parentheses in **Table 13.57**, but are included in the table as the potential loss of biota in such areas is of relevance to the evaluation of potential impacts of the project as a whole.

Table 13.57 - Direct Habitat Loss predicted as a consequence of the project in ha

Habitat	Kwu Tung North	Fanling North	Total
Dry Agriculture	0.22	9.10	9.32
Wet Agriculture	-	0.58	0.58
Grassland	29.13	31.03	60.16
Grassland/ Shrubland	1.18	0.45	1.63
Major Watercourse	<0.01	0.01	0.02
Minor Watercourse	0.37	2.06	2.44
Mitigation Wetland	0.43	2.32	2.75
Mitigation plantation	3.69	7.07	10.75
Orchard	2.29	5.09	7.38
Plantation	57.37	24.71	82.08
Pond	2.71	0.37	3.08
Seasonally Wet Grassland	2.86	1.21	4.07
Secondary Woodland	0.23	0.00	0.23
Shrubland	1.11	0.00	1.11
(Urban/ Residential Area)	114.16	38.36	152.52
(Village Area)	25.25	8.49	33.74
Waste Ground	5.64	0.65	6.29
Total	247.33	133.63	380.96

13.7.3.2 Indirect Impacts

Indirect impacts comprise the secondary effects of development on habitats or wildlife away from the development footprint. While direct impacts in the form of habitat loss are relatively easily recognised, the mechanism and effects of indirect impacts are less straightforward. These impacts include such secondary impacts as run-off from construction sites that affects water quality of nearby watercourses, and indirect disturbance impacts in both construction and operation phases that do not prevent a species from using an area (as habitat loss does), but may reduce the area's suitability for that species. Types of indirect impacts on habitats are further described below.

Disturbance impacts

These impacts include active disturbance arising from noise or other human activities, and passive disturbance resulting from avoidance by fauna of building structures. For fauna species there are two main reactions to disturbance. The earliest reaction is to become alert, which usually involves cessation of foraging or roosting; this in itself is energy-intensive and reduces foraging efficiency. The second reaction is to move away or (in the case of birds) take flight, or 'flush', when it is felt security is threatened.

Disturbance effects may cause the complete avoidance of an area because a sense of security is compromised all the time (which is comparable to habitat loss), reduced densities (where only less-sensitive individuals utilise an area) or reduced habitat quality (where feeding efficiency is reduced as a result of increased vigilance). Thus, although a species may be observed close to a disturbance source, this is not necessarily evidence that there is no disturbance effect. Ultimately, an organism will only approach a potential disturbance source up to the point at which the negative effects prevent achieving sufficient benefits of being there.

Disturbance from roads tends to be fairly low compared to that from buildings where people are highly visible or where disturbance events are unpredictable. As with buildings, construction is usually more disturbing than operation. Mitigation for such disturbance impacts in the form of visual and noise barriers is, thus, recommended in principle.

Night-foraging or night-roosting birds may be subject to impacts from glare or direct lighting from buildings, which might make certain areas unattractive as foraging or roosting sites. The main species groups affected by disturbance are those such as large waterbirds (cormorants, egrets and herons) and birds of prey such as owls, as well as mammals. In general, the larger the species, the greater the distance from a disturbance source at which an impact occurs.

In Hong Kong, disturbance impacts are most significant to larger mammals and large birds using open habitats, notably waterbirds and large raptors. Conversely, woodland fauna other than mammals, smaller birds and other fauna are relatively insensitive to disturbance.

Faunal surveys in the Study Area have demonstrated that it does not support significant numbers or diversity of large mammals or raptors, but that it is important for large waterbirds, with the populations of these species concentrated in Long Valley and, to a lesser extent, along the main river channels in the following order of significance: Sheung Yue River, Ng Tung and Shek Sheung Rivers (**Section 13.5.4.3**). Within this order, tidal Ng Tung River is of greater significance than the non-tidal section. Disturbance impacts to large waterbirds may therefore be of potential significance in these in these habitats.

Potential disturbance impacts to waterbirds from construction and operation of development in Hong Kong were analysed and the resultant predictions of the distance at which waterbird species would be disturbed (excluded or occurring at reduced densities) were utilised in the EIA for the LMC Station and Spur Line (Binnie Black & Veatch 2002). Whilst there are many differences between the projects, the principles followed remain of relevance and have been utilised in informing the process of assessing the potential disturbance impacts on the current project. Accordingly, the predicted disturbance distances of relevance to species occurring regularly in Long Valley and the river channels are shown in **Table 13.58**.

The distances within which species were predicted to be excluded and disturbed which are shown here relate to the construction and operational phase, which were not distinguished in the analysis. It is assumed that the predicted distances were the maxima, which, for most disturbance sources, would be experienced during the construction phase of the project, and do not allow for the known phenomenon of habituation, whereby birds become more tolerant of disturbance over a period of time, especially where the activity causing the disturbance is regular.

Table 13.58. Predicted distances at which waterbird or wetland-associated species were predicted to be disturbed by the operation of the Lok Ma Chau Spur Line (Source: Binnie Black & Veatch 2002).

Species	Lok Ma Chau station complex and viaduct section		Viaduct track sections only		Overall disturbance sensitivity
	Exclusion distance (m)	Max distance of reduced density (m)	Exclusion distance (m)	Max distance of reduced density (m)	
Grey Heron	100	200	100	150	High
Great Egret	100	200	100	150	High
Little Egret	20	100	30	100	Moderate - High

Species	Lok Ma Chau station complex and viaduct section		Viaduct track sections only		Overall disturbance sensitivity
	Exclusion distance (m)	Max distance of reduced density (m)	Exclusion distance (m)	Max distance of reduced density (m)	
Chinese Pond Heron	20	30	0	110	Moderate
Cinnamon Bittern	20	20	50	75	Low
Common Teal	50	100	50	100	Moderate - High
Black-winged Stilt	50	50	50	75	Moderate - High
Snipe <i>Gallinago</i> spp.	30	30	0	60	Moderate
Red-billed Starling	50	50	50	75	Moderate
Bluethroat	20	30	0	50	Low

Note: the table has been amended to include only species where potentially significant disturbance impacts from the NDA Project are predicted. Distances assumed the implementation of screen planting, but no other *in situ* mitigation. Application of these distances to impacts on Long Valley is directly comparable in this respect, as Long Valley is surrounded by mitigation plantation on all sides which would be impacted by the project, however this is not the case in respect to impacts on the Ng Tung River in KTN where no such screen planting can be assumed.

Whilst there are many differences between the projects, the predicted disturbance from the station and viaduct complex has some similarities to the predicted disturbance from the construction of large buildings, as is proposed to the southwest of Long Valley and along the Ng Tung River in FLN, while predicted disturbance from viaduct track sections has many similarities with predicted disturbance from roads and bridges over the rivers.

The two most disturbance-sensitive species regularly occurring in Long Valley and in the river channels are Grey Heron and Great Egret, which were both predicted to be disturbed within 200m of the LMC Station and excluded within 100m of the Station. For the viaduct sections the disturbance and exclusion distances were predicted to be 150m and 100m respectively.

However, the numbers of both species foraging in Long Valley and the main river channels are relatively low in comparison with some other ardeids, in particular those of Little Egret and, to a lesser extent, Chinese Pond Heron. Furthermore, both species occur in the Study Area only as non-breeding visitors, unlike Little Egret and Chinese Pond Heron, both of which breed at Ho Sheung Heung and Man Kam To Egrettries. Impacts on breeding birds are considered to be more significant than those on non-breeding birds as the former are more restricted in their foraging locations than the latter and have to forage more efficiently, or for longer, to collect sufficient food for themselves and their young, than non-breeding birds which have only to fend for themselves.

For these reasons, whilst acknowledging that this represents a simplification of the severity of disturbance impacts on different species, disturbance and exclusion distances for Little Egret, which is both more disturbance-sensitive and which uses the river channels in larger numbers than Chinese Pond Heron, have been indicated on **Figure 11a-b**. The disturbance distance of Little Egret was considered to be 100m from both the LMC Station and viaduct sections of the LMC Spur Line, while the exclusion distances were considered to be 20m and 30m from the station and viaduct sections respectively. On a precautionary basis the greater exclusion distance of 30m has been shown in respect to exclusion distances from major additional sources of disturbance arising from the current project (large buildings and new road bridges) in **Figure 13.11a-b**.

Both the LMC Station and the Spur Line viaduct are large structures. Accordingly Binnie, Black and Veatch (2002) did not address disturbance impacts on birds from minor works and projects. In a number of areas where development will take place under the current project, works will be minor and/or no large structures will be erected. Such areas include open space zones along the rivers and elsewhere, where only landscape works, pipe laying or other works to utilities and erection of minor structures will take place. In addition, experience since 2002 in various places in Hong Kong, for example Tin Shui Wai, the Kam Tin Main Drainage Channel, the San Tin East Drainage Channel and indeed in the Sheung Yue and Ng Tung Rivers, suggests that Binnie, Black and Veatch (2002) over-estimated disturbance and exclusion distances of some species (including ardeids) and that these will forage much closer to disturbance sources than was predicted. This tolerance is both a function of time as birds become habituated to disturbance from a particular source (whether this is a structure or a human activity) and the frequency of occurrence (thus regular disturbance may actually be tolerated more than irregular disturbance in a location where the birds are unfamiliar with the disturbing event).

To take account of both of these factors (i.e. the lower level of disturbance likely to be occasioned by minor works or small structures, and the over-estimation of disturbance and exclusion effects in Binnie, Black and Veatch (2002)), disturbance and exclusion distances have been adjusted in respect to minor works and small structures on **Figures 13.11a-b**. Accordingly, in these Figures, no exclusion distances are shown/predicted in respect to minor works/structures and only a 30m disturbance zone is shown/predicted in respect to such works/structures.

The consequence of the unmitigated disturbance impact evaluation process described above and shown on Figure 13.11a-b, is summarised below, as follows:

- There are predicted to be disturbance impacts and possible displacement of large waterbirds from the section of the Sheung Yue River to the south of the new bridge which will

carry the eastern primary distributor road P2. This area is currently used by moderate numbers of disturbance-sensitive waterbirds;

- There are predicted to be significant, albeit somewhat lower, disturbance impacts on large waterbirds foraging in the section of the Sheung Yue River between the new bridge for Road P2 and the new pedestrian footbridge over the river to the southeast of KTN area D1-5. This area is currently used by moderate numbers of disturbance-sensitive waterbirds;
- There will be some reduction in the carrying capacity of the remainder of the north side of the Sheung Yue River and the fringes of Long Valley north of the Sheung Yue River and west of the Shek Sheung River, especially during the construction phase of works in KTN areas D1-1 to D1-5 and in the open space zones alongside the north side of the Sheung Yue River, the west side of the tidal Ng Tung River and the west side of the Shek Sheung River. This section of the Sheung Yue River (shown in blue in **Figure 13.11a**) is currently used by large numbers of some waterbird species, including Little Egrets breeding in the Ho Sheung Heung Egretty; the tidal section of the Ng Tung River and the Shek Sheung River are currently used by moderate numbers of waterbirds as foraging areas; the tidal Ng Tung River and its riparian corridor is also utilised as a flight-line by ardeids breeding at Ho Sheung Heung Egretty and provides a linkage for waterbirds to the Deep Bay wetland ecosystem;
- There will be potential disturbance/exclusion impacts on most of the non-tidal Ng Tung River. These will be greatest on the south side of the river to the north of the extension to the Shek Wu Hui Sewage Treatment Works, and on both sides of the river to the east of Sheung Shui Wa Shan; and will be lowest on the north side of the river to the east of FLN area A1-2 and to the east of area A1-8. All of the non-tidal section of the Ng Tung River is utilised by moderate numbers of some species of waterbirds at present. However, the section to the west of the Man Kam To Road Bridge is of greatest significance as it is used as a corridor by some Chinese Pond Herons breeding at the Man Kam To Road Egretty.

The analysis above has been utilised later in this section in evaluating the significance of relevant impacts. It has also been utilised in **Section 13.8** in addressing the mitigation of impacts.

Dust Deposition

Unmitigated construction operations create significant levels of dust under certain weather conditions due to the use of haul roads and the

phenomenon of wind-blown dust from works areas. This dust is deposited on nearby habitats, which can cause vegetation damage and, as a secondary effect, have an impact on fauna such as insects and birds. Impacts from dust deposition of these types will, however, be temporary and reversible, and standard construction best practices as mitigation measures can be implemented to negate harmful impacts. Dust deposition impacts arising from the Project are not, therefore, considered to be significant in most instances. Accordingly, dust deposition is only elaborated in this section where impacts may be of significance.

Increased Sediment and Nutrient Load

Dust and exposed earth from construction operations may also enter watercourses via run-off, particularly during periods of heavy rain. This can lead to high turbidity from soil particles (which can block the gills of aquatic organisms) and eutrophication as a result of nutrient enrichment. Aquatic macrophytes may be reduced as a result of reduced light penetration or increased free-floating algae populations following eutrophication. Severe eutrophication can lead to oxygen depletion and the impoverishment of aquatic communities, as well as animals that prey on them (e.g. waterbirds). Such effects are usually greatest in the construction phase of a project, though can also occur in the operation phase.

Organisms at a higher trophic level are unlikely to be directly impacted by run-off before their prey (i.e. fish), the availability of which will reduce. In extreme cases, this may lead to abandonment of habitat. Such impacts are most likely to occur during the construction phase, but are also possible in the operational phase.

Additional sediment inputs to watercourses from the Project, while not necessarily significant in terms of the watercourses themselves, may still be of significance further downstream in the intertidal areas of Deep Bay. Increased sedimentation of the inner Deep Bay area in particular could increase the spread of mangrove into the mudflat area, which in turn would reduce the available foraging area for waterbirds. Mitigation measures are required and can be implemented to prevent such adverse impacts.

Impacts from construction site run-off are addressed in **Section 5.6.1.1** and are only elaborated in the current section where they are considered to potentially be of particular ecological significance.

Pollution

Pollution of air or water may arise from a large number of different sources and could occur during construction, operation or both. The severity of a pollution event would depend upon the type of pollutant being released, the nature and ecological value of the habitat affected,

the size of the habitat affected, the amount of pollutant released, duration of the event and the sensitivity of species potentially affected. Given the number of factors involved, the potential impacts of pollution are difficult to evaluate with a high degree of accuracy. Impacts of water pollution are of particular importance due to the sensitivity of the species involved and the high ecological value of wetland habitats in HK. In contrast, air pollution generally disperses over a larger area and the impacts are evident regionally but mostly do not affect local ecology.

In a HK context air quality issues are of concern generally. However, unless a project has a particular local emissions impact over and above those anticipated from normal urban and infrastructural development, it is not considered that there would be significant marginal impact on flora and fauna. Examples where emissions impacts might be of concern for local ecology are airports, ports and major industrial facilities. Development with regard to the NDA projects is not of this nature. As such, although all fauna and flora are sensitive receivers, the significance of any impacts at an individual species level is not considered significant.

There is potential for toxic pollutants from contaminated mud or storage activities to be disturbed and enter surrounding watercourses. Furthermore, spills and run-off from construction sites can contain high levels of toxic pollutants such as oil, which may cause direct mortality of flora and fauna or sub-lethal impacts (e.g. reduced breeding success, reduced foraging efficiency). Bio-accumulation may also occur should toxic substances be passed up the food chain in increasing concentrations. Such a process would impact top-level predators such as large waterbirds. Although likely to be of lower magnitude, toxic pollutants such as oil or petrol could enter water bodies during the operation phase as a result of run-off from road surfaces.

Impacts from pollution are addressed in **Section 5.6.1.1** and are only considered in the current section where they are considered to potentially be of particular ecological significance.

Hydrological disruption

Hydrological disruption as a result of changes to water flow or impacts on the underground water table could impact surrounding water bodies and other habitats. Most habitats which are considered to be potentially sensitive to hydrological disruption are primarily wetlands. These include Long Valley, wet agricultural land, marsh, ponds, mitigation wetlands and seasonally wet agricultural land. Lowland dryland habitats, including dry agricultural land and grassland, may also be sensitive to flooding or an increase in the level of the water table due to changes which impede surface or underground flow of water. All these habitats are considered to be Water Quality Sensitive Receivers (see **Section 5.4**); potential hydrological impacts on these habitats are assessed in full in **Section 5.6**, only hydrological impacts of particular relevance to the ecological impacts of the project are addressed specifically in this ecological impact.

In practice, hydrological disruption to wetland habitats is likely to be of much greater significance ecologically, especially as most lowland dryland habitats have been evaluated as of low ecological value in the Study Area. Upland dryland habitats are not sensitive to hydrological disruption except at a very local level.

A particular issue, which is of relevance in the NDA Project area, is that of construction phase changes to the management regime of channelised watercourses. Currently the levels of the Ng Tung River in FLN and the Sheung Yue River above the Fanling Highway are controlled by fabridams (**Figure 13.4**). If that on the Ng Tung River were to be lowered, for example to facilitate construction upstream, there would be impacts on the ecological function of the river. That on the Sheung Yue River is primarily of significance ecologically in that the water which is impounded above the fabridam is the source for the water which is abstracted from the river and which provides Long Valley with some of the water required for irrigation.

One natural, or at least semi-natural, watercourse, Ma Tso Lung Stream may experience hydrological disruption in the section to be diverted and the section downstream from the diverted section. Such hydrological disruption may have significant impacts on stream fauna and on fauna which are associated with habitats which are hydrologically linked to the stream (see also **Section 5.6.1.2**).

Hydrological impacts on other channels, including the main drainage channels are addressed in **Section 5.6.1** (Construction Phase) and **Section 5.6.2** (Operational Phase) of this EIA Report, and are not evaluated in detail in the current section. No significant hydrological impacts are predicted.

Fragmentation

Fragmentation is the appearance of discontinuities in habitat that render it less attractive to flora or fauna or isolate populations of a species, potentially leading to reduced viability of a population. This is most easily seen in infrastructural links, where roads and rail lines break up habitat into smaller units, but also arises from disturbance impacts, where organisms avoid certain areas due to secondary impacts from nearby development. Where the infrastructural link prevents mobility of organisms, fragmentation has occurred.

Construction within a large, continuous habitat patch may result in an edge effect reducing the overall value of the habitat. Generally, larger areas of habitat are of higher importance than smaller areas; this is not simply an arithmetical relationship; for example, doubling the area of a particular habitat may result in more than double the ecological value. Many species require a minimum area of a habitat and would not utilise two smaller fragments amounting to the same area. The severity of fragmentation impacts will depend upon the extent to which severance

occurs (whether this is partial or total), the relative sizes of resulting fragments, the extent and complexity of previous linkages and the baseline species diversity.

At its most extreme, fragmentation impacts may result in the loss of populations of a species if the remaining fragments are too small to support a viable population. Species most affected by fragmentation impacts are habitat specialists, terrestrial species and species with low mobility. Birds and flying insects are generally less affected than mammals, herpetofauna and non-flying invertebrates.

In the current study, the Project may result in potential fragmentation effect at both a local level, whereby an area of habitat is fragmented into smaller areas or from adjacent areas of habitat with which there are ecological linkages, but also at a macro level, in terms fragmentation of habitats from habitats with which they have significant linkages well outside the assessment area. In this respect, linkages for large waterbirds using Long Valley with the Deep Bay area are of particular significance.

Flight-line impacts are a particular type of fragmentation impacts that affect flying fauna, usually birds or bats. A flight-line can be defined as a route which is regularly followed for local movements of one or more individuals of bird or bat over a period of time (unlike a flight path, which is the route of a single flying bird or bat on a single occasion, or a flyway, which is a broad route followed by a large number of migrating individuals over a long distance). A common example relevant to the NDAs is the flight-line between an egretty and the foraging sites used by breeding egrets; birds will follow such a flight-line regularly over the course of the day to collect food and then return to the nest to incubate or to feed young.

Typically flight-lines involve routes followed between feeding and roosting areas or between feeding and breeding areas. Starting and finishing points of flight-lines may be tightly defined (such as a roost site or a breeding site) or cover a wider area (for example a foraging area covering a wide area of habitat). Geographical features may influence the location of flight-lines; for example waterbirds tend to follow water features such as rivers and may follow valleys even when a route crossing a line of hills would be shorter.

Development located on a flight-line may result in a decrease in the suitability of a foraging, breeding or roosting site by preventing movement to another site or by reducing the efficiency of movement between sites. In an extreme case, this may lead to the total abandonment of one or both sites. There may also be an increased risk of mortality by collision with structures constructed on or close to a flight-line.

Potential significant direct, indirect and fragmentation impacts on habitats in the assessment area in the absence of mitigation are described below. Where any or all of such impacts are not of relevance, for example

impacts of hydrological disruption on non-wetland habitats, or not predicted, these are not addressed in this report.

13.7.3.3 Long Valley

There will be no direct habitat loss in Long Valley arising from the Project; the area to the south and east of the Sheung Yue River will be zoned as Other Uses (Nature Park), while the area north and west of Long Valley will retain its current agricultural zoning.

Indirect Impacts

Potential indirect impacts to Long Valley in the absence of mitigation are assessed below. Potential disturbance impacts on Long Valley are considered separately in this section; other potential indirect impacts, which are more closely related, are presented together.

Potential disturbance impacts to Long Valley could arise from development on the west side of the Sheung Yue River in KTN areas B3-1 to B3-16, C1-1 and C1-2, D1-1 to D1-5, D1-7, D1-9 and the roundabout northwest of B3-8, as well as from the construction of two road bridges and a footbridge over the Sheung Yue River and the rechannelisation of the Long Valley Watercourse between the Sheung Yue River and the northeast corner of KTN area C1-1. In addition, disturbance could also arise from any construction activities along the west side of the river in Open Space zone C2-1 and the subsequent use of the open space zone by people. Of these developments, the bridges, the proposed Commercial, Research & Development complexes in B3-5, B3-8 and B3-12, the developments along the north side of the river at D1-1 to D1-5 and the Open Space zone, and rechannelisation of the Long Valley Watercourse are the largest in scale and/or the closest to Long Valley, and thus have the potential to cause the greatest disturbance during construction and operation. Locations of those proposed developments predicted to cause the greatest disturbance impacts in the absence of mitigation and the areas which would be disturbed are shown in **Figure 13.11**. Disturbance from most of these sources would occur in both the construction and operational phases of the project but would be significantly greater in the former.

Other development areas are more than 200m from the areas in Long Valley used by significant numbers of large waterbirds (the most disturbance-sensitive receivers occurring in significant numbers in the Study Area) or are separated from Long Valley by intervening existing development, and hence are not predicted to be disturbed significantly by nearby developments.

In addition to disturbance impacts from development, Long Valley may be impacted by increased disturbance from human activities as a consequence of the greater population within the area and the increased ease of access. Currently the areas that receive the greatest number of

human visitors are the roads alongside the Sheung Yue and Shek Sheung Rivers, which are used by large numbers of cyclists and walkers and a few vehicles. The farmland areas receive fewer visitors but are disturbed by farmers and birdwatchers.

The intensity of human disturbance within Long Valley compared with the baseline is not predicted to increase during the construction phase of the project. During the operational phase of the project it is assumed that the management of LVNP will, as a minimum, result in disturbance not being greater than at present in LVNP; there may, however, be a small increase in disturbance to the areas north and west of the Sheung Yue River due to the larger number of people living nearby; however these areas are distant from the main population and commercial centres and transport nodes of the NDAs.

Dust deposition may have a localised and short term impact during the construction period, especially in the southwest of Long Valley which is the area closest to major proposed construction activity. This may have a short-term effect on crop growth and food supply for some bird species.

Long Valley is largely made up of wetland habitats and these depend upon rainfall, wells and water supplied from the Sheung Yue River, both directly and that which is extracted to and distributed from the Long Valley Watercourse to the part of Long Valley south and east of the River. Accordingly, increased sediment and nutrient load in, and pollution and hydrological disruption of, the Sheung Yue River, the Long Valley Watercourse or the water table would, have a downstream impact on Long Valley wetland habitats. Effects of increased sedimentation and nutrient load would be minor as Long Valley habitats are already eutrophic and wetlands are turbid, but disruption to interruption of the water supply would be highly significant.

Hydrological impacts on Long Valley would potentially be significant were the water supply to Long Valley from the Long Valley Watercourse to be interrupted unexpectedly and/or for a prolonged period, especially if this occurred during the dry season. The water supply is currently abstracted from the Sheung Yue River above the fabridam located to the south of the Fanling Highway (**Figure 13.4**). Disruption could occur if this abstraction process were to be interrupted, or if the flow through the watercourse were to be interrupted to facilitate development in the areas to the southwest of Long Valley, especially in KTN area B3-12, or if the flow were to be interrupted to facilitate the proposed rechannelisation of this watercourse as an element of this project.

Table 13.59 - Potential impacts of disturbance and hydrological disruption on Long Valley in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Large area, a mosaic of wetland habitats of high and very high ecological value primarily due to high numbers and diversity of waterbirds, including many species of conservation significance; also of importance for other wetland-dependent fauna.
Species	High diversity of wetland bird species, some of which are large waterbirds of conservation significance sensitive to disturbance; other fauna diversity lower and not including disturbance-sensitive species in significant numbers. Many of the species of conservation significance are wetland-dependent, hence would be affected by impacts of hydrological disruption.
Size/Abundance	<p>Construction Phase disturbance and hydrological impacts: a large area of habitat potentially impacted, with high abundance of bird species.</p> <p>Operational Phase: a significantly smaller area would be disturbed from off-site sources; no impact from on-site disturbance sources predicted in LVNP (as it will be managed) but casual disturbance from visitors could increase slightly in the area north and west of the Sheung Yue River. Hydrological disruption could still affect a large area but contingency plan to mitigate for impacts should assist in remediation.</p>
Duration	<p>Construction Phase: temporary for construction phase disturbance impacts from development in areas adjacent to Long Valley (scheduled from 2017-2029). Duration of hydrological impacts dependent upon cause of disruption; unplanned disruption likely to be short-term and remediation possible.</p> <p>Operational Phase: permanent increase in disturbance from human activities in developed areas once developments are completed; permanent increase in disturbance during the operational phase from increased human population in the area to the area north and west of the Sheung Yue River. Duration of hydrological impacts dependent upon cause of disruption; unplanned disruption likely to be short-term and remediation possible.</p>
Reversibility	Most impacts of disturbance and hydrological disruption could be reversed during both construction and operational phases, but some permanent disturbance due to increased human activity in the area.

Criteria	Assessment
Magnitude	<p>Disturbance: Long Valley is currently disturbed by residents and their dogs, farming activities and by visitors, and fauna use reflects this. Of these, the first two sources of disturbance will apply only during the construction phase of the project and will end when LVNP is operational and visitor activities will be managed. These changes will offset much of the increase in disturbance from off-site sources. Accordingly, magnitude of increase of disturbance from off-site construction activity is predicted to be low to moderate for large waterbirds (as only a small part of Long Valley will be affected for a small number of species (Figure 13.11a)), but low for other fauna; no significant increase in impact from visitors in managed LVNP; magnitude of impact from increased visitor numbers in operational phase in the area north and west of the Sheung Yue River is predicted to be low.</p> <p>Hydrological disruption: magnitude of disruption potentially large if water supply from the Long Valley Watercourse were to be disrupted for a prolonged period, especially during in the dry season.</p>
Impact Severity	<p>Disturbance impacts of Low severity during construction phase as only part of Long Valley and disturbance-sensitive large waterbirds will be affected; lower, but still of significance, during operational phase.</p> <p>Impacts of hydrological disruption Low to High severity depending upon scale, duration and time of year.</p>

Table 13.60 - Potential indirect impacts, in addition to disturbance and hydrological impacts, on Long Valley in the absence of mitigation measures

Criteria	Dust deposition and increased sediment and nutrient load	Pollution
Habitat Quality	Large area, a mosaic of wetland habitats of high and very high ecological value, primarily due to the high numbers and diversity of waterbirds including many species of conservation significance.	
Species	High diversity of bird species, many of which are dependent on, or associated with wetland habitats; much of the other flora and fauna is wetland-associated or dependent.	
Size/Abundance	A large area of habitat potentially impacted, with high abundance of wetland-dependent bird species and other fauna.	
Duration	Risk would be greatest during construction phase and temporary (scheduled from 2017-2029). No significant impacts during operation (permanent).	Risk of impacts would be greatest during construction (2017-2029); risk small, but not insignificant during operation (permanent); duration may vary according to the nature of the event.
Reversibility	Most impacts would be reversible; dust deposition impacts would be reversed naturally by rainfall.	All impacts would be reversible; but larger events would take longer to remediate.

Criteria	Dust deposition and increased sediment and nutrient load	Pollution
Magnitude	Impacts of low magnitude, especially as sedimentation in eutrophic riparian wetlands is a natural process.	Magnitude of pollution event depends on type, size and duration of pollution event. Larger pollution events likely to be detected more quickly, so duration likely to be shorter. However, most pollution events are likely to be small, detected less quickly, but to affect smaller areas. Higher magnitude events unlikely during construction phase as monitoring will be in place and highly unlikely during operational phase as KTN development will largely be commercial and residential, hence potential sources for major events are highly limited.
Impact Severity	Construction phase: severity of impacts Low as only a small part of the habitat would be affected and most habitats and species are not sensitive. Operational phase: severity of impacts Low .	Nature of project is such that sources major pollution sources will not be present: most events likely to be of low magnitude, severity of which would be Low to Moderate . Operational phase pollution impacts: although dependent on nature and scale, most impacts likely to be Low .

Fragmentation

Potential fragmentation impacts on Long Valley include both potential fragmentation impacts within Long Valley and potential fragmentation of Long Valley from other habitats with which it has linkages. The avoidance of development within Long Valley does not wholly ensure that fragmentation within Long Valley will be avoided, as such impacts could arise if the Sheung Yue River, which divides the north and west of Long Valley from the south and east, were to be impacted in such a way that fauna species are deterred from crossing between the two areas. The development areas under the Project will not result in any reduction in connectivity between the two areas; however, construction works and increased human activity along the river may have some disturbance effects.

Long Valley has important linkages with the Ho Sheung Heung and Man Kam To Egrettries in the form of flight-line links for foraging ardeids.

Table 13.61 - Potential Fragmentation Impacts on Long Valley in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Large area, a mosaic of wetland habitats of high and very high ecological value, primarily due to the high numbers and diversity of waterbirds, including many species of conservation significance.
Species	High diversity of wetland bird species, many of which are large waterbirds that require or prefer larger habitat blocks and are absent from fragmented areas. Individuals of some species move between Long Valley and the Inner Deep Bay area and utilise the Ng Tung River corridor. Linkages between Long Valley and the Ho Sheung Heung and Man Kam To Egrettries are highly significant for ardeids breeding at these egrettries. Populations of other wetland fauna (except aquatic fauna able to use the Ng Tung and Sheung Yue Rivers) are largely already fragmented from wetland fauna elsewhere and, within Long Valley, by the Sheung Yue River, except for species that are able to use anthropogenic habitats; hence, there will be little or no increase in fragmentation for these groups.
Size/Abundance	A large area of habitat potentially impacted, with high abundance of bird species potentially affected by fragmentation impacts of areas on either side of the Sheung Yue Rive and the Ng Tung River corridor. Lower abundance of other fauna potentially impacted by fragmentation.
Duration	Fragmentation impacts from development activity along the Sheung Yue River will be temporary. Impacts of increased human activity will be permanent.
Reversibility	Construction phase impacts would be reversible; operational phase impacts irreversible; remediation possible in both construction and operational phases.
Magnitude	Moderate during construction phase; low to moderate during operational phase for some waterbirds but not significant for most fauna, hence low overall.
Impact Severity	Low to Moderate during construction phase, Low during operational phase (except on some waterbirds in the southwestern part of Long Valley which is closest to proposed development areas where impact severity will remain Low to Moderate).

13.7.3.4 Wet Agricultural Land

The ecological value of wet agricultural land in the Study Area has been assessed as Low to Moderate.

Small areas of wet agricultural land will be lost as a result of the Project. These comprise two fragments totalling 0.58ha, on the north and south sides of the Ng Tung River in the west of FLN. Whilst wet agriculture is often a habitat of relatively high ecological value, the value of these fragments is limited by their small size; this is somewhat compensated by linkages with Long Valley in respect to that at KTN and the Ng Tung River for those in FLN.

Wildlife species found are generally common and widespread and present in small numbers, consistent with the small size of the areas, though moderate numbers of amphibians were found in the wet

agricultural areas in KTN. Most of these species are common and widespread in Hong Kong, but wetland bird species of conservation significance use these areas in small numbers. However, only seven wetland bird species (Watercock, Pintail Snipe, Swinhoe's Snipe, Citrine Wagtail, Pallas's Grasshopper Warbler and Oriental Reed Warbler) are restricted to wet agricultural land and one other wetland habitat (Long Valley). Loss of this habitat will therefore, not be of significance for these species due to the small number of individuals using wet agricultural land relative to Long Valley. Red-billed Starling utilises wet agricultural land in moderate numbers but this is a highly mobile species which forages opportunistically in a large number of wet and dry lowland habitats. Impacts on this species from the loss of small areas of wet agricultural land will, therefore, be insignificant. One butterfly species of conservation significance, Danaid Egg-fly is associated with wet agricultural land (but also occurs around other lowland wetland habitats and in shrubland). However, it was not found in or near any areas which will be impacted. Moderate numbers of amphibians are present in wet agricultural land, but all are common in many wetland habitats and the effect of the loss of the small areas of wet agricultural land will be insignificant at a species level. One amphibian species of conservation significance, Chinese Bullfrog, was found in one of the patches in FLN which will be lost, however this species is common in Hong Kong, hence the impact on this species will not be significant.

In addition to direct impacts on wet agricultural land which are evaluated in **Table 13.62**, some small areas of wet agricultural land in outside the boundary of the FLN NDA may experience some indirect impacts from the Project (**Table 13.62a**).

Table 13.62 - Potential Direct Ecological Impacts on Wet Agricultural Land in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small areas of wet agriculture of Low to Moderate ecological value; partly fragmented from similar habitats, but with some linkages with nearby wetland habitats.
Species	Largely common and widespread fauna species, but including bird species of conservation significance, all in small numbers, and only seven species of which are restricted to wet agricultural land and Long Valley habitats; numbers in Long Valley are greater for all species. A moderate number and diversity of amphibians is present but all species are found in several wetland habitats. One individual of an amphibian species of conservation significance, Chinese Bullfrog, was found in an area of wet agricultural land which will be lost in FLN.
Size/Abundance	Small area (0.58ha) will be permanently lost; small numbers of most animals but moderate numbers of amphibians in patches in FLN. However, all species (including Chinese Bullfrog, are common in Hong Kong, and impacts of displacement will be minor as these species are able to utilise a variety of wetland habitats.
Duration	Permanent loss.
Reversibility	Irreversible.
Magnitude	Low.

Criteria	Assessment
Impact Severity	Low to Moderate in both construction and operational phases, primarily due to impacts on amphibians.

Table 13.62a - Potential Indirect and Fragmentation Impacts on Wet Agricultural Land in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small areas of wet agriculture of Low to Moderate ecological value north and south of the non-tidal Ng Tung River; partly fragmented from similar habitats, but with some linkages with nearby wetland habitats.
Species	Largely common and widespread fauna species, but including bird species of conservation significance, all in small numbers, and only seven species of which are restricted to wet agricultural land and Long Valley habitats; numbers in Long Valley are greater for all species. Moderate numbers and diversity of amphibians are present but all species are found in several wetland habitats. One individual of an amphibian species of conservation significance, Chinese Bullfrog, was found in an area of wet agricultural land which may be disturbed, but this species is not disturbance-sensitive.
Size/Abundance	Small area may be disturbed by noise and human activity, dust and hydrological changes; small numbers of most animals but moderate numbers of amphibians. However, all species (including Chinese Bullfrog, are common in Hong Kong, and impacts of disturbance are likely to be minor as any impacts will be low and these species are able to utilise a variety of wetland habitats and are not sensitive to most types of disturbance impacts.
Duration	Disturbance from noise and human activity will be permanent but probably lower during the operational phase; dust and sediment run-off largely during the construction phase; hydrological impact could be temporary or permanent depending upon cause.
Reversibility	Mostly reversible.
Magnitude	Low.
Impact Severity	Low in view of small area, likely low magnitude and small number of sensitive receivers.

13.7.3.5 Dry Agricultural Land

The ecological value of wet agricultural land in the Study Area has been assessed as Low.

Direct Impacts

The small areas of dry agricultural land that will be lost in KTN are highly fragmented and not used by significant numbers or diversity of fauna. A larger area of dry agricultural land will be lost in FLN, mainly between the existing urban area and Ng Tung River. The dry agricultural fields that will be lost in this area are highly fragmented by village areas. While areas of dry agricultural land may be ecologically linked to lowland grasslands; lowland grassland habitat has also been assessed as of Low ecological value as it too does not support significant numbers and diversity of species. Further, none of the species using lowland grassland are restricted to this, or this and a small number or area of other habitats. Nevertheless, small numbers of several fauna species of conservation significance have been recorded in dry agricultural land in this area. However, none of these species are dependent upon or strongly

associated with dry agricultural land, and most are birds and amphibians that occur in higher numbers and more regularly in wet agricultural land or other habitats. Only one species, Bull-headed Shrike, is largely restricted to a small number of habitats (it also utilises wet agricultural land and Long Valley habitats). This species only just meets the criterion of regularly occurring in the Study Area, with, at most, a handful of individuals likely to be present, and as a non-breeding visitor. This species is of marginal occurrence in Hong Kong, which is at the extreme south of its wintering range, the impacts of displacement of one or two individuals into other areas would be insignificant.

Indirect and Fragmentation Impacts

There will be no significant indirect and fragmentation impacts on dry agricultural land in KTN; one parcel of dry agricultural land in FLN to the east of Fanling is close to the Fanling Bypass and may be indirectly affected by dust and run-off during the construction phase and disturbance and fragmentation during the construction and operational phase of the project (Table 13.64).

Table 13.63 - Potential Direct Ecological Impacts on Dry Agricultural Land in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small, fragmented and disturbed areas individually but a moderate area overall (9.33ha, all except 0.22ha of which are in FLN) of Low ecological value.
Species	Low abundance and diversity of wildlife, largely common and widespread fauna species not restricted to this or a small number of habitats, but including a small number of species and individuals of some species of conservation significance, only one of which, Bull-headed Shrike, is distributed in this and a small number of other habitats. A large area of suitable habitat not affected by the project is present in the Study Area for these species. None of these species are present in numbers which would result in direct impacts causing a significant reduction in the carrying capacity of the areas to be lost such that any displaced individuals would not be able to be absorbed within the carrying capacity of unimpacted dry agricultural land or other habitats suitable for the species.
Size/Abundance	A moderate area totalling 9.33 ha; numbers of organisms are low.
Duration	Permanent loss.
Reversibility	Irreversible.
Magnitude	Low as area is disturbed and fragmented, number of organisms is small and few, if any, are dependent on this habitat.
Impact Severity	Low.

Table 13.64 - Potential Indirect and Fragmentation Impacts on Dry Agricultural Land in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small area (4.59ha) of Low ecological value.
Species	Low abundance and diversity of wildlife, largely common and widespread fauna species not restricted to this or a small number of habitats, but including a small number of species and individuals

Criteria	Assessment
	of some species of conservation significance, only one of which, Bull-headed Shrike, is distributed in this and a small number of other habitats. A large area of suitable habitat not affected by the project is present in the Study Area for these species. None of these species are present in numbers which would result in indirect impacts causing a significant reduction in the carrying capacity of the areas to be impacted such that any displaced individuals would not be able to be absorbed within the carrying capacity of unimpacted dry agricultural land or other habitats suitable for the species.
Size/Abundance	Small area; low numbers of fauna due to small size.
Duration	Any impacts from dust deposition and run-off would be short term and only during part of the construction phase; disturbance impacts would be permanent but reduced during the operational period.
Reversibility	Construction phase impacts mostly reversible; operational phase impacts irreversible; remedial measures to reduce impacts possible in both construction and operational phases.
Magnitude	Low due to small area impacted and limited scope of disturbance impacts; number of organisms is small and none are dependent on this habitat.
Impact Severity	Disturbance and fragmentation impacts both Low as both area and number of individuals affected are small.

13.7.3.6 Pond

Direct Impacts

A total of 3.08ha of pond habitat, all but 0.37ha of which is in KTN, will be directly impacted by the Project. Most of the ponds in KTN are small and isolated both from each other and habitats with which they might have ecological linkages, and support few wetland faunal species, although the fish fry ponds at Fung Kong attract some ardeids and two ponds at Ho Sheung Heung, though largely surrounded by developed areas, have linkages with Long Valley habitats.

At FLN NDA, one small inactive fish pond located to the west of the Man Kam To Road, to the north of Ng Tung River, will be directly impacted. Being close to Ng Tung River, this and nearby ponds have some linkages with the river for more vagile fauna, especially birds, and also have a role in maintaining linkages for waterbirds with Long Valley. Thus, although the ponds generally attract few wetland species, they have been assessed as being of Moderate ecological value. Diversity of fauna in ponds along the Ng Tung River was assessed as low to moderate, however, due to its small size, fauna diversity in this one pond is low.

Indirect Impacts

In addition to the single pond directly impacted, the other ponds in this area are potentially indirectly impacted by construction noise, increased sediment and nutrient load and hydrological disruption arising from the development of the proposed Police Driving and Traffic Training Complex

in FLN area A1-8 to the east, proposed WSD facilities in FLN area A1-2, Open Space in FLN area A1-4, and the Sewage Treatment Works Extension in FLN area A2-3.

Table 13.65 - Potential Direct Ecological Impacts on Ponds in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small areas of Low (0.59ha in KTN), Low to Moderate (2.12ha in KTN) and Moderate (0.37ha in FLN) ecological value; largely fragmented by urban habitats and somewhat disturbed by human activities.
Species	Small numbers and diversity of floral species in active ponds, more floral diversity in inactive ponds but with many exotic herb species, low diversity of fauna but small numbers of waterbird species of conservation significance occur occasionally.
Size/Abundance	Habitat area is small (3.19ha) and faunal abundance is low.
Duration	Permanent.
Reversibility	Irreversible.
Magnitude	Low.
Impact Severity	Low for ponds small scattered ponds in KTN but Low to Moderate for pond at Fung Kong, those near Ho Sheung Heung and that in FLN due to use by some wetland fauna and linkages with other wetland habitats.

Table 13.66 - Potential Indirect and Fragmentation Impacts on Ponds in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small area (2.75ha) of Moderate ecological value; somewhat fragmented by developed areas and somewhat disturbed by human activities.
Species	Floral diversity low with many exotic herb species; low diversity of fauna in ponds where disturbance may occur (ponds with low to moderate diversity of fauna will not be disturbed) but small numbers of waterbird species of conservation significance occur occasionally. Some of these species are largely restricted to pond and Long Valley habitats in the Study Area; however, these largely occur in ponds along the Ng Tung River, not the ponds which will be disturbed. One species of conservation significance, Little Grebe, may occur regularly in the disturbed ponds; however this waterfowl species tolerates relatively high levels of disturbance, including noise, presence of humans and human activities.
Size/Abundance	Habitat area is small and faunal abundance is low.
Duration	Temporary in respect of construction impacts, permanent in respect of operational impacts.
Reversibility	Mostly reversible; but operational phase disturbance irreversible; remedial measures possible in both construction and operational phases.
Magnitude	Low for impacts of run-off and hydrological disruption; moderate for construction phase disturbance, low to moderate for operational phase disturbance, low for fragmentation.
Impact Severity	Construction stage disturbance impact of Low to Moderate severity and operational phase disturbance impact of Low severity; severity of run-off, hydrological disruption and fragmentation Low in both construction and operational phase.

Marsh

There will be no direct impacts to marsh habitat arising from the Project.

Indirect and Fragmentation Impacts

Marsh areas outside the KTN NDA boundary at Ma Tso Lung may be indirectly impacted by development to the south.

Potential disturbance impacts to the marsh at Ma Tso Lung from development nearby are not predicted as the marsh area is not used by significant numbers of disturbance-sensitive species; however, since the marsh is downstream of development areas of the Project, impacts of run-off and hydrological disruption during the construction and, to a lesser extent, the operational phase of the Project may occur. However, the marsh is a moderate area of habitat which currently experiences seasonal fluctuations in water levels and turbidity; hence impacts of run-off and hydrological disruption are likely to be of low significance.

Fragmentation impacts on this habitat are addressed as an element of fragmentation impacts on the Ma Tso Lung Stream and its riparian corridor of which this habitat constitutes an element.

Table 13.67 - Potential Indirect Ecological Impacts on Marsh in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Moderate area (4.16ha) of Low to Moderate ecological value; somewhat fragmented by developed areas and somewhat disturbed by human activities.
Species	Floral diversity low; several wetland fauna species, including one amphibian, one butterfly and one dragonfly of conservation significance.
Size/Abundance	Habitat area is moderate but faunal abundance is low.
Duration	Temporary in respect of construction impacts, permanent in respect of operational impacts.
Reversibility	Mostly reversible but operational phase disturbance impacts irreversible; remedial measures possible in both construction and operational phases.
Magnitude	Low during construction and operational phases in respect to impacts of run-off and hydrological disruption. Low during both construction and operational phases in respect to disturbance impacts.
Impact Severity	Impact severity of run-off, hydrological disruption and pollution Low ; severity of disturbance impacts Low .

13.7.3.7 Mitigation Wetland

Potential ecological impacts on mitigation wetland parcels, other than the parcels in Long Valley which were considered as an element of assessment of impacts on Long Valley habitats, are assessed below.

Direct Impacts

Three mitigation wetland parcels alongside the Sheung Yue River and seven on the Ng Tung River will be directly impacted by the Project. The areas are small (2.75ha in aggregate), but the parcels alongside the Sheung Yue River form an element of the Long Valley wetland complex, albeit they are somewhat fragmented from the main area of that wetland by non-wetland habitats; both these and the parcels along the Ng Tung River have linkages with the adjacent river channels.

One mitigation wetland parcel on the Sheung Yue River is 140m upstream of the Project Area boundary and is unlikely to be used by significant numbers of the more disturbance sensitive waterbirds. No significant impacts on this wetland parcel are predicted.

Indirect Impacts

One mitigation wetland parcel on the north side of the Ng Tung River in FLN area A1-7 is proposed to be retained as wildlife habitat and zoned as Conservation Area (CA) in the revised RODP. Indirect impacts to this parcel could arise from construction and operation of the Police Driving and Traffic Training Complex (in FLN A1-7) just over 100m to the east, and any landscape works along the Ng Tung River, as well as increased human activity during the operational phase of the Project. The Sewage Treatment Works Extension is 200m to the west of A1-7 so disturbance impacts from this source are not considered to be significant. However, a new footbridge to be constructed over the Ng Tung River is within 50m and hence is a potential source of disturbance during construction. Dust deposition may have a localised and temporary impact on this parcel during the construction period. This may have a short-term effect on plant growth and food supply for some species of fauna. Water supply to the wetland is from the Ng Tung River but this supply will not be affected by the project as no works requiring this to be interrupted are proposed; further, works are not predicted to result in any hydrological disruption. However, increased sediment and nutrient load in, and pollution of, the Ng Tung River would have an impact on the habitat. Effects of increased sedimentation and nutrient load would be minor, as water in the habitat is already eutrophic and turbid.

Fragmentation Impacts

Potential fragmentation impacts to this mitigation meander could arise from interruption of linkages to adjacent wetland habitat (the Ng Tung River) or with nearby wetland habitat with which it has linkages (Long

Valley). Linkages with the Ng Tung River would be affected by construction work on the road and by increased use of the road by vehicles or pedestrians during the operational period. Linkages with Long Valley will not be impacted significantly permanently, as the single development in the intervening area (Sewage Treatment Works Extension) will only slightly increase the development area and mass relative to the existing Sewage Treatment Works.

Table 13.68 - Potential Direct Ecological Impacts on Mitigation Wetlands in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Small areas of semi-natural pond and marsh habitat, somewhat fragmented, but those along the Sheung Yue River have linkages with Long Valley and all parcels have linkages with the adjacent river channels. Parcels along the Sheung Yue River (0.43ha) are considered to be of Moderate ecological value as an element of the Long Valley wetland complex; those along the Ng Tung River (2.32ha) are more fragmented from other wetland habitats and are used by smaller numbers of fauna, hence are of Low to Moderate ecological value.
Species	Parcels along the Sheung Yue River are used by many of the pond and marsh-associated fauna of Long Valley wetland; those along the Ng Tung River have a low diversity of wetland birds and most fauna, but a moderately diverse dragonfly community, including one species of conservation significance, Dingy Dusk-hawker, albeit this species is common in Hong Kong.
Size/Abundance	Habitat area is small (2.75ha in aggregate) and abundance of fauna is low.
Duration	Permanent.
Reversibility	Irreversible.
Magnitude	Low.
Impact Severity	Low to Moderate severity.

Table 13.69 - Potential Impacts of Disturbance and Hydrological Disruption on Mitigation Wetland in FLN A1-7

Criteria	Disturbance	Hydrological Disruption
Habitat Quality	Small area (0.34ha) of wetland of Moderate ecological value with some linkages to the Ng Tung River and Long Valley.	
Species	Low diversity of species due to the small size of this one parcel, but some wetland flora and small numbers of wetland birds of conservation significance.	
Size/Abundance	Area of habitat and fauna numbers are both small.	
Duration	Temporary for construction phase impacts from nearby development. Permanent from human activities in these areas once developments are completed. Permanent increase in disturbance during the operational phase from increased human population in the area causing number of visitors to increase.	Temporary for construction phase impacts from nearby development.

Criteria	Disturbance	Hydrological Disruption
Reversibility	Mostly reversible, but operational stage disturbance impacts irreversible; remedial measures possible in both construction and operational phases.	Reversible.
Magnitude	Magnitude of increase of disturbance is predicted to be low (see Figure 13.11b).	Only minor works under the project are predicted nearby and interruption to water supply is not planned and is unlikely to occur accidentally.
Impact Severity	Low severity.	Low severity.

Table 13.70 - Potential impacts of dust deposition, increased sediment and nutrient load and pollution on mitigation wetland in FLN A1-7 in the absence of mitigation measures

Criteria	Assessment in respect of dust deposition, increased sediment and nutrient load to, pollution of, or hydrological disruption to the water supply
Habitat Quality	Small area of wetland of Low to Moderate ecological value with some linkages to the Ng Tung River and Long Valley.
Species	Low diversity of species but some wetland flora and small numbers of wetland birds of conservation significance.
Size/Abundance	Area of habitat and fauna numbers are both small.
Duration	Temporary for changes to water quality.
Reversibility	Mostly reversible and remedial measures may be possible.
Magnitude	Low.
Impact Severity	Low during construction, not significant during operation.

Table 13.71 - Potential fragmentation Impacts on mitigation wetland in FLN A1-7 in the absence of mitigation measures

Criteria	Assessment in respect of fragmentation
Habitat Quality	Small area of wetland of Moderate ecological value with some linkages to the Ng Tung River for more vagile wetland fauna.
Species	Low diversity of species but some wetland flora and small numbers of wetland birds of conservation significance.
Size/Abundance	Area of habitat and fauna numbers are both small.
Duration	Temporary for any construction impacts. Impacts of increased human activity will be permanent.
Reversibility	Mostly irreversible but remedial measures may be possible.
Magnitude	Construction phase impacts of low to moderate magnitude; operational phase impacts of low magnitude.
Impact Severity	Low to Moderate during construction phase, Low during operational phase.

13.7.3.8 Direct, Indirect and Fragmentation impacts on the Major Channelised Watercourses

Two new road bridges and one new footbridge will be constructed over the Sheung Yue River; one new footbridge will be constructed over the tidal Ng Tung River and two new road bridges and three new footbridges will be constructed over the non-tidal Ng Tung River. In addition, four footbridges and one road bridge will be upgraded on the non-tidal Ng Tung River. Bridge construction will result in a small direct loss of habitat in the major channelised watercourses as a consequence of the construction of piers in the river beds. The area occupied by the piers will be very small, both in absolute terms and in relation to the size of the rivers; it is estimated that approximately 60m² will be lost on the Sheung Yue River, 10m² and 80m² will be lost on the Ng Tung River, assuming that the new bridges are of a similar design to existing bridges.

Construction of the new bridges will require the creation of temporary cofferdams in many or all cases. The direct impact of the temporary habitat loss will be of low significance, as will hydrological impacts as the areas required for cofferdams will be small and will not affect the rivers hydrologically (see **Section 5.6.1.2**). Disturbance and fragmentation impacts of pier construction will not be materially different from those of bridge construction as the disturbance and fragmentation will affect the same sensitive receivers (large waterbirds) as other elements of the construction process. Locations of new bridges over the channels are shown on **Figure 13.11a-b**.

In addition to impacts of hydrological disruption, there may be indirect impacts on the three main channelised watercourses from disturbance, pollution, sedimentation, increased nutrient load and fragmentation. In the following impact evaluations direct and disturbance impacts, which are similar in nature in respect to this habitat are considered together; as are other indirect impacts (including hydrological impacts). Fragmentation impacts on large waterbirds utilising this habitat are addressed

separately, as these are somewhat different in nature in that they only affect a limited number of species, but may be relatively significant for some of these.

The Sheung Yue River is used by some species of waterbirds on a regular basis, though the numbers are insignificant in a Hong Kong context; while the Ng Tung and the tidal lower section of the Shek Sheung River are used by moderate numbers of the same species. Grey Heron and Great Egret are the most disturbance sensitive of these species, but they are not known to rely significantly on the water channels. The waterbird species usually present in the largest numbers is Little Egret. The species and circumstances for which the foraging habitat is considered to be of most significance are Little Egret and Chinese Pond Heron during the breeding season, as they are most likely to be reliant on this habitat.

Roads alongside the rivers are currently used by local residents, small numbers of vehicles, but considerable numbers of cyclists and pedestrians. Accordingly, birds using the river channels are already exposed, and hence habituated, to moderate amounts of disturbance in the area. However, disturbance levels will increase significantly on the Sheung Yue and Ng Tung Rivers as a consequence of the Project, both through construction activity adjacent to the channels and increased population within the NDAs during the operational period. Disturbance is predicted to increase most along the southern section of the Sheung Yue River, especially in the south where there will be development on both sides and along much of the non-tidal section of Ng Tung River in FLN (**Figure 13.11**). There will be no significant disturbance impacts to the Shek Sheung River during the construction phase of the project, but disturbance may increase during the operational phase.

Disturbance impacts to the rivers are predicted to be greatest to the Sheung Yue and Ng Tung Rivers during the construction phase, but will be lower, especially along the tidal section of Ng Tung River, during the operational phase as much of the land adjacent to the river will be zoned as open space, in which disturbance impacts will be largely restricted to disturbance from human recreational and leisure activities.

Development adjacent to, or upstream of, the watercourses may result in increased sedimentation, nutrient load, pollution or hydrological disruption. Any assessment of potential impacts from these sources must, however, be set in the context of the large size of the rivers (length, width and, in the case of the Ng Tung River, water volume) and their current eutrophic, turbid and relatively polluted state.

Fragmentation Impacts

Potential fragmentation impacts to major channelised watercourses include additional barriers to the movement of aquatic fauna, especially in the sections with unimpeded flow at present, and bridges or other

structures that would impede flying birds. Additional barriers to water movement are not proposed under the Project, but a new road bridge and footbridge will be built over the Sheung Yue River and the Ng Tung River.

Fragmentation impacts may also be caused if the movement corridors along the rivers are narrowed by development or activities in adjacent areas and/or if movement corridors along or across the rivers are impacted by development or activities along the rivers such that fauna are deterred from using them.

In the case of the Sheung Yue River, there are two movement corridors; that along the river, which extends upriver beyond the Study Area, and that across the river between the areas north and west and south and east of the river. The first of these corridors is primarily used by waterbirds foraging in the river; the second by waterbirds moving between wetland habitats in Long Valley on either side of the river and by ardeids flying between Long Valley south and east of the river and Ho Sheung Egrettry. Both of these corridors are used by moderate numbers of waterbirds; the latter is of particular significance for breeding ardeids. In the case of the Shek Sheung River, the river corridor is used primarily by waterbirds foraging in the river, and hence is used by fewer waterbirds.

The corridor along the Ng Tung River in FLN is used by waterbirds foraging along the river and by ardeids breeding at Man Kam To Road Egrettry; while that along the Ng Tung River north of the confluence with the other rivers and Area C2-2 of KTN NDA, form an important ecological linkage, especially for waterbirds, to Hoo Hok Wai and the Deep Bay wetland ecosystem. Again, the species and circumstances for which fragmentation impacts are considered of potential significance are Little Egrets and Chinese Pond Herons foraging in this habitat during the breeding season and breeding at Ho Sheung Heung and Man Kam To Egrettries.

Table 13.72 - Potential Direct Ecological Impacts and Disturbance Impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Habitat is artificial and has been created by entirely remodelling former river channels. However, Sheung Yue River and the tidal section of the Ng Tung River are of Moderate ecological value, and the non-tidal section of the Ng Tung River and the Shek Sheung River are of Low to Moderate ecological value, primarily because of their importance to some waterbird species.
Species	Low floral diversity; low to moderate diversity of fauna species on Sheung Yue River, low diversity of fauna species on the other rivers. Of significance to some waterbird species; however, all species of conservation significance use a variety of wetland habitats and all occur more regularly and usually in larger numbers, in Long Valley.

Criteria	Assessment
Size/Abundance	Habitat area is large (total length of approximately 9,500m). Sheung Yue River and tidal section of Ng Tung River used by moderate numbers, non-tidal section of Ng Tung River by low to moderate numbers, Shek Sheung River by low numbers of waterbirds. Low abundance of other fauna of conservation significance.
Duration	Permanent in respect of direct habitat loss and operational phase impacts, temporary in respect of construction phase impacts.
Reversibility	Construction phase impacts of small area occupied by cofferdams for bridge piers mostly reversible; permanent habitat loss for bridge piers irreversible; construction stage disturbance impacts mostly reversible. Remedial measures possible during both construction and operational phases.
Magnitude	Direct habitat loss of very low magnitude during operation, larger, but still low relative to the size of the rivers, during construction. Construction phase disturbance to the Sheung Yue River moderate; to the non-tidal section of the Ng Tung River and the Shek Sheung River would be of low to moderate magnitude; and to the tidal section of the Ng Tung River, low. Operational phase disturbance to large waterbirds on the Sheung Yue River and non-tidal section of the Ng Tung River would be of low to moderate magnitude but all other disturbance impacts on the habitat and species would be of low magnitude or not significant; operational phase disturbance to the non-tidal section of the Ng Tung River and the Shek Sheung Rivers would not be significant as all significant ecological functions would be restored.
Impact Severity	Impact of direct habitat loss of Low severity during both construction and operational phases, as area is small, relative to the size of the rivers. Construction phase: Moderate severity on Sheung Yue River due to the relatively large number of waterbirds present; Low to Moderate severity on non-tidal section of the Ng Tung River; Low severity on tidal section of the Ng Tung River and on the Shek Sheung River. Operational phase: Low severity (in view of small number of species and single foraging function) on waterbirds in the Sheung Yue River and the non-tidal section of Ng Tung Rivers but all other habitat functions and functions for fauna would be restored; not significant elsewhere as only a small number of species (the most disturbance-sensitive large waterbirds) will be affected and other ecosystem functions will be restored.

Table 13.73 - Potential Impacts of increased sediment and nutrient load, pollution and hydrological disruption on Ng Tung, Sheung Yue and Shek Sheung Rivers in the absence of mitigation measures

Criteria	Increased sediment and nutrient load and pollution	Hydrological disruption
Habitat Quality	Habitat is artificial and has been created by entirely remodelling former river channels. However, Sheung Yue River and the tidal section of the Ng Tung River are of Moderate ecological value, and the non-tidal section of the Ng Tung River and the Shek Sheung River are of Low to Moderate ecological value, primarily because of their importance to some waterbird species.	
Species	Low floral diversity; low to moderate diversity of fauna species on	

Criteria	Increased sediment and nutrient load and pollution	Hydrological disruption
	Sheung Yue River, low diversity of fauna species on the other rivers. Of significance to some waterbird species; however, all species of conservation significance use a variety of wetland habitats and all occur more regularly and usually in larger numbers, in Long Valley.	
Size/Abundance	Habitat area is large (total length of approximately 9,500m. Sheung Yue and Ng Tung Rivers are used by moderate numbers and Shek Sheung River by low numbers of waterbirds. Low abundance of other fauna of conservation significance.	
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.	Temporary and only during construction phase.
Reversibility	Construction phase impacts mostly reversible; operational phase impacts irreversible; remedial measures possible during both construction and operational phases.	Reversible.
Magnitude	Magnitude mostly low, due to potential scale of impacts relative to the size of the channels; some pollution events could be of moderate magnitude.	Magnitude low: pier construction will utilise cofferdams which will not have significant effects on hydrology of rivers (see Section 5.6.1.2).
Impact Severity	Low in most circumstances, but some construction phase pollution impacts could be of Moderate severity.	Low .

Table 13.74 - Potential Fragmentation Impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers in the absence of mitigation measures

Criteria	Assessment in respect to fragmentation
Habitat Quality	Habitat is artificial and has been created by entirely remodelling former river channels. However, Sheung Yue River and the tidal section of the Ng Tung River are of Moderate ecological value, and the non-tidal section of the Ng Tung River and the Shek Sheung River are of Low to Moderate ecological value, primarily because of their importance to some waterbird species.
Species	Of potential significance to bird species if linkages between the rivers and Long Valley are affected, or linkages along the rivers to other habitats with which Long Valley has ecological linkages are affected. There are no significant linkages between the rivers and other habitats for other fauna.
Size/Abundance	The tidal section of the Ng Tung River is large and is used by moderate numbers of waterbirds, including breeding egrets, as a movement corridor. However, the movement corridor is considerably wider than the river itself and includes a relatively wide riparian corridor, much of which contains wetland habitats, and which is largely unobstructed by development. The non-tidal section of the Ng Tung River is large; moderate numbers of waterbirds use the river as a movement corridor to Long Valley and perhaps the Sheung Yue River. The Sheung Yue River is moderate in size; moderate to large numbers of waterbirds move between the river and Long Valley,

Criteria	Assessment in respect to fragmentation
	but relatively few birds use the Sheung Yue River as a movement corridor as there is little suitable habitat upstream of the Fanling Highway. The Shek Sheung River is small; a small number of birds move between this river and Long Valley but the river itself is not a significant movement corridor.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Fragmentation impacts caused by construction activity largely reversible but impacts due to avoidance of structures largely irreversible; some remediation possible for construction phase impacts.
Magnitude	Not significant for impacts on linkages between the Sheung Yue and Shek Sheung Rivers and Long Valley as these linkages will largely be unaffected; low to moderate for impacts on linkages between the non-tidal Ng Tung River and Long Valley during both construction and operational phases as number of birds is moderate but few species are involved in significant numbers, low for impacts on linkages along the tidal Ng Tung River during the construction phase as development area is small relative to the corridor width; not significant during the operational phase as no significant increase in sources of fragmentation.
Impact Severity	Low to Moderate severity in respect to impacts on linkages between the non-tidal Ng Tung River and Long Valley during construction and operation; Low severity in respect to impacts on linkages along the tidal Ng Tung River during the construction phase, but not significant during the operational phase.

13.7.3.9 Minor Watercourse/Stream

Ma Tso Lung Stream

There will be no direct impacts on the mid/upstream section of the Ma Tso Lung Stream where a Three-banded Box Terrapin was found during surveys conducted for this project.

Ma Tso Lung Stream will be impacted directly by construction of the Eastern Link Road to LMC Loop. The road will cross the stream on viaduct, though a section of 130m of the stream will be diverted and the 30m wide riparian corridor on either side of this section will be narrowed to between 15m and 30m on the west side of the stream. One minor tributary will be diverted for a combined length of 120m in its upper reaches in order to avoid proposed development areas in KTN areas E1-2 (Primary School). This stream section is disturbed by adjacent developed areas at present.

Where the road is on viaduct over the stream, no direct impact on the stream is predicted.

However, Ma Tso Lung Stream may be indirectly impacted downstream of the viaduct and at-grade sections by run-off and hydrological disruption arising from the road construction and diversion and the stream and the riparian corridor may receive fragmentation impacts from these sources.

In addition, both the stream and its tributary, Ma Tso Lung San Tsuen Stream, may be indirectly impacted and experience fragmentation impacts as a consequence of development in KTN area F1-1, proposed for Sports Ground/Sports Complex, F1-2 proposed for a Sewage Pumping Station, and F1-3 proposed for Research and Development in Support of Lok Ma Chau Loop Development.

Fragmentation impacts on the stream and riparian corridor are primarily of concern if the project element which may cause impacts severs continuous areas of a habitat or severs habitats which have significant ecological linkages. In the case of Ma Tso Lung Stream and tributaries, these comprise the natural and semi-natural habitats of the riparian corridor, as well as the stream itself. The riparian corridor is largely wooded in the middle and upstream sections and grassland, seasonally wet grassland and marsh in the downstream section. The alignment of the road is such that it will cross the stream approximately 320m upstream of the northern boundary of the Project Area, then will run parallel and to the west of the stream (including the section to be diverted) as far as the limits of the Study Area. As a consequence fragmentation impacts could arise in one of three ways: fragmentation where the stream crosses the road; fragmentation, if disturbance impacts on the corridor deter fauna from using the corridor where this parallels the road; and fragmentation of linkages between stream corridor habitat and other areas of the same or ecologically linked habitat on the western side of the road.

Of these three types of fragmentation impact, the first, the severance of the stream corridor where the road crosses the stream is potentially the most severe impact; disturbance of the corridor also has the potential to be a severe impact if it deters fauna of conservation significance which are reliant on the riparian corridor habitats from using the corridor. The third type of fragmentation impact is likely to be of lower severity to fauna using the riparian corridor, but may be of significance for fauna moving between habitats on either side of the corridor, or moving between the corridor and non-riparian habitats to the west.

Table 13.75 - Potential Direct Ecological Impacts on Ma Tso Lung Stream and tributaries in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Ma Tso Lung Stream is of Moderate to High ecological value as the watercourse within the Study Area is natural or semi-natural and supports stream fauna of conservation significance); the section of minor tributary which will be diverted is disturbed by neighbouring development and is of Low ecological value.

Criteria	Assessment
Species	Flora diversity is low but fauna includes three wetland-dependent species of conservation importance in or near the stream including the globally Critically Endangered Three-banded Box Terrapin (though the latter is unlikely to utilise the area of stream which will be impacted on a regular basis as this species prefers wooded habitats which are not present in the section of Ma Tso Lung Stream which will be diverted and its downstream riparian corridor, while the tributary section to be diverted is disturbed at present and is located some way from where the terrapin was recorded).
Size/Abundance	Both diverted sections of streams are small as compared to the total length of the stream and tributaries (6600m). Numbers of fauna which may be impacted are small.
Duration	Permanent.
Reversibility	Irreversible.
Magnitude	Moderate.
Impact Severity	Moderate in respect of diversion of lower stream course, Low in respect of disturbed minor tributary.

Table 13.76 - Potential Indirect Ecological Impacts on Ma Tso Lung and Ma Tso Lung San Tsuen Streams in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Ma Tso Lung Stream and Ma Tso Lung San Tsuen Streams are of Moderate to High ecological value as the watercourses within the Study Area are natural or semi-natural and support stream fauna of conservation significance. The section of minor tributary to be diverted is disturbed by neighbouring development and is of Low ecological value.
Species	Flora diversity is low but fauna includes seven wetland-dependent species of conservation importance in or near the stream, including the globally Critically Endangered Three-banded Box Terrapin (though the latter is unlikely to utilise the area of stream which will be impacted on a regular basis as this species favours wooded habitats which are not present in the section of Ma Tso Lung Stream which will be diverted and its downstream riparian corridor, while the tributary section to be diverted is disturbed at present and is located some way from where the terrapin was recorded). None of these species are highly disturbance-sensitive, but reptile species (including Three-banded Box Terrapin) may be displaced from potential habitat by disturbance. Two aquatic species (<i>Somanniathelphusa zanklon</i> and Small Snakehead) and two species with partially aquatic life cycles (Chinese Bullfrog and Ruby Darter) of conservation significance may be impacted by pollution, though all four species are relatively tolerant of high turbidity and organic pollutants.
Size/Abundance	Both streams are small (but the total length of the stream and tributaries is large (6600m); the length that might be impacted is moderate due to potential downstream hydrological disruption and impacts of pollution and disturbance impacts on riparian fauna. Numbers of fauna which may be impacted are small but include <i>Somanniathelphusa zanklon</i> and Small Snakehead.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Construction phase impacts mostly reversible; operational phase impacts irreversible; remedial measures to reduce disturbance possible in both construction and operational phase.

Criteria	Assessment
Magnitude	Disturbance: moderate during both construction and operational phases Run-off and hydrological disruption: moderate during construction phase, low during operational phase.
Impact Severity (Disturbance)	Low during construction phase; Low during operational phase, in respect of main stream; Low during construction and Low during operation in respect of the tributary.
Impact Severity (Pollution and Hydrological Disruption)	Moderate during construction phase; Low to Moderate during operational phase, in respect of both the main stream and the tributary, due to the relatively large area which may be affected downstream.

Table 13.77 - Potential Fragmentation Impacts on Ma Tso Lung Stream and tributaries and riparian corridor in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Ma Tso Lung Stream and Ma Tso Lung San Tsuen Streams are of Moderate to High ecological value as the watercourses within the Study Area are natural or semi-natural and support stream fauna of conservation significance.
Species	Terrestrial fauna may be affected by fragmentation of the stream corridor or of linkages between habitats on either side of the riparian corridor. Such fauna includes seven wetland-dependent species of conservation importance in or near the stream, including the globally Critically Endangered Three-banded Box Terrapin. Of these species, two (Three-banded Box Terrapin and Chinese Bullfrog) may be affected by fragmentation of the riparian corridor. Also of relevance is Red Muntjac, found to the west of the stream, as this species may cross the riparian corridor. All aquatic fauna of conservation significance was found downstream of the area where fragmentation impacts may occur so impacts on the species are predicted to be small at most.
Size/Abundance	Both streams are small, but fragmentation has the potential to impact a large area. Numbers of fauna which may be impacted are small.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible; though remedial measures possible during operational phase.
Magnitude	Low to moderate as number of species and individuals which will be affected are both small.
Impact Severity	Moderate on Ma Tso Lung Stream during both construction and operational phases as number of individuals is small but ecological importance of potentially impacted fauna (in particular Three-banded Box Terrapin) is high. Low on tributaries during construction and operation.

Pak Shek Au and Chau Tau Watercourse

This watercourse is a concrete-lined drainage ditch alongside Castle Peak Road. It has only intermittent flow and supports no fish or stream fauna. Road improvement works will directly impact the whole watercourse.

Chau Tau Watercourse is a small partly-channelised polluted stream located in the east of Chau Tau Village. Small numbers of the crab, *Somanniathelphusa zanklon*, which is of conservation significance, have been found in this watercourse. The watercourse is outside the Project Area boundary and is upstream of any areas where impacts are predicted.

Table 13.78 - Potential Ecological Impacts on Pak Shek Au and Chau Tau Watercourses in the absence of mitigation measures

Criteria	Pak Shek Au Watercourse	Chau Tau Watercourse
Habitat Quality	Man-made habitat of Low ecological value.	Partially channelised but largely natural bed and sides; polluted.
Species	No fish or stream fauna.	<i>Somanniathelphusa zanklon</i> present in small numbers.
Size/Abundance	Very small with intermittent flow.	Stream is small; numbers of <i>Somanniathelphusa zanklon</i> appear to be small.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.	No impacts on the stream or stream fauna area predicted.
Reversibility	Irreversible.	N/A.
Magnitude	All of watercourse will be impacted but very small; therefore low.	N/A.
Impact Severity	Low.	No impacts predicted.

Tung Fong/Shek Tsai Ling Watercourse and Kwu Tung Watercourse

These small, connected watercourses fall entirely within the development area of the Project in KTN. They are largely channelised but a short upstream section of Tung Fong Watercourse has a semi-natural stream course, though this is highly disturbed and flow is intermittent in this section. One crab species of conservation significance, *Somanniathelphusa zanklon*, was found in a channelised section of the Tung Fong Watercourse and may also be present in the semi-natural section. This species is present in a number of streams in the area and is tolerant of polluted conditions; only one individual was found in this stream and there is little suitable habitat present.

Table 13.79 - Potential Ecological Impacts on Tung Fong/Shek Tsai Ling Watercourse and Kwu Tung Watercourse in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Largely man-made habitat of Low ecological value; a small semi-natural upstream section is highly disturbed and polluted and flow is intermittent; this section also of Low ecological value.

Criteria	Assessment
Species	One individual of a crab species of conservation significance, <i>Somanniathelphusa zanklon</i> is present. This species is of conservation significance however has been recorded in a number of watercourses in the northern New Territories and occurs in a variety of lotic wetlands. This species is not significantly restricted by either geographical or habitat constraints to the impacted habitat.
Size/Abundance	Small, limited habitat for <i>Somanniathelphusa zanklon</i> present. Only one individual found suggesting that the population in the impacted is small and unlikely to be significant
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible.
Magnitude	All of watercourses will be impacted but small; therefore low.
Impact Severity	Low as <i>Somanniathelphusa zanklon</i> is present in several watercourses in the area, population in the impacted habitat is likely to be small and this stream does not provide significant areas of suitable habitat for this species.

Fung Kong and Ho Sheung Heung Watercourses

These small, connected, watercourses fall entirely within the development area of the Project in KTN. They are channelised but a part of Fung Kong Watercourse is not concrete-lined. The watercourses are highly disturbed and polluted and no fish or stream species of conservation significance have been recorded.

Table 13.80 - Potential Ecological Impacts on Fung Kong and Ho Sheung Heung Watercourses in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Man-made habitat of Low ecological value.
Species	No species of conservation significance recorded.
Size/Abundance	Small area; small numbers of stream fauna.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible.
Magnitude	All of watercourses will be impacted but small; therefore low.
Impact Severity	Low

Tsung Yuen, Lo Wu and Ngam Pin Watercourses

These small watercourses do not fall within, and are not downstream of any areas which will be developed under, the Project, and no impacts arising are predicted.

Long Valley Watercourse

The middle and downstream sections of this watercourse are irrigation ditches within Long Valley. No stream fauna (fish or invertebrates) of conservation significance occurs in the watercourse, though it is utilised by species of conservation significance using Long Valley.

However, this watercourse delivers water to Long Valley, and thus it has an important hydrological function. The upstream channelised section does not support stream fauna of ecological significance, but run-off from construction activity and hydrological disruption to this watercourse from the Project are potentially of significance.

The upstream section of the watercourse which flows through KTN Areas B3-12 and forms the boundary between the proposed LVNP and KTN area C1-4 will be re-channelised as an element of the project. Ecological impacts of rechannelisation works will be limited; however construction phase hydrological disruption to Long Valley could be significant if the water supply is disrupted for longer than the water storage capacity of ponds in Long Valley, especially if such disruption took place in the dry season and/or unexpectedly. The design and scheduling of rechannelisation works and construction works in developments areas through which the Long Valley Watercourse flows at present should, therefore, take account of the predicted hydrological impacts on Long Valley in the absence of mitigation.

Table 13.81 - Potential Ecological and Hydrological Impacts on Long Valley Watercourse in the absence of mitigation measures

Criteria	Ecological Impacts	Hydrological Impacts
Habitat Quality	Upstream section is a man-made habitat flowing through developed areas; lower sections are a man-made network of irrigation ditches. Stream is of Low to Moderate ecological value, primarily due to its linkages with other wetland habitats.	
Species	It does not support any stream fauna of conservation significance but it is utilised by many wetland-dependent species of conservation significance in Long Valley.	
Size/Abundance	Small area; small numbers of stream fauna. However it is used by many wetland-dependent species. In addition, many more wetland-dependent species and large numbers of individuals are partly dependent on water from this channel to maintain suitable conditions in their required habitats.	
Duration	Construction phase only.	Temporary in both construction and operational phases.
Reversibility	Reversible and remedial measures possible.	Reversible in both construction and operational phases, though restoration of habitats may take some time if disruption is prolonged. Remedial measures easy to implement but advance planning to avoid requirement for emergency remediation measures.
Magnitude	Magnitude small as area is small and few individuals or species would be affected.	Magnitude small if disruption is short term or occurs in the wet season; moderate if long-term and in the dry season.
Impact Severity	Low.	Low if short term and during the wet season; Moderate if long-term and in the dry season.

Cheung Po Tau and Fu Tei Au Watercourses

The upstream section of Cheung Po Tau Watercourse is semi-natural but seasonal, and supports no stream fauna of conservation significance. This section could be impacted by run-off during construction of the proposed Fanling North Freshwater Service Reservoir in FLN area A3-1. The downstream section of these linked watercourses, the Fu Tei Au Watercourse, flows through FLN area A1-8, which is proposed to be developed as a Police Driving and Traffic Training Complex. This section could be directly impacted and could also be hydrologically disrupted and/or impacted by construction run-off. However, this downstream section is entirely channelised and no fauna of conservation significance have been found in this section.

Table 13.82 - Potential Ecological Impacts on Cheung Po Tau and Fu Tei Au Watercourses in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Upstream section of Cheung Po Tau Watercourse is natural but seasonal; downstream sections of this watercourse and Fu Tei Au Watercourse are man-made. Upstream section of Cheung Po Tau Watercourse is of Low to Moderate ecological value; other sections are of Low ecological value.
Species	No species of conservation significance found in the watercourses but two protected orchid species found in riparian corridor of the Cheung Po Tau Watercourse.
Size/Abundance	Small area; small numbers of stream fauna.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Habitat loss irreversible, other construction phase impacts reversible; operational phase impacts irreversible but remedial measures possible.
Magnitude	Magnitude of loss and disturbance impacts both low due to small size of stream and intermittent stream flow.
Impact Severity	Direct habitat loss, disturbance, hydrological and run-off impact severity all Low .

Sheung Shui Wa Shan Watercourses

The upstream sections of these watercourses are outside the Project Area boundary and no significant impacts are predicted. One crab species of conservation significance, *Somanniathelphusa zanklon* was found in the eastern watercourse, again upstream of the Project Area; hence, no significant impacts on this species are predicted.

The downstream sections of these streams may be impacted by the Fanling Bypass and development in FLN area B1-2 (Open Space). These stream sections are channelised and no stream fauna of conservation significance have been found. No significant impacts on these stream sections from the Project are predicted.

Table 13.83 - Potential Ecological Impacts on Sheung Shui Wa Shan Watercourses in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Largely channelised, highest upstream sections are semi-natural but seasonal. The watercourses are considered to be of Low to Moderate ecological value due to the presence of <i>Somanniathelphusa zanklon</i> .
Species	One individual of a crab species of conservation significance, <i>Somanniathelphusa zanklon</i> , was found in the eastern channel, upstream of the potentially impacted stream sections.
Size/Abundance	Small area; small numbers of stream fauna.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible, though remedial measures possible in operational phase.
Magnitude	Magnitude of loss and disturbance impacts both low due to small size of stream.
Impact Severity	Direct habitat loss, disturbance, hydrological and run-off impact severity all Low .

Siu Hang San Tsuen Watercourse

This watercourse is in a concrete-lined channel in its lowest section where it joins the Ng Tung River, but upstream the channel, though highly modified by agricultural activities, has natural sides and bottom. This stream supports populations of three wetland-dependent species of conservation significance, Predaceous Chub, Blue Sprite and Emerald Cascader. Direct impacts to this stream will be avoided (construction of a pipe and pipe cap would be required within 10m of the stream in its downstream section but not in the watercourse), and much of it is outside the NDA boundary, while the Fanling Bypass will cross the lower section of the stream on a viaduct. However, the lower section may be impacted by disturbance and run-off during the construction and operational phases of the Project by the Fanling Bypass and development and use of the area around this stream section as an Open Space zone (FLN area D1-3).

Table 13.84 - Potential Impacts on Siu Hang San Tsuen Watercourse in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	A man-made habitat; however, upstream section (outside the Project Area) has banks and bed of natural materials, albeit channel highly modified by agricultural activities. The upstream section has been assessed as of Moderate ecological value due to the presence of three faunal species of conservation significance; the downstream channelised section (within the Project Area) has been assessed as of Low to Moderate ecological value. Downstream section only will be disturbed by Fanling Bypass construction and will be permanently shaded by the Bypass structure during operation.
Species	Three wetland-dependent species of conservation significance present in the upstream section. None of these species are present in the section of stream which will be disturbed.
Size/Abundance	Habitat area is small and stream length is short. Fauna numbers are low to moderate.
Duration	Construction phase: temporary Operational phase: permanent

Criteria	Assessment	
Reversibility	Construction Phase: construction phase disturbance and run-off impacts are all reversible and remediation is possible.	Operational Phase: shading of the stream by the viaduct would be permanent. However, any loss of vegetation cover could be remediated.
Magnitude	Construction phase: low magnitude as impacts would be localised to the downstream stream section and effects would be minor,	Construction phase; low magnitude as area which would be shaded is small and effects of shading would be minor.
Impact Severity	Construction Phase: construction phase re-channelisation, run-off and disturbance impacts of Low severity.	Operational phase: shading impacts of Low severity; no other impacts of significance.

Man Kok Village, Ting Ping Shan Tsuen, Shek Wu San Tsuen and Ma Shi Po Watercourses

These four watercourses, located to the north of Sheung Shui/Fanling and south of the Ng Tung River, will all be directly impacted by the Project. All are channelised, largely in concrete-lined channels, but part of Tin Ping Shan Tsuen Watercourse, which passes through farmland, has sides and bed of natural materials. A crab species of conservation significance, *Somanniathelphusa zanklon*, was found in this watercourse. This species is present in a number of streams in the area and is tolerant of polluted conditions; only one individual was found in this stream and there is little suitable habitat present.

Table 13.85 - Potential Ecological Impacts on Man Kok Village, Ting Ping Shan Tsuen, Shek Wu San Tsuen and Ma Shi Po Watercourses in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Man-made habitat of Low ecological value.
Species	One individual of a crab species of conservation significance, <i>Somanniathelphusa zanklon</i> was recorded in Tin Ping Shan Tsuen Watercourse.
Size/Abundance	Small, limited habitat for <i>Somanniathelphusa zanklon</i> is present.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible.
Magnitude	All watercourses will be impacted but remains of small magnitude; therefore low.
Impact Severity	Low as <i>Somanniathelphusa zanklon</i> is present in several watercourses in the area and this stream does not provide significant areas of suitable habitat for this species.

Ma Wat River

This is much the largest of the smaller watercourses considered and is channelised throughout its length in the Study Area; the river downstream of the point where it is crossed by the Fanling Highway is highly disturbed

and has been assessed as of Low ecological value. However, the section upstream of this point has some natural features and includes a section near Nam Wa Po that has been designated as an EIS on account of its fish community, including species of conservation significance. This upstream section has been assessed as of Moderate ecological value.

A 700m length of the river will be rechannelised upstream of the point where it crosses the Sha Tau Kok Road, and the mid and downstream sections of the river will be crossed by the Fanling Bypass viaduct in a number of, and hence will be indirectly impacted by the Project; no impacts are predicted to the section of the Ma Wat River upstream of the Fanling Highway, which is outside the Project Area.

In addition to the fish species of conservation significance known to be present in the upstream section of the river, a crab species of conservation significance, *Somanniathelphusa zanklon*, is also present. This is the only species of conservation significance known to have been found in the section of the watercourse impacted by the Project; however, fish species of conservation significance known to be present in the upstream section may occur on occasion, albeit the habitat conditions are such that numbers are unlikely to be of significance.

Table 13.86 - Potential Ecological Impacts on Ma Wat River in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Man-made habitat; mid and downstream sections of Low ecological value; section above the Fanling Highway crossing point of Moderate ecological value.
Species	Two fish species of conservation significance known from the upstream section. No impacts from the project are predicted on the stream section where these fish species are present.
Size/Abundance	River is of moderate length (approx. 3.5km) and size; fish are relatively abundant in the upstream section but exotic species are numerically dominant.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Reversible and remedial measures possible.
Magnitude	Construction phase disturbance impacts of low magnitude, construction phase run-off may be of moderate magnitude; operational phase magnitude low.
Impact Severity	Re-channelisation impact Low . Low to Moderate for construction phase run-off and hydrological impacts, Low for construction phase disturbance and operational phase disturbance and operational impacts.

San Uk Tsuen, Ma Wat Wai and Tong Hang Watercourses

These three watercourses all drain into the Ma Wat River. All are channelised, lie in developed areas and were assessed as of Low ecological value. None of these watercourses will be directly impacted by the Project, but the Tong Hang Watercourse may be indirectly impacted by the construction and operation of the Fanling Bypass viaduct.

Table 13.87 - Potential Ecological Impacts on San Uk Tsuen, Ma Wat Wai and Tong Hang Watercourses in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Largely man-made habitat but with some semi-natural sections upstream. San Uk Tsuen and Tong Hang Watercourses were assessed as of Low ecological value; however Ma Wat Wai Watercourse has been assessed as of Low to Moderate ecological value due to semi-natural upstream sections and presence of <i>Sommaniathelphusa zanklon</i> .
Species	<i>Sommaniathelphusa zanklon</i> recorded from the Ma Wat Wai Watercourse; no other species of conservation significance known.
Size/Abundance	Streams are small. A single specimen of <i>Sommaniathelphusa zanklon</i> was found.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible.
Magnitude	Low for both disturbance and run-off impacts in both construction and operational phases in the Tong Hang Watercourse; no significant impacts on other watercourses.
Impact Severity	Low at Tong Hang Watercourse, no significant impacts on other watercourses or on <i>Sommaniathelphusa zanklon</i> are predicted.

Kau Lung Hang Watercourses

The Kai Lung Hang Lo Wai, Kau Lung Hang San Wai and Yuen Leng Watercourses are designated as an EIS due to the presence of stream fish of conservation significance. Some of the upper reaches of these streams are natural, but the sections within the Study Area are wholly or largely channelised. Two fish species of conservation significance, *Acrossocheilus parallens* and Small Snakehead, have been found in these streams. The sections of streams designated as EIS are entirely outside the Project Area; however, a downstream section of the Kau Lung Hang Watercourses near Kiu Tau, where the streams join before discharging into the Ma Wat River, may be indirectly impacted by the construction and operation of the Fanling Bypass viaduct.

Table 13.88 - Potential Ecological Impacts on Kau Lung Hang Watercourses in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Man-made habitat of Moderate ecological value in the Study Area.
Species	Two fish species of conservation significance known: <i>Acrossocheilus parallens</i> and Small Snakehead.
Size/Abundance	Streams are small individually but combined length of the stream system is moderate. <i>Acrossocheilus parallens</i> is abundant; numbers of Small Snakehead are probably small.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Irreversible.
Magnitude	Low for both disturbance and run-off impacts in both construction and operational phases as impacts would only affect a short downstream section of the stream system.
Impact Severity	Low

Nam Wa Po Watercourses

These short seasonal tributaries of Ma Wat River have been assessed as of Low ecological value. None will be directly impacted or significantly indirectly impacted by the Project

13.7.3.10 Upland Grassland

Direct Impacts

A small area of upland grassland (6.95ha) will be directly impacted by the Project. As upland grassland is maintained by periodic fires, it has low floral diversity and is dominated by fire-tolerant grass species. Faunal numbers and species diversity are low and few species are dependent on this habitat in the Study Area. However, one grassland and shrubland associated bird species of conservation significance, Grey Nightjar, has been found at Cheung Po Tau and at Wa Shan, and another species associated with these habitats, Eurasian Eagle Owl, has occurred in the Chau Tau area in the past. Other grassland species of conservation significance found in this habitat (Golden-headed Cisticola found outside the breeding season and Small Three-ring which is not restricted to this or a small number of habitats) are not considered to be impacted by loss of this habitat to a significant extent.

Eurasian Hobby forages over upland grassland but is only sensitive to disturbance at breeding sites (which are always in an elevated abandoned nest of another species (usually a corvid) hence would not breed in grassland.

No direct loss of upland grassland will occur from the Project at Chau Tau and Wa Shan, but a small area will be lost at Cheung Po Tau other areas of significance noted above.

Indirect Impacts

Disturbance impacts on upland grassland fauna will be relatively limited as few disturbance-sensitive species (mammals and larger birds) utilise this habitat in the Study Area. However, there will be some disturbance during the construction phase of the Project and the increased human population in the area during the operational phase is likely to result in increased recreational use of upland grassland areas. Such disturbance is likely to be concentrated along footpaths, where it may result in localized disturbance to fauna and erosion; however, if greater visitor use increases the frequency of hill fires the impacts would be greater.

Eurasian Eagle Owl is potentially sensitive to disturbance, but the area in which it may occur is on the edge of the Study Area and disturbance impacts on this area from the Project are not predicted.

Table 13.89 - Potential Direct Ecological Impacts on Upland Grassland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Upland grassland is largely undisturbed but supports low diversity of flora and diversity and density of fauna. The ecological value of upland grassland in the Study Area is Low in general, but that at Cheung Po Tau is considered to be of Low to Moderate ecological value due to the presence of Grey Nightjar.
Species	Low diversity of fauna and flora species; one bird species (Grey Nightjar) of conservation significance known to occur near a directly impacted area at Cheung Po Tau, but it is unlikely to be nesting in the impacted area, which forms a small part of this habitat in the area.
Size/Abundance	A small habitat area (6.95ha) in relation to the area of this habitat in the Study Area. Fauna occurs at low densities and is dispersed.
Duration	Permanent.
Reversibility	Irreversible.
Magnitude	Magnitude moderate overall, but magnitude of loss in the Cheung Po Tau area is small.
Impact Severity	Severity Low as upland grassland is a very common habitat in the Study Area and the New Territories, and supports few species and a low number of organisms at low densities.

Table 13.90 - Potential Indirect Ecological Impacts on Upland Grassland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Upland grassland is largely undisturbed but supports low diversity of flora and diversity and density of fauna. The ecological value of upland grassland in the Study Area is Low in general, but that north of Chau Tau is considered to be of Low to Moderate ecological value due to the possible presence of Eurasian Eagle Owl, and that above Sheung Shui Wa Shan is considered to be of Low to Moderate ecological value due to the presence of Grey Nightjar.
Species	Low diversity of fauna and flora species; most fauna species not very disturbance sensitive; of two bird species of conservation significance known to be/may be present in this habitat, Eurasian Eagle Owl is relatively disturbance sensitive; Grey Nightjar relies on camouflage when roosting (during the day) and nesting is relatively insensitive to disturbance.
Size/Abundance	Area which would be disturbed is small relative to the area present. Fauna occurs at low densities and is dispersed.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Construction phase impacts reversible; operational phase impacts irreversible but remedial measures may be possible.
Magnitude	Low except for fires covering large areas of upland grassland which would be of moderate magnitude.
Impact Severity	Low as no increase in disturbance to upland grassland in the area where Eurasian Eagle Owl may occur is predicted and Grey Nightjar is not particularly sensitive to disturbance.

13.7.3.11 Lowland Grassland

Direct Impacts

A total of 53.21ha of lowland grassland, largely formed by vegetation succession on abandoned agricultural land, will be directly impacted by the Project. Unlike upland grassland, which is relatively unfragmented in the Study Area, lowland grassland is fragmented by other habitat types. Fauna using this habitat in the Study Area are largely habitat generalists that also utilise other modified or man-made lowland habitats, including agricultural land, waste land and urbanized and village areas. No species of conservation significance found in the Study Area are dependent upon, or strongly associated with this habitat, though small numbers of wetland bird species and amphibian species will use this habitat opportunistically.

Indirect Impacts

Only small areas of lowland grassland, largely on the north side of the Ng Tung River in FLN will be disturbed by the Project. Disturbance impacts on lowland grassland fauna will be limited as few disturbance-sensitive species (mammals and larger birds) utilise this habitat in the Study Area on a regular basis and this habitat is not of importance for disturbance-sensitive waterbird species.

Table 13.91 - Potential Direct Ecological Impacts on Lowland Grassland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Disturbed and fragmented habitat around villages and urban areas of Low ecological value.
Species	Low diversity of flora species and low diversity of fauna species, most of which are habitat generalists; habitat is not utilised preferentially by any fauna of conservation significance in the Study Area, but may be used opportunistically by small numbers of some species.
Size/Abundance	A moderate area (53.21ha) in total; fauna abundance is low to moderate.
Duration	Permanent.
Reversibility	Irreversible.
Magnitude	Low.
Impact Severity	Low as lowland grassland is a very common habitat in the Study Area and the New Territories, supporting low to moderate numbers and diversity of species that are habitat generalists.

Table 13.92 - Potential Indirect Ecological Impacts on Lowland Grassland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Disturbed and fragmented habitat around villages and urban areas of Low ecological value.
Species	Low diversity of flora species and low diversity of fauna species, most of which are habitat generalists; not utilised preferentially by any fauna of conservation significance in the Study Area, but may be used opportunistically by small numbers of some species.

Criteria	Assessment
Size/Abundance	A small area (additional to that which will be lost); fauna abundance is low to moderate.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.
Reversibility	Construction phase impacts reversible; operational phase impacts irreversible; remedial measures possible in both construction and operational phases.
Magnitude	Low.
Impact Severity	Low

13.7.3.12 Seasonally Wet Grassland

Direct Impacts

Small areas of seasonally wet grassland are impacted by the Project near Ma Tso Lung Stream and in two areas near Ng Tung River in FLN. None of these areas is floristically diverse, while the latter does not support significant numbers of fauna species. However, that at Ma Tso Lung is utilised by low numbers of marsh fauna in season, including Chinese Bullfrog, and is connected to other wetland habitats.

Indirect Impacts

An additional area of seasonally wet grassland at Ma Tso Lung immediately to the north of the KTN NDA may be indirectly impacted by construction activity, including construction of the Eastern Connection Road for the LMC Loop, both within and just outside the Project Area.

Potential indirect impacts to the seasonally wet grassland on the north side of Ng Tung River in FLN are predicted to be small, as the areas are small and they are not utilised by significant numbers of disturbance-sensitive fauna.

Fragmentation impacts on this habitat are addressed as an element of fragmentation impacts on the Ma Tso Lung Stream and its riparian corridor of which this habitat constitutes an element.

Table 13.93 - Potential Direct Ecological Impacts to Seasonally Wet Grassland in the absence of mitigation measures

Criteria	Ma Tso Lung	Along Ng Tung River in FLN
Habitat Quality	Seasonally wet grassland at Ma Tso Lung is floristically poor but is used by small numbers of marsh fauna when wet and has some ecological linkages with Ma Tso Lung marsh. The ecological value is Low to Moderate.	Two small areas of seasonally wet grassland near the Ng Tung River are likewise floristically poor and support limited wetland fauna due to lack of microhabitat diversity, small area and disturbed condition. Ecological value is Low.
Species	Low diversity of fauna and flora species; may be utilised by species of conservation significance present in the areas but not a habitat used preferentially by such species.	

Criteria	Ma Tso Lung	Along Ng Tung River in FLN
Size/Abundance	Habitat area is small (2.86ha). A low number of individuals of fauna species are present.	Habitat area is small comprising two areas totalling 1.24ha. A low number of individuals of fauna species are present.
Duration	Permanent.	
Reversibility	Irreversible.	
Magnitude	Low	Low
Impact Severity	Low to Moderate	Low

Table 13.94 - Potential Disturbance Impacts on Seasonally Wet Grassland in the absence of mitigation measures

Criteria	Ma Tso Lung	Along Ng Tung River in FLN
Habitat Quality	Seasonally wet grassland at Ma Tso Lung is floristically poor but is used by small numbers of marsh fauna when wet and has some ecological linkages with Ma Tso Lung marsh. The ecological value of these areas is Low to Moderate.	Areas of seasonally wet grassland on the north side of the Ng Tung River which will be indirectly impacted are floristically poor and support limited wetland fauna due to lack of microhabitat diversity, small area and disturbed condition. Ecological value is Low.
Species	Low diversity of fauna and flora species; may be utilised by species of conservation significance present in the areas but not a habitat used preferentially by such species.	
Size/Abundance	Habitat area is small. A low number of individuals of fauna species are present.	
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.	
Reversibility	Construction phase disturbance reversible but operational phase disturbance is irreversible; remedial measures are possible in both construction and operational phases.	
Magnitude	Low to moderate in construction phase, low in operational phase.	Low in construction and operational phases.
Impact Severity	Low to Moderate in construction phase. Low in operational phase.	Low in construction and operational phases.

Table 13.95 - Potential Impacts of increased sediment load, pollution, or hydrological disruption on seasonally wet grassland in the absence of mitigation measures

Criteria	Ma Tso Lung	Along Ng Tung River in FLN
----------	-------------	----------------------------

Criteria	Ma Tso Lung	Along Ng Tung River in FLN
Habitat Quality	Seasonally wet grassland at Ma Tso Lung is floristically poor but is used by small numbers of marsh fauna when wet and has some ecological linkages with Ma Tso Lung marsh. The ecological value of these areas is Low to Moderate.	Areas of seasonally wet grassland on the north side of the Ng Tung River which will be indirectly impacted are floristically poor and support limited wetland fauna due to lack of microhabitat diversity, small area and disturbed condition. Ecological value is Low.
Species	Low diversity of fauna and flora species; may be utilised by species of conservation significance present in the areas but not a habitat used preferentially by such species.	
Size/Abundance	Habitat area is small. A low number of individuals of fauna species are present.	
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.	
Reversibility	Mostly reversible.	
Magnitude	Low to moderate in construction phase, low in operational phase.	Low in both construction and operational phases.
Impact Severity	Low to Moderate in construction phase. Low in operational phase.	Low in both construction and operational phases.

13.7.3.13 Grassland / Shrubland

Direct Impacts

Grassland/shrubland habitats are an intermediate stage in vegetation succession, resulting from the spread of shrubland species into grassland habitats. Small areas of this habitat, all in lowland areas and often close to sources of human disturbance, will be lost to development. Lowland grassland/shrubland in the Study Area is floristically poor and woody species often include a high proportion of invasive exotic species. Fauna species in lowland grassland/shrubland are largely habitat generalists that utilise a variety of lowland habitats, including farmland, grassland, plantation and urban and village areas, though may include some woodland associated species in small numbers. No fauna species in the Study Area are dependent on this habitat or use it preferentially.

No significant indirect impacts are predicted to the small areas of grassland/shrubland in the assessment area.

Table 13.96 - Potential Direct Ecological Impacts on Grassland/Shrubland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Habitat is of Low ecological value due to small size and high levels of disturbance.

Criteria	Assessment
Species	No species use this habitat preferentially; some species of conservation significance may occur in this habitat on occasion but it is not of significance for any species.
Size/Abundance	A small area (1.63ha)
Duration	Permanent.
Reversibility	Irreversible.
Magnitude	Low.
Impact Severity	Low

13.7.3.14 Shrubland

This is a very common habitat type in Hong Kong, but little shrubland is present in the development areas for the Project. Small patches of disturbed shrubland of Low ecological value on the fringes of settlements in KTN will be lost to development.

Direct and Indirect Impacts

A large area of shrubland of Moderate ecological value on Crest Hill is close to the proposed Kwu Tung North Fresh Water Service Reservoir in KTN area G1-5 and a small area of shrubland is present within the footprint of this development. The direct habitat loss will be small; however, the larger area may be disturbed during the construction phase of the Project. However, most species for which shrubland is of importance at Crest Hill (butterflies and, to a lesser extent, smaller bird species) are relatively tolerant of disturbance, but breeding Eurasian Hobby may be disturbance-sensitive depending on location of the nest site relative to the disturbance source. Danaid Egg-fly, found in shrubland on the east side of Crest Hill is not disturbance-sensitive and the area where it was found will not be disturbed.

Eurasian Hobby, which has bred in an abandoned corvid nest on a pylon in shrubland in the past, is sensitive to disturbance when nesting (see **Table 13.58**), especially if construction activity commences after a nest site has been selected. There is a large area of shrubland habitat where this species may nest; hence it is statistically unlikely that a nest site, if present, would be located in or close to area G1-5. However, should such a co-incidence occur, impact on this species may be significant.

No significant fragmentation impacts on shrubland areas of ecological significance are predicted, as the habitat will not be fragmented in itself or from habitats with which there exist significant linkages.

Table 13.97 - Potential Direct Ecological Impacts on Shrubland in the absence of mitigation measures

Criteria	Shrubland on Crest Hill	Small areas of shrubland on fringes of KTN developed area
----------	-------------------------	---

Habitat Quality	Large continuous area of shrubland of Moderate ecological value.	Patches are small and disturbed and of Low ecological value.
Species	Diverse butterfly community, including Danaid Egg-fly of conservation significance, other species of conservation significance recorded in the past; one bird species of conservation significance, Eurasian Hobby has bred in the past in this habitat was found in the area during the current study.	A low number of species present, none of which are of conservation significance in this habitat.
Size/Abundance	Habitat area is small (0.07ha) and fauna numbers are low.	Habitat area is small (1.04ha) and fauna numbers are low.
Duration	Permanent.	
Reversibility	Irreversible.	
Magnitude	Low.	
Impact Severity	Most likely Low , but Low to Moderate in the unlikely event that a Eurasian Hobby nest site is in the Project Area.	

Table 13.98 - Potential Indirect Ecological Impacts on Shrubland in the absence of mitigation measures

Criteria	Shrubland on Crest Hill	Small areas of shrubland on fringes of KTN developed area
Habitat Quality	Large continuous area of shrubland of Moderate ecological value	Patches are small and disturbed and of low ecological value.
Species	Diverse butterfly community, which may include species of conservation significance, however butterfly species are not sensitive to disturbance unlikely to be affected by indirect impacts of the project; one bird species of conservation significance, Eurasian Hobby has bred in the past in this habitat was found in the area during the current study.	A low number of species present, none of which are of conservation significance in this habitat.
Size/Abundance	Habitat area which may be impacted is moderate; fauna numbers are low to moderate.	Small area with low abundance of fauna.
Duration	Permanent in respect of operational impacts, temporary in respect of construction impacts.	
Reversibility	Construction phase impacts are reversible, operational phase impacts are irreversible; remediation possible in both construction and operational phases.	
Magnitude	Low to moderate in construction phase, low in operational phase.	Low in both construction and operational phases.

Impact Severity	Construction phase: most likely Low , but Low to Moderate in the unlikely event that a Eurasian Hobby nest site is in the Project Area. Operational phase: Low .	Low .
------------------------	--	--------------

13.7.3.15 *Fung Shui* Woodland

No *fung shui* woodland will be directly impacted by the Project.

Indirect and Fragmentation Impacts

Fung shui woodland at Kam Tsin and Tsung Pak Long are remote from project development areas, but that at Ho Sheung Heung is adjacent to proposed residential development in KTN D1-7. Direct impact from development has been avoided. Fragmentation impacts on terrestrial fauna have also been avoided, as both linkages between *fung shui* woodland and the adjoining secondary woodland, and linkages between these habitats and woodland and shrubland on Crest Hill, with which they are linked ecologically, will not be affected by the project. However, potential impacts in the absence of mitigation include indirect impacts from dust deposition and disturbance. Habitat linkages for birds will not be impacted significantly, especially during the operational period of the Project. In general, small bird species are not very disturbance-sensitive and most are not restricted to this habitat.

Table 13.99 - Potential Indirect Ecological Impacts on Ho Sheung Heung *fung shui* woodland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Semi-natural mature woodland assessed as of Moderate ecological importance.
Species	Flora is moderately rich. Flora species of conservation importance and protected flora species in <i>fung shui</i> woodland and adjoining secondary woodland include <i>Ailanthus fordii</i> , <i>Aquilaria sinensis</i> , <i>Gnetum luofuense</i> and <i>Pavetta hongkongensis</i> . Some mammal species of conservation significance may occur in small numbers; diverse butterfly community including many woodland-associated species; species of conservation significance recorded in the past and may still be present. Of these species only flora is a significant receiver of impacts of dust deposition and only birds and mammals are significant receivers of disturbance impacts. However, smaller woodland bird species are relatively insensitive to disturbance impacts.
Size/Abundance	Area is small (4.57ha); fauna numbers low.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Dust deposition would be reversed naturally by rainfall. Construction phase disturbance reversible; operational phase disturbance irreversible; remediation possible in both construction and operational phases.
Magnitude	Low to moderate during construction phase, low during operational phase.

Impact Severity	Low to Moderate on mammals during construction phase, Low during construction phase on flora and other fauna; Low during operational phase.
------------------------	--

Table 13.100 - Potential Fragmentation Impacts on Ho Sheung Heung *fung shui* woodland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Semi-natural mature woodland assessed as of Moderate ecological importance.
Species	Some mammal species of conservation significance may occur in small numbers. However, fragmentation impacts on these species will be small as there will be no fragmentation of the most important linkages for mammals; those between the <i>fung shui</i> wood and the adjoining secondary woodland and between these habitats and Crest Hill woodland and shrubland.
Size/Abundance	Area is small; fauna numbers low.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Some construction phase impacts reversible; operational phase impacts largely irreversible; some remediation possible during both construction and operational phases.
Magnitude	Low for terrestrial fauna during construction and operational phases.
Impact Severity	Low during construction phase and Low during operational phase, as numbers of fragmentation-sensitive fauna are small and most important linkages will not be affected.

13.7.3.16 Secondary Woodland

The ecological value of woodland patches present is dependent to some extent upon their linkage to other areas of similar habitat and upon the age of the woodland. Since secondary woodland is a relatively rare habitat in the north and west of the New Territories, this limits the potential value of woodland in the area, but also means that these patches are potentially of significant ecological value by providing a refuge for woodland species.

Crested Serpent Eagle has been recorded in secondary woodland (and plantation woodland) in the Study Area. This species is listed as of Local Concern as by breeding species by Fellowes *et al.* (2002) and as Vulnerable in the CRDB. This species ranges widely and is frequently recorded over habitat where it does not breed such as shrubland and developed areas. There is no suggestion that it breeds in any areas which would be directly or indirectly impacted by the project, hence it is not considered further in the evaluation of the significance of potential impacts of the project.

Direct Impacts

A small area (0.23ha) of secondary woodland will be lost near Ho Sheung Heung due to proposed residential development in KTN area D1-11. As discussed in **Section 13.1.4.6**, alternatives to avoid and minimise loss of secondary woodland were adopted where feasible. However, at

the current (RODP) stage, unavoidable loss of 0.23ha of secondary woodland is predicted, in the absence of mitigation.

Indirect and Fragmentation Impacts

Few secondary woodland patches in the Study Area are in direct or close proximity to development areas of the Project; very often, as in the area to the south of Pak Shek Au, Fu Tei Au, Sheung Shui Wa Shan and southeast of Fanling, they are separated and buffered from disturbance and other indirect impacts by areas of plantation and/or village habitat at least 100m in width. Indirect impacts on woodland habitats and fauna in these areas will not be significant as very few woodland fauna species would be disturbed at distances of more than 100m from the sources of disturbance. The buffering effect of the intervening habitat will be greater in areas where there is also a significant difference in elevation between the source of disturbance and the woodland area; such a difference applies in woodland areas south of Pak Shek Au, west of Nam Wa Po and east of Kau Lung Hang – the latter area being that where larger mammals, the most disturbance-sensitive woodland fauna, are most likely to be present in significant numbers.

However, there are two locations in the Study Area where secondary woodland areas are in direct proximity with, or are relatively close to, potential sources of disturbance. These areas are Ho Sheung Heung, where secondary (and *fung shui*) woodland are located close to development areas in KTN; and to the west of Siu Hang San Tsuen where secondary woodland is close to the proposed Fanling Bypass.

Secondary woodland patches present in the Study Area are very frequently linked with plantation and shrubland areas; thus consideration of indirect and, especially, fragmentation impacts requires assessment of to what extent an area of wooded habitats as a whole may be impacted by the Project. Taking such linkages into account; potential fragmentation impacts of significance are predicted only at Ho Sheung Heung; other secondary woodlands will not be fragmented or fragmented from other wooded habitats

Table 13.101 - Potential Direct Ecological Impacts on Secondary Woodland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Secondary woodland at Ho Sheung Heung is of moderate ecological value and shares species, including some of conservation significance, with the adjacent <i>fung shui</i> wood; habitat assessed as of Moderate ecological value.
Species	Flora is moderately rich, and species of conservation importance and protected plant species in secondary woodland and linked <i>fung shui</i> woodland include <i>Ailanthus fordii</i> , <i>Aquilaria sinensis</i> , <i>Gnetum luofuense</i> and <i>Pavetta hongkongensis</i> , though none of these are believed to be present in the area directly impacted. Some mammal species of conservation significance may occur in small numbers; diverse butterfly community, including many woodland-associated species; species of conservation significance

Criteria	Assessment
	recorded in the past may still be present.
Size/Abundance	Habitat area is small (0.23ha) and faunal abundance is low.
Duration	Permanent.
Reversibility	Not reversible; compensation is feasible but woodland takes a long time to become mature.
Magnitude	Low.
Impact Severity	The area is small but the woodland is of moderately high quality, hence impact severity is Low to Moderate .

Table 13.102- Potential Indirect Ecological Impacts on Secondary Woodland in the absence of mitigation measures

Criteria	Ho Sheung Heung	West of Siu Hang San Tsuen	Elsewhere in the Study Area
Habitat Quality	Moderate ecological value due to age and presence of fauna of conservation significance.	Moderate ecological value, primarily due to relatively large area.	Moderate ecological value at Ma Tso Lung, Chau Tau and on hill slopes southeast of Fanling; Low to Moderate ecological value elsewhere.
Species	Protected plant species present; small numbers of mammals of conservation significance may be present; high diversity of butterfly species, possibly including some of conservation significance. Of these species, only flora is a significant receiver of impacts of dust deposition and only birds and mammals are significant receivers of disturbance impacts. However, smaller woodland bird species are relatively insensitive to disturbance impacts.	No woodland-dependent species of conservation significance recorded. Of these species, only flora is a significant receiver of impacts of dust deposition and only birds and mammals are significant receivers of disturbance impacts. However, smaller woodland bird species are relatively insensitive to disturbance impacts. No mammal species of conservation significance are known to be present but potential impacts are evaluated on a precautionary basis.	Protected plant and woodland fauna of conservation significance present in secondary woodland and ecologically linked plantation in wooded areas southeast of Fanling; other areas not of significance for woodland-dependent fauna. Of these species, only flora is a significant receiver of impacts of dust deposition and only birds and mammals are significant receivers of disturbance impacts. However, smaller woodland bird species are relatively insensitive to disturbance impacts.
Size/Abundance	Small (2.74ha), abundance of fauna low.	Moderate in size (27.10ha); abundance of fauna is low.	Moderately large area (83.02ha); abundance of fauna low.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.		

Criteria	Ho Sheung Heung	West of Siu Hang San Tsuen	Elsewhere in the Study Area
Reversibility	Dust deposition would be reversed naturally by rainfall. Construction phase disturbance reversible; operational phase disturbance irreversible; remediation possible in both construction and operational phases.		
Magnitude	Impact of dust deposition low during construction phase and not significant during operational phase. Disturbance impact on fauna low during both construction and operational phases.		Low during construction and operational phases.
Impact Severity	Low to Moderate during construction phase, Low during operational phase.	Low during construction phase, Low during operational phase.	Low during both construction and operational phases.

Table 13.103 - Potential Fragmentation Impacts on Ho Sheung Heung Secondary Woodland in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Semi-natural mature woodland assessed as of Moderate ecological importance.
Species	Some mammal species of conservation significance may occur in small numbers. However, fragmentation impacts on these species will be small as there will be no fragmentation of the most important linkages for mammals; those between the <i>fung shui</i> wood and the adjoining secondary woodland and between these habitats and Crest Hill woodland and shrubland.
Size/Abundance	Area is small; fauna numbers low.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Some construction phase impacts reversible; operational phase impacts largely irreversible; some remediation possible during both construction and operational phases.
Magnitude	Low for terrestrial fauna during construction phase, low during operational phase. Small numbers of individuals impacted and most important linkages not affected.
Impact Severity	Low during construction phase, Low during operational phase; because numbers of fragmentation-sensitive fauna are small.

13.7.3.17 Plantation

Direct Impacts

An area of 80.56ha of plantation will be directly impacted by the Project. Much of the area to be lost comprises habitat fragments alongside roads and in villages and other developed areas. This applies, in particular, to loss of plantation in the largely developed areas in KTN and to the south of the Ng Tung River in FLN. These plantation areas are highly disturbed, contain a high proportion of exotic tree and shrub species, and are of limited ecological value. Associated wildlife largely comprises widespread species tolerant of high levels of disturbance and which are common in such areas throughout Hong Kong.

Hillside plantations within the Project Area often contain some semi-natural vegetation and in some locations support a moderate diversity of faunal species, including some woodland-associated bird and butterfly species. No fauna species of conservation significance are strongly associated with, or utilise this habitat preferentially; however, it may be utilised by woodland-dependent or associated species in small numbers. Such plantation areas are considered to be of low to moderate ecological value (**Figure 13.11**), and this value has the potential to increase as native species colonise.

Such plantations are present in the northwest of KTN, south of the Fanling Highway in KTN, north of the Ng Tung River in KTN and to the east and south of Fanling along the Ma Wat River. In addition to their intrinsic ecological values, some of these plantation areas provide a corridor for the movement of woodland species through habitats which would otherwise be unsuitable.

Plantation south of the Fanling Highway and east and south of Fanling will not be directly impacted by the Project, but some areas of plantation will be lost due to development in the north and west of KTN and north of the Ng Tung River in FLN (**Figure 13.14a-c**).

The Man Kam To Road egretty is located in roadside plantation habitat situated between the Man Kam To Road and an open storage area in FLN NDA. The plantation was damaged by site clearance activity in the open storage area in 2012. Despite this damage, the egretty was re-occupied in April 2013.

This egretty site will be directly impacted by the interchange of the Fanling Bypass and the Man Kam To Road. Although this area of plantation is highly disturbed and otherwise of low ecological significance, the presence of the egretty raises its value due to its importance as a breeding site for Chinese Pond Herons and Little Egrets.

Crested Serpent Eagle has been recorded in plantation (and secondary woodland) in the Study Area. This species is listed as of Local Concern as by breeding species by Fellowes *et al.* (2002) and as Vulnerable in the CRDB. This species ranges widely and is frequently recorded over habitat where it does not breed such as shrubland and developed areas. There is no suggestion that it breeds in any areas which would be directly or indirectly impacted by the project, hence it is not considered further in the evaluation of the significance of potential impacts of the project.

Indirect and fragmentation Impacts

Roadside and urban plantation fragments are already highly disturbed and subject to pollution, and hence are utilised by wildlife species relatively insensitive to indirect and fragmentation impacts. However, even small areas of plantation habitat may provide short-term refugia for more vagile woodland-associated fauna such as birds, providing habitat 'islands' or 'stepping stones' permitting movement through areas that are

otherwise unsuitable. Loss of such plantation areas may, therefore, increase habitat fragmentation even if the areas lost are small and otherwise of little ecological significance.

Hillside plantation will not be fragmented significantly by the Project, nor will it be fragmented significantly from habitats with which it has important ecological linkages; however, some areas of hillside plantation and associated fauna will receive disturbance impacts from the Project.

The Ho Sheung Heung Egretty is located in plantation and orchard to the northeast of Lo Wu Correctional Institution. This plantation/orchard is disturbed by adjacent residential and industrial areas; however, the egretty is large in a Hong Kong context and hence of high ecological significance. This egretty will not be directly impacted by the Project but may experience disturbance and/or fragmentation impacts.

Table 13.104 - Potential Direct Ecological Impacts on Plantation in the absence of mitigation measures

Criteria	Hillside Plantation Northwest of KTN and North of the Ng Tung River in FLN	Roadside and Urban Plantation	Man Kam To Road Egretty Plantation
Habitat Quality	Plantation blocks, small to moderate in size, often with linkages to other habitats, including secondary woodland and shrubland, which permit movement of fauna and colonisation by native species. Such plantation, 8.65ha of which will be lost, is assessed as of Low to Moderate ecological value.	Fragmented and highly disturbed by human activities with a high proportion of exotic trees; assessed as of Low ecological value. There is a large area (73.43ha) of such plantation.	Roadside plantation of 0.27ha assessed as of Low to Moderate ecological value due to presence of egretty. Habitat is disturbed and the plantation was damaged in 2012 due to construction activity.
Species	Species diversity low to moderate; may be utilised by woodland-associated fauna of conservation significance in small numbers.	Species diversity is low and species are common and widespread habitat generalists highly tolerant of disturbance.	Plantation at Ma Kam To Road Egretty supports two ardeid species (Chinese Pond Heron and Little Egret).
Size/Abundance	Patches are small in size but aggregate area is moderate. Fauna density is low.	Fauna occurs at low density but aggregate numbers may be moderate.	Habitat area is small; number of breeding ardeids at Man Kam To Road Egretty is small in a Hong Kong context.
Duration	Permanent.		
Reversibility	Irreversible.		
Magnitude	Low magnitude	Low magnitude	Egretty is relatively

Criteria	Hillside Plantation Northwest of KTN and North of the Ng Tung River in FLN	Roadside and Urban Plantation	Man Kam To Road Egretry Plantation
	overall as number of organisms impacted would be small.	overall as number of organisms impacted would be moderate and these are highly disturbance-tolerant.	small in a Hong Kong context and relocation of egretries is not infrequent; however, egretry would be entirely lost therefore magnitude of loss would be low to moderate.
Impact Severity	In view of the low number of organisms, impact severity is Low .	Fauna is highly tolerant of disturbance, hence impact severity is Low .	Egretry is small in a Hong Kong context and the ardeids could relocate to another site, hence impact severity is Low to Moderate .

Table 13.105 - Potential Indirect Impacts on Plantation in the absence of mitigation measures

Criteria	Hillside Plantation	Roadside and Urban Plantation	Ho Sheung Heung Egretry Plantation
Habitat Quality	Plantation blocks, moderate in size, often with linkages to other habitats, including secondary woodland and shrubland which permit movement of fauna and colonisation by native species. Assessed as of Low to Moderate ecological value.	Fragmented and highly disturbed by human activities with a high proportion of exotic trees, assessed as of Low ecological value.	Relatively disturbed plantation and orchard, but assessed as of Moderate to High ecological value due to presence of egretry.
Species	Species diversity low to moderate; utilised by woodland-associated fauna of conservation significance in small numbers.	Species diversity is low and species are common and widespread habitat generalists.	Three ardeid species of conservation significance breed regularly and one other species has bred in the past.
Size/Abundance	Patches that may be indirectly impacted are moderate in size. Fauna density is low.	Patches are small in size, but aggregate area is moderate. Fauna occurs at low density but aggregate numbers of some disturbance-tolerant groups, including birds	Habitat area is small; number of breeding ardeids at Ho Sheung Heung Egretry is large in a Hong Kong context.

Criteria	Hillside Plantation	Roadside and Urban Plantation	Ho Sheung Heung Egretty Plantation
		and butterflies may be moderate.	
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.		
Reversibility	Construction phase impacts largely reversible; operational phase impacts irreversible; remediation possible for both construction and operational phase impacts.		
Magnitude	Low to moderate magnitude overall as number of organisms impacted would be relatively small and most are not disturbance-sensitive.	Low magnitude overall as organisms are not disturbance-sensitive.	Egretty site is distant (>500m) from development areas of the Project and areas where human activity will increase significantly, therefore magnitude of disturbance will be low.
Impact Severity	Relatively low number of disturbance-sensitive species but utilised by small numbers of some species of conservation significance; thus, impact severity is Low to Moderate .	Habitat is abundant and organisms impacted are common, widespread and not disturbance sensitive; thus, impact severity is Low .	No significant increase in disturbance is predicted, hence impact severity is Low .

Table 13.106 - Potential Fragmentation Impacts on Plantation in the absence of mitigation measures

Criteria	Hillside Plantation	Roadside and Urban Plantation	Ho Sheung Heung Egretty Plantation
Habitat Quality	Plantation blocks, moderate in size, often with linkages to other habitats, including secondary woodland and shrubland which permit movement of fauna and colonisation by native species. Assessed as of Low to Moderate ecological value.	Fragmented and highly disturbed by human activities with a high proportion of exotic trees, assessed as of Low ecological value.	Relatively disturbed plantation and orchard, but assessed as of Moderate to High ecological value due to presence of egretty.
Species	Species diversity low to moderate; utilised by woodland-associated fauna of conservation significance in small numbers.	Species diversity is low and species are common and widespread habitat generalists.	Three ardeid species of conservation significance breed regularly and one other species has bred in the past.
Size/Abundance	Patches which may be fragmented	Patches are small in size, but	Habitat area is small; number of breeding

Criteria	Hillside Plantation	Roadside and Urban Plantation	Ho Sheung Heung Egretty Plantation
	indirectly impacted are small in size. Fauna density is low.	aggregate area is moderate. Fauna occurs at low density but aggregate numbers of some disturbance-tolerant groups, including birds and butterflies may be low to moderate.	ardeids at Ho Sheung Heung Egretty is large in a Hong Kong context.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.		
Reversibility	Construction phase impacts largely reversible; operational phase impacts irreversible; remediation possible for both construction and operational phase impacts.		
Magnitude	Low magnitude overall areas and number of organisms impacted would be small.	Low magnitude overall as number of organisms impacted would be small, most are not disturbance-sensitive and intrinsic ecological value of patches is small.	Breeding egrets are dependent upon linkages to foraging areas. Some of those breeding at Ho Sheung Heung forage in the Project Area, notably in Long Valley and the Sheung Yue River, both of which may be disturbed by the Project in the absence of mitigation. However, flight-lines and foraging areas to the north and east will not be impacted, impacts to the flight-line between the egretty and the Sheung Yue will be small and there will be no significant structures erected along the flight-line, a new footbridge over the Ng Tung River being the largest project element in this area. This footbridge is not on the main flight-line. Further, Long Valley foraging areas will be retained by the project.

Criteria	Hillside Plantation	Roadside and Urban Plantation	Ho Sheung Heung Egrettry Plantation
			Accordingly magnitude may be low to moderate.
Impact Severity	Low	In view of the abundance of this habitat in Hong Kong and the low number of organisms and their low sensitivity to disturbance, impact severity is Low .	Potential fragmentation impact on flight-lines could have an impact of breeding ardeids. Accordingly potential impact severity is Low to Moderate .

13.7.3.18 Mitigation Plantation

A number of small areas of mitigation plantation will be impacted along the Ng Tung, Sheung Yue and Shek Sheung Rivers. These mostly comprise corridors of plantation managed as mitigation for impacts arising from channelisation of the rivers and to be reprovisioned under the Cycle Track Projects. Existing tree species are largely exotic, though some native species and bamboos are present. Their ecological value as wildlife habitat is limited, but they are assessed as of Low to Moderate ecological value due to their function as a screen to reduce disturbance to fauna using the adjacent river channels. Mitigation plantation around Long Valley performs a similar function and would be retained under the NDA project where feasible; potential impacts on mitigation plantation around Long Valley were addressed along with those on other Long Valley habitats.

Table 13.107 - Potential Direct Ecological Impacts on Mitigation Plantation in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Plantations largely of exotic species, fragmented and lacking in understorey vegetation other than grasses. Wildlife diversity and abundance is low but they screen wildlife using the river channels from disturbance. Ecological value is Low to Moderate as a consequence of this screening function.
Species	Low floral and faunal diversity, but may be utilised by species of conservation importance, including species using the adjacent wetlands, in small numbers.
Size/Abundance	Areas be lost are small individually but total area is moderate (10.75ha). Faunal numbers are low.
Duration	Permanent
Reversibility	Irreversible
Magnitude	Loss of individual patches would be of low magnitude but the cumulative magnitude would be moderate.
Impact Severity	Low , as <i>in-situ</i> ecological value is limited.

Table 13.108 - Potential Indirect Ecological Impacts on Mitigation Plantation in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Plantations largely of exotic species, fragmented and lacking in understorey vegetation other than grasses. Wildlife diversity and abundance is low but they screen wildlife using the river channels from disturbance. Ecological value is Low to Moderate as a consequence of their screening function.
Species	Low floral and faunal diversity; but may be utilised by species of conservation importance, including species using the adjacent wetlands, in small numbers.
Size/Abundance	Areas impacted are small individually but total area is moderate. Faunal numbers are low.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Construction phase impacts largely reversible; operational phase impacts irreversible; remediation possible for both construction and operational phase impacts.
Magnitude	Disturbance of individual patches would be of low magnitude but the cumulative magnitude would be moderate.
Impact Severity	Low , as disturbance impact on mitigation plantation has limited impact on its ecological function in mitigating disturbance impacts on other habitats and species.

Table 13.109 - Potential Fragmentation Impacts on Mitigation Plantation in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Plantations are fragmented but they provide some habitat linkages for woodland species and help to maintain linkages for species using the rivers by reducing disturbance. Ecological value is Low to Moderate.
Species	Utilised by woodland species in small numbers and help to maintain linkages along rivers.
Size/Abundance	Areas impacted are small individually but total area is moderate. Faunal numbers that benefit from role in maintaining linkages are moderate and include some species of conservation significance.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Construction phase impacts largely reversible; operational phase impacts irreversible; remediation possible for both construction and operational phase impacts.
Magnitude	Fragmentation impacts on individual patches would be of low magnitude but the cumulative magnitude would be moderate.
Impact Severity	Low , as <i>in-situ</i> ecological value is limited.

13.7.3.19 Orchard

Several small orchard areas, generally located close to villages, will be lost to development. These orchards are fragmented from other woodland habitats, usually have a closed canopy with little understorey vegetation and are regularly disturbed by human activity. Accordingly both floral and faunal diversity is generally low.

Table 13.110 - Potential Ecological Impacts on Orchard in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Ecological value is low due to small size, low vegetation and faunal diversity and relatively high levels of disturbance.
Species	Vegetation dominated by a small number of fruit trees. No species of conservation importance recorded.
Size/Abundance	Small total habitat area (7.38ha) and low numbers of fauna present.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Construction phase impacts largely reversible; operational phase impacts irreversible; remediation possible for both construction and operational phase impacts.
Magnitude	Low.
Impact Severity	Low

13.7.3.20 Village, Urban/Residential, Waste Ground

Much of the land in each NDA comprises developed land, including village areas, urban/residential development and waste ground. Vegetation diversity is low and many species are exotic. Faunal diversity in these areas is also low and species present are habitat generalists tolerant of human activities which are common and widespread in Hong Kong. .

Table 13.111 - Potential Ecological Impacts on Developed Land (Village Areas, Waste Ground and Urban/Residential) in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Low ecological value.
Species	Faunal diversity is low and species present are habitat generalists tolerant of human activities that are common and widespread in Hong Kong. Displacement of the fauna would not have a significant effect on these species, and as a consequence of the long duration of the project, the number of individuals which will be displaced at any one time will be small. Further, as the project proceeds the area where development has been completed (and hence is available for re-occupation) will increase; accordingly there will be no cumulative increase in the number of displaced individuals as the project progresses.
Size/Abundance	Habitat occupies a large part of the Study Area. Not utilised by any species of conservation significance except incidentally.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Largely irreversible during the construction phase but reversible in the operational phase.
Magnitude	Habitat is of low ecological value and no fauna of conservation significance utilises this habitat other than incidentally. Further, the area impacted at any one time will be a minor element of the habitat available to these species as they are not restricted to a few habitats or area. Accordingly, magnitude of impact is low.
Overall Impact Severity	Low

13.7.3.21 Impacts on Deep Bay Ecosystem

Pollution

The Project Area is located within the catchment for rivers feeding into Deep Bay via the Shenzhen River. Water discharging from the Project Area will thus flow into habitats of very high ecological value in Deep Bay, including intertidal mudflats and extensive mangrove ecosystems. These habitats are at risk of pollution as a result of discharge of untreated or partially-treated domestic effluent, discharge of industrial chemicals or surface runoff of pollutants from paved areas. Such pollution could prove toxic to important wildlife or could lead to eutrophication of local watercourses and the wider Deep Bay ecosystem. Such pollution could occur during either the construction or the operational phases of the Project.

A related risk will arise during the construction phase of the Project as a result of increased sedimentation from exposed soil.

An increase in the paved area present as a consequence of the Project would lead to a higher rate of stormwater runoff from road surfaces and other pollutant sources. Ultimately this stormwater could carry pollutants from road surfaces in the project area into the bay.

The most ecologically important habitats in Deep Bay are located well downstream from the Project Area. This increases the chance that any pollution event is detected prior to this reaching the bay, and thus reduces the risk of pollution of the bay arising from the NDA.

Most non-tidal wetland areas around Deep Bay (primarily the fish pond areas surrounding the bay) have no direct hydrological links to the Project Area and would not be impacted by the proposed development, although a small number of fishponds at Hoo Hok Wai may import water directly from Ma Tso Lung Stream.

Table 13.112 - Potential Indirect Ecological Impacts on the Deep Bay Catchment in the absence of mitigation measures

Criteria	Impacts from Sedimentation	Impacts from Pollutant Run-off
Habitat Quality	Deep Bay intertidal mudflats and mangrove habitats are of High ecological value and of international importance.	
Species	A high abundance and diversity of species in intertidal areas, many of which are of conservation significance regionally or globally.	
Size/Abundance	Deep Bay covers a large area and contains very extensive areas of intertidal mudflats and of mangroves. Large numbers of birds, fish and invertebrates are present.	
Duration	Risk of impacts would be greatest during construction and would be temporary.	Risk of impacts would be greatest during construction phase but some impacts could remain into the operational phase. Duration may vary depending on the nature of the pollution event.

Criteria	Impacts from Sedimentation	Impacts from Pollutant Run-off
Reversibility	Siltation would be largely incorporated into natural processes.	Smaller-scale pollution events would be easier to contain and reverse. Large-scale pollution events would be more difficult to reverse.
Magnitude	Sedimentation is a natural process and impacts would be of low magnitude.	Magnitude of impacts would be dependent upon the nature and quantity of pollutant; chemical pollution (especially oil) would have a serious impact to a large number of species. More significant pollution events are likely to be detected sooner, so of shorter duration. Magnitude of most events likely to be low due to the large size of Deep Bay and its distance from the Project Area.
Impact Severity	Construction phase impacts of Low to Moderate severity. Operational phase impacts of Low severity.	Construction phase: certain pollution events (e.g. oil spills or other chemical pollution) have potential for High severity depending on nature and scale; most pollution events likely to be of Low to Moderate severity as magnitude likely to be small. Operational phase: although dependent on nature and scale, most likely to be Low .

13.7.4 Impacts on species of conservation importance

Impacts to species, other than those arising as a consequence to direct impacts on their habitats, which were assessed in **Section 13.7.3**, are considered in this section. These include direct mortality of fauna and species level impacts to flora and fauna, in particular species of conservation significance including potential flight-line impacts to birds.

13.7.4.1 Flora: death/mortality and damage of individuals

Direct impacts on species of flora arise from vegetation clearance and felling of trees required as part of development works. While transplanting or replanting of species affected can be carried out, the feasibility of such measures depends on the specimens affected, their age/size, the tolerance of any time lag required for growth to maturity and the availability of suitable relocation sites.

The protected tree, *Aquilaria sinensis*, is present in *fung shui* woodland/secondary woodland at Ho Sheung Heung, Ma Tso Lung, south of Pak Shek Au, east of Tong Hang Tung Chuen and east of Wo Hop Shek. Three other flora species of conservation significance, the trees *Ailanthus fordii* and *Pavetta hongkongensis*, and the climber

Gnetum luofuense (which is common in Hong Kong) have been recorded in *fung shui* woodland/secondary woodland at Ho Sheung Heung. *Gnetum luofuense* is also present in secondary woodland near Siu Hang Tsuen. The fern *Cibotium barometz* is present near the Ngam Pin Watercourse and two protected orchid species, *Pecteilis susannae* and *Spathoglottis pubescens*, are present in plantation near the Cheung Po Tau Watercourse, Sha Ling.

None of the specimens found are located in areas that will be directly impacted by the Project, or are in areas where significant indirect impacts are predicted; however, Ho Sheung Heung *fung shui* and secondary woodland is immediately adjacent to development areas and may be indirectly impacted by dust deposition and disturbance by site staff during the construction phase of the Project.

Table 13.117 - Potential death/mortality or damage to plant specimens in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Woodland at Ho Sheung Heung is of Moderate ecological value for flora.
Species	Flora species of conservation significance and protected flora species.
Size/Abundance	<i>Gnetum luofuense</i> is common; only a few sapling specimens of <i>Aquilaria sinensis</i> were found during surveys for the current study; <i>Ailanthus fordii</i> and <i>Pavetta hongkongensis</i> found previously and in this woodland and may still present but are likely to be rare.
Duration	Construction phase.
Reversibility	Dust deposition will be reversed by rainfall; damage by site staff may be irreversible but remediation possible.
Magnitude	Magnitude low as the area does not support significant populations of these species.
Impact Severity	Dust deposition of Low severity; damage/death of specimens of protected species of Low severity; but damage/death of species of conservation significance would be of Low to Moderate severity.

13.7.4.2 Fauna: mortality of individuals

Direct mortality involves the death of organisms as a result of the development. Animals may be hit and killed or injured by rapidly-moving vehicles or by collision with stationary objects such as buildings or noise barriers. Birds and mammals appear to be most susceptible (Van der Grift and Kuijsters 1998), though herpetofauna are also prone. Should roads pass through areas of high animal population density, or cut across regular lines of movement, such mortality is likely to be greater. The risk of animal mortality arising from road kill and collision with buildings, windows or transparent noise barriers is likely to be greater in rural areas than in already developed, urban areas, as wildlife populations are higher in the former.

Numerous studies have documented avian mortality associated with buildings, usually the result of collision with tall buildings or windows. Long-term studies have documented the chronic nature of collision

mortality associated with some buildings. Over a three-year period in Toronto, Ontario, Ogden (1996) counted 5,454 dead birds at 54 tall glass buildings. Inclement weather during the migration seasons is known to exacerbate nocturnal collision mortality, as birds become disorientated in such weather conditions. The combination of strong night-time lighting emitted from a tall building or structure is a particular source of mortality.

Collisions also occur in daytime, though the causes are generally related to the nature of the building exterior (glass being the prime culprit), and the key risk factors are transparency and reflectivity. Building façades that constitute transparent glass appear not to present an obstacle to flight and birds may strike windows as they attempt to access potential perches, plants, food and water sources or other lures seen through the glass. Design features such as glass skywalks joining buildings, glass walls around planted atria and windows installed perpendicularly at building corners are dangerous as birds perceive these an unobstructed route.

In addition, materials that reflect surrounding natural vegetation impart the appearance of being suitable for foraging or perching. Where nearby vegetation is limited in extent, even extensive glass surfaces may produce only a few collisions per year; but where vegetation is extensive and “mirrored glass exteriors” face “forested patches” (O’Connell 2001), high collision rates may occur. Glass windows in the lower storeys of a building are, typically, a much greater threat as they are more likely to reflect trees and other landscape features that attract birds. Windowed courtyards and open-topped atria, especially if heavily planted, are also hazardous. Birds fly down into such areas, but may try to leave by flying directly towards reflections on walls. Gelb and Delacretaz (2009) found that in New York the combination of open space, vegetation and large windows greater than 1m x 2m are more predictive of bird mortality than building height. The angling of glass up toward the sky also appears to confuse birds (Klem 1990) and constitute an exacerbating factor.

In the same manner, noise barriers are problematic if they are transparent, and thus appear to allow clear passage to suitable habitat on the far side, or are reflective of surrounding habitats. A particular complicating factor is that if a surface is not obviously impenetrable from some distance, it may be difficult for birds to take evasive action at a closer range. Birds, whether by instinct or morphology, often cannot rapidly reduce flight speed as it results in stalling, and a fall from the air; thus, if there is insufficient distance to avoid a barrier by flying over or around, collision is inevitable (Martin 2011). Consequently, surfaces that appear to be solid only at close range (for example, where a pattern such as hatching is not visible at longer range) may still cause significant mortality.

Birds have evolved to fly through tree canopies at speed. As a result, such measures as the placing of falcon silhouettes, owl decals and large eye patterns do not reduce strike rates by a statistically significant level

(Kruuk 1995). Such objects have to be distributed sufficiently densely across the problem surface so as to break the glass swaths to less than 4" vertically or 2" horizontally (San Francisco Planning Dept. 2011) in order to be effective. Such a density is unlikely to be considered aesthetically pleasing on buildings, though may be acceptable for roadside noise barriers.

Direct mortality of fauna may occur during the construction and operational phase of the Project as a consequence of such fauna being accidentally or deliberately killed by human agency, by displacement from required habitat as a consequence of loss or disturbance to that habitat and by fragmentation of habitat such that the remaining habitat fragments are too small to meet the ecological requirements of all the individuals isolated in the fragments. Direct mortality may also occur as a result of a combination of these factors when individual factors are not, in themselves, sufficient to cause mortality; a well-known example of factors acting in concert resulting in direct mortality is the death of amphibians on roads as they try to move between terrestrial habitats, occupied for much of the year by adults, to wetlands utilised when breeding.

Terrestrial Mammals and Herpetofauna

Terrestrial mammal numbers in the Study Area are low. As a consequence, mortality of mammals during the construction and operational phases of the Project is likely to be small. However, mortality may still be of significance at a population level, especially in respect of slower breeding and rarer species. These include Eurasian Otter, which has been recorded once in the north of the Study Area and occurs regularly in areas to the north.

Some herpetofauna species may be slow-moving, especially when temperatures are low, and some species may utilise road surfaces to assist in maintaining body temperatures. Some species may also find it difficult or impossible to climb out of vertical or steep-sided artificial structures such as drainage channels. As with other fauna, mortality of species of conservation significance as a direct or indirect consequence of the Project may be of importance if this is sufficient to affect populations at a local or higher level.

As indicated above, most of the Project Area mortality of terrestrial fauna, and especially terrestrial fauna of conservation significance, is unlikely to be of significance. However, the Eastern Connection Road is located in close proximity the riparian corridor of Ma Tso Lung Stream where Three-banded Box Terrapin is present, as are other herpetofauna species of conservation significance. Though not known from the Study Area, it is possible that Eurasian Otter may occur in this area. Accordingly, it is considered that mortality impacts on terrestrial fauna may be of conservation significance in this area.

Table 13.113 - Potential mortality impacts on Terrestrial Mammals and Herpetofauna in the absence of mitigation

Criteria	Assessment
Habitat Quality	Most mammal species in the Study Area use woodland habitats, especially larger and older woods; Bandicoot Rat occurs in lowland habitats around Long Valley and Eurasian Otter utilises wetland, including riparian corridors; reptiles occur in a variety of habitats, with wetlands and the Ma Tso Lung area of greater significance; amphibians are wetland-dependent.
Species	All species of conservation significance recorded in the Study Area.
Size/Abundance	The areas of preferred habitat (wetlands and older/larger woodlands) are relatively small, but other habitats may be utilised on occasion. The Study Area does not support any mammal populations of significance in a Hong Kong context, but populations of some herpetofauna are of importance; that of Three-banded Box Terrapin may be globally significant. Mortality of any individuals of species of conservation importance could be significant at a local level.
Duration	Permanent in respect of operational phase impacts; temporary in respect of construction phase impacts.
Reversibility	Not reversible; but remediation measures possible.
Magnitude	Generally low but could be low to moderate in the Ma Tso Lung area.
Impact Severity	Low in the Project Area as a whole but Low to Moderate in the Ma Tso Lung area for riparian fauna of conservation significance and Moderate to High for any mortality of Three-banded Box Terrapin.

Bats

Bats are not significantly impacted by most potential causes of direct mortality potentially arising from the Project; however, they may be vulnerable to direct mortality from destruction of roost sites, especially those occupied by nursing females or by winter bat roosts. Potential impacts on bat roosts are considered below.

Table 13.114 - Potential Mortality Impacts on Bat Roosts in the absence of Mitigation

Criteria	Assessment
Habitat Quality	Variable, roost locations may be in habitats such as villages that are otherwise of limited ecological value.
Species	Bat species of conservation significance known to occur in the Study Area include Short-nosed Fruit Bat, Brown Noctule and Lesser Yellow Bat; given their vagility, other species may occur. All bats are protected under the Wild Animals Protection Ordinance.
Size/Abundance	Large area of potential habitat; bat roosts are likely to occur in most habitats where roost requirements are met, including anthropogenic habitats. Bats are abundant in lowland agricultural and wetland areas impacted by the Project.
Duration	Impacts would only be of significance during the construction stage of the Project.
Reversibility	Irreversible; but remediation possible.
Magnitude	Low as period of vulnerability will be short and localised.
Impact Severity	Low as population level impacts highly unlikely.

Birds

Like bats, birds will be able to avoid most direct impacts of the Project. However, birds are vulnerable to direct mortality, especially of eggs or nestlings, when breeding. Potential mortality to breeding birds is assessed below.

Table 13.115 - Potential Direct Mortality Impacts on Breeding Birds in the absence of Mitigation

Criteria	Assessment
Habitat Quality	Variable, breeding locations do not necessarily reflect the habitat quality of the immediate area.
Species	Moderate diversity of wetland-dependent bird species and others of conservation significance breed in the area, including ardeid species at two locations.
Size/Abundance	Large; some breeding birds are present in all habitats; abundance higher in woodland and wetland habitats and lower in grassland and developed areas; ardeid nests are concentrated at two locations.
Duration	Construction phase.
Reversibility	Irreversible but remediation possible.
Magnitude	Generally low as period of vulnerability at any one location will be short and localised. Moderate if egret locations were to be cleared during the breeding season.
Impact Severity	Generally Low severity but potentially Moderate if egret locations were to be cleared during the breeding season.

Collision mortality on birds from buildings or other barriers is potentially of significance from the Project. The height of some buildings in the Project Area will be substantial, and as modern buildings tend to have large areas of glass, avian mortality is possible. Much depends on the nature of the glass, however, with highly reflective surfaces causing greater mortality, especially if adjacent to dense areas of shrubs or trees.

Collision frequency is also related to the number of birds present, with numbers of birds in an area increasing the likelihood of collision, irrespective of other factors. Similarly, the risk of collision is increased if development is located across a flight-line regularly utilised by birds in significant numbers. In the assessment area significant concentrations of birds occur in Long Valley and, to a lesser extent, along the major river channels. However, the most significant flight-line is that used by large waterbirds (which, as a group, are not particularly prone to collision with structures) linking Long Valley northwards along the Ng Tung River to the Shenzhen River and Deep Bay; also of significance for waterbirds is the flight-line along the Ng Tung River eastwards, although this is used by smaller numbers and fewer species. A flight-line for some soaring species follows the hills in the north of the Study Area, though this is of much less significance in terms of the number of individuals using it and this flight-line is also elevationally separated from development areas.

In any location, species involved in collisions will generally reflect the habitats in the immediate vicinity. The development areas of the project will be planted with trees and shrubs that will attract the typical common

and widespread species that have adapted to this habitat in Hong Kong. Some species using adjacent areas of shrubland and secondary woodland will opportunistically use such habitats in the developed areas, but in relatively small numbers. Consequently, any mortality in these areas is not anticipated to be different in nature to that which occurs in other areas of Hong Kong.

Data from the only study of mortality of birds caused by noise barriers in Hong Kong, which was not systematic, are presented on the website of the Hong Kong Bird Watching Society. Though informal, the data suggest that mortality from transparent noise barriers alongside roads can be significant. Most of the species suffering collision at the study site were small in size due to the nature of habitats in the surrounding area. The issue at this and similar sites concerns birds flying between separate patches of wooded or shrubland habitat, where the transparent glass imparted an impression of unobstructed passage.

The larger species present in Hong Kong are less prone to such impacts as they tend to fly more slowly and at greater heights in more open areas, away from roads and buildings. Consequently, it is not anticipated that larger species, in particular the large waterbirds which are common in the Study Area, will be significantly impacted in this way, given appropriate selection of building materials and design. The main issue for these larger species, including the largely nocturnally-foraging Grey Heron and Black-crowned Night Heron, and migratory birds in general is probably lighting. Certain types of lighting, especially in tandem with poor weather, may impose an impact.

The part of the Project Area where the risk of mortality of birds from buildings is of most significance is the area to the southwest of Long Valley, where a concentration of non-residential buildings is proposed to be constructed close to an area with a concentration of birds.

Areas where noise barriers are most likely to be of concern in respect to mortality of birds are areas where barriers are planned between sensitive noise receivers and wooded areas; however since experience has shown that almost any transparent noise barrier has the potential to cause bird mortality, it is recommended to avoid transparent noise barriers throughout the Project Area.

Table 13.116 - Potential collision mortality impacts on bird species in the absence of mitigation

Criteria	Assessment
Habitat Quality	Wetlands of high ecological value at Long Valley and along the main river channels which support a large number of waterbirds; other habitats of lower value elsewhere in the Study Area support small numbers of waterbirds and small to moderate numbers of landbirds.

Criteria	Assessment
Species	Species of conservation value, wetland-dependent species and a diverse variety of landbirds are present in the area. Susceptibility to mortality more dependent upon size than habitat preferences with larger species being less susceptible; however, species of the same size which typically utilise closed habitats tend to be more susceptible than species of the same size which typically utilise open habitats.
Size/Abundance	Abundance of birds is high, especially in Long Valley, while the area of buildings and roads that could potentially cause mortality is large.
Duration	Construction phase impact will be short-term but operational phase impacts are long-term.
Reversibility	Irreversible but can be remediated to some extent reversible via installation of measures to minimise impacts.
Magnitude	Probably of low magnitude for larger bird species, including larger species of conservation significance; number of smaller birds impacted may be larger but this is balanced by their generally larger populations, fecundity and shorter generation times, hence of low magnitude at a species level.
Impact Severity	Low , mainly in relation to small to medium-sized birds, but also including smaller numbers of waterbirds, especially along the Ng Tung River in KTN.

13.7.4.3 Impacts at Species Level

Mammals

The following terrestrial species of conservation significance: Greater Bandicoot Rat, East Asian Porcupine, Masked Palm Civet, Leopard Cat and, at least historically, Red Muntjak, have been recorded in the Long Valley and Ho Sheung Heung areas in wetland and woodland habitats, and may be impacted by the Project indirectly, or experience fragmentation or cumulative impacts, in these areas. In addition, Eurasian Otter, a species of global conservation concern, has been recorded on the east side of the Ng Tung River near Sha Ling and has been reported regularly just to the north of the Study Area at Hoo Hok Wai and may occasionally occur within the area in the Ma Tso Lung area. Accordingly, this species may also be impacted by the project.

All bat species are protected in Hong Kong but the only species of conservation significance that has been reported from the assessment area with certainty is Brown Noctule, recorded in Ho Sheung Heung village during the current study. In addition, Pomona Leaf-nosed Bat was tentatively recorded in KTN during the Hong Kong Biodiversity Survey (Dudgeon and Corlett (2001), and hence is treated as a species which may be significantly affected by the project on a precautionary basis. However, in view of the difficulties involved in observing and identifying

bats and their mobility, it is not unlikely that additional species of conservation significance occur.

Table 13.118 - Potential Ecological Impacts on Mammals in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	The habitat value of the mosaic of wetland habitats in Long Valley is High; Ho Sheung Heung woodland is of Moderate value, while shrubland at Crest Hill, which may also be utilised by some mammal species, is of Moderate to High value. Riparian habitats in the Ma Tso Lung area are of variable ecological value but the combined habitats are of ecological significance for a number of fauna species. Bats may be found in a variety of habitats, and location of roosts (where bats are most vulnerable to impacts) may not be related to habitat quality in the immediate area.
Species	Mammal species of conservation significance of which Greater Bandicoot Rat (found at Long Valley) and Eurasian Otter (found near the Ng Tung River at Sha Ling and to the north of the Study area at Hoo Hok Wai) have restricted distributions in Hong Kong.
Size/Abundance	Except for some bat species, which are abundant in lowland areas, mammal populations in the assessment area are probably low in a Hong Kong context.
Duration	Construction phase impacts will be temporary but operational phase impacts will be permanent.
Reversibility	Mostly irreversible, but remedial measures are possible in both construction and operational phases.
Magnitude	Magnitude likely to be low as the area does not appear to support significant populations of species of conservation importance.
Impact Severity	Construction phase: Low in respect to mortality and Low in respect to fragmentation due to potential for greater disturbance and fragmentation impacts from construction activities. Operational phase: Low to Moderate in the Ma Tso Lung area, primarily due to the potential fragmentation impacts of the LMC Loop Eastern Connection Road, but Low in the Long Valley and Ho Sheung Heung areas and elsewhere as habitats of significance to mammals will be retained, habitat linkages will be retained, and disturbance will decrease.

Birds

The assessment area is of high importance to wetland bird species of conservation importance, supporting both a high diversity of wetland bird species and high numbers of some of these species. Both species diversity and numbers are highest in Long Valley, which is particularly important in a Hong Kong context to species that favour freshwater wetland and wetland agriculture. The Sheung Yue River and, to a lesser extent, the Ng Tung and Shek Sheung Rivers are also of importance to wetland birds, though numbers, and especially, diversity are lower than in Long Valley and species using these rivers are not restricted to these habitats or these and a small number of other habitats. Other wetland areas in the assessment area are small and scattered and not used by any wetland bird species in significant numbers.

Open or largely open-canopy dryland habitats in the assessment area, especially those away from Long Valley, are of much lower significance in a Hong Kong, national, or international context. Two species of conservation significance in Hong Kong have been recorded in upland grassland and shrubland habitat in the Study Area in circumstances meeting the criteria used in this assessment and in Fellowes *et al.* (2002): Eurasian Hobby and Grey Nightjar. Of these species, Eurasian Hobby, has bred at Crest Hill in the past (Carey *et al.* 2001), and was recorded in the same area during the current study, and Grey Nightjar was recorded in upland grassland (a suitable breeding habitat) near Cheung Po Tau and Wa Shan, again during the current study. In addition, Eurasian Eagle Owl, though not of certain occurrence in the Study Area, may be present in upland grassland north of Chau Tau.

Other species of open dryland habitats recorded in the Study Area, such as Japanese Quail, Zitting Cisticola, Golden-headed Cisticola, Chestnut-eared Bunting, Yellow-breasted Bunting and Grey-capped Greenfinch are either not of regular occurrence in the Study Area, not of regular occurrence in such habitats, or are not restricted to a single habitat, or a few habitats or areas in the Study Area. Red-billed Starling and Chinese Grosbeak are found in a variety of open country habitats, including both wetland and dryland habitats and developed areas. Both species are primarily non-breeding visitors to Hong Kong and occur in flocks which forage opportunistically where food sources are temporarily abundant; Red-billed Starling is generally commonest in wetland habitats, whereas Chinese Grosbeak is often found in trees in or near village areas, perhaps because *Cinnamomum camphora* trees, the seeds of which are a favoured food source, are often planted in such areas. Numbers of both species in the Study Area as a whole may be significant in a Hong Kong context; however, as both species occur in a wide variety of habitats, including developed areas and forage in mobile flocks, impacts on these species from the project are not considered to be significant. White-shouldered Starling, which is largely a breeding summer visitor or passage migrant through Hong Kong, has similar habitat requirements to Red-billed Starling, but is perhaps more closely associated with wooded habitats and is even more closely associated with developed areas, where it breeds in man-made structures. This species is listed by Fellowes *et al.* (2002) as restricted as a breeding species, albeit numbers have increased in Hong Kong in the past ten years (M.R. Leven pers. obs.). Impacts of the project on this species are also not considered to be significant.

Whilst not of significant intrinsic habitat value, plantation and orchard east of Ho Sheung Heung and plantation at Man Kam To Road north of the Ng Tung River are of significance as egret locations. In some years Ho Sheung Heung Egret is one of the largest in Hong Kong.

Mature secondary woodland which meets the habitat requirements of woodland-dependent bird species is rare in the assessment area; the

largest area of older secondary woodland and contiguous *fung shui* woodland in the Study Area lies to the west of Ho Sheung Heung.

Crested Serpent Eagle has been recorded over wooded areas (including shrubland). This species, which is listed by Fellowes *et al.* (2002) as a restricted breeding species, breeds in wooded areas in the New Territories (Carey *et al.* 2001). It has been recorded from a number of areas and habitats in the Study Area but there is no evidence that it breeds in any of the areas which may be impacted by the project. White-throated Kingfisher, listed by Fellowes *et al.* (2002) as of Local Concern as a breeding species, has been recorded in or near some woodland areas and may breed in at least some of these; however, again there is no evidence that it breeds in any locations which will be significantly affected by the project. Also recorded in wooded areas away from Long Valley are Brown-headed Thrush (a rare winter visitor to Hong Kong), and Black-naped Oriole (a former common breeding species which has now largely disappeared (as a breeding species) from Hong Kong).

Table 13.119 - Potential Ecological Impacts on Wetland-dependent Birds in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Long Valley habitat is of High to Very High ecological value for wetland-dependent birds, including many species of conservation importance. Sheung Yue River is of Moderate ecological value for a much smaller number of wetland-dependent bird species, but including some species of conservation significance; tidal Ng Tung River is of Moderate ecological value and non-tidal Ng Tung River and Shek Sheung River are of Low to Moderate ecological value for wetland-dependent birds as they support, moderate and small numbers, respectively, and a more limited diversity of wetland-dependent species. Other wetland habitats and non-wetland habitats are of low ecological value to wetland bird species other than habitats used by breeding egrets.
Species	A high diversity of wetland-dependent species, including many species of conservation importance, is present in Long Valley. Main river channels support a low to moderate diversity of wetland-dependent bird species; wetland habitats elsewhere and non-wetland habitats are not of significance for wetland-dependent bird species.
Size/Abundance	Long Valley is a large area of freshwater wetland in a Hong Kong context; Ng Tung and Sheung Yue Rivers are large areas of channelised river habitat, while the Shek Sheung River is a moderate area of this habitat; other areas are small. Abundance of wetland-dependent species is high in Long Valley and moderate on the Ng Tung and Sheung Yue Rivers and low elsewhere.
Duration	Loss of wetland habitats and associated birds would be permanent. Disturbance impacts would be permanent but would be reduced during the operational phase. Duration of construction phase impacts will vary due to phasing of the project: those on Long Valley will be highest during the Advance Works Phase; those on the Sheung Yue River will be greatest during road bridge construction by which time there will be no significant disturbance impacts on Long Valley as a whole. Fragmentation

Criteria	Assessment
	impacts on flight-lines of wetland-dependent waterbirds, in particular breeding ardeids, would be permanent in respect to linkage between Long Valley and the non-tidal Ng Tung River; other fragmentation impacts would be lower from other sources and largely in later phases, as the main flight-lines would not be affected by development in their path.
Reversibility	Direct loss of wetland habitat and fragmentation of linkage between Long Valley and Ng Tung River would be irreversible; disturbance impacts from structures would be irreversible; remedial measures possible to reduce disturbance and other fragmentation impacts would be possible during both construction and operational phases.
Magnitude	<p>Construction phase: magnitude of direct habitat loss low, magnitude of disturbance impacts on birds using Sheung Yue River north of the new footbridge and tidal Ng Tung River low to moderate during Advance Works period then low thereafter; magnitude on birds using southern section of Sheung Yue River low to moderate during early part of the construction phase but high during road bridge construction, and during development of areas on either side of the river.</p> <p>Magnitude of disturbance impact on birds using the non-tidal Ng Tung River moderate to high throughout overall, but related to phasing of individual project elements.</p> <p>Magnitude of disturbance on birds using the Shek Sheung River low to moderate during Advance works phase, low thereafter.</p> <p>Magnitude of impact on Long Valley low throughout but low to moderate on areas along the river channels during Advance Works phase.</p> <p>Overall trend for magnitude of impact to decline over time due to habituation.</p> <p>Overall magnitude of construction phase disturbance low to moderate as impacts on most species and on most individuals low or low to moderate. However, magnitude of impact on foraging habitat for some species using Sheung Yue River may be moderate, especially in the case of Little Egret and Chinese Pond Heron breeding at Ho Sheung Heung Egretty and foraging in the river. Magnitude of fragmentation impact on linkage between Long Valley and Deep Bay wetland ecosystem low, magnitude of fragmentation impact on linkage between Long Valley and non-tidal Ng Tung River low as few individuals and species are involved.</p> <p>Operational phase: low except for disturbance impact which would be low to moderate on birds using the Sheung Yue River and low to moderate on birds using non-tidal sections of the Ng Tung River;.</p>
Overall Impact Severity	<p>Impact of direct habitat loss: Low.</p> <p>Construction phase: Low to Moderate on most species using Sheung Yue River but Moderate on breeding individuals of Little Egret and Chinese Pond Heron; Low to Moderate on birds using non-tidal Ng Tung Rivers; Low on birds elsewhere including Long Valley.</p> <p>Operational phase: Low on birds using Sheung Yue River, Low to Moderate on birds using non-tidal Ng Tung River; not significant on birds using Long Valley and tidal Ng Tung Rivers; not significant or Low on wetland birds elsewhere.</p>

Table 13.120 - Potential Ecological Impacts on Non Wetland-dependent birds in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Most lowland dryland habitats are disturbed by human activity and do not support important bird communities and are of Low ecological value. Dry agricultural land in FLN is of Low to Moderate ecological value; this habitat/area is used by some bird species of conservation significance in small numbers but it is not regularly used by significant numbers of these species. Upland grassland and grassland/shrubland are largely of Low ecological value; however, that at Cheung Po Tau, Wa Shan and Chau Tau are considered to be of Low to Moderate ecological value due to the presence and suspected presence, respectively, of Grey Nightjar and Eurasian Eagle Owl. Upland shrubland at Crest Hill is of Moderate to High ecological value, partly as a consequence of the presence of Eurasian Hobby, and that at Ma Tso Lung is of Low to Moderate ecological value. Most woodlands areas are too small and/or young and fragmented to support woodland-dependent bird species, but Ho Sheung Heung <i>fung shui</i> woodland and secondary woodland and Siu Hang Tsuen woodland, both of Moderate ecological value, support a few woodland-dependent species which are unusual in the Study Area.
Species	A moderate diversity of species but most are common and widespread in Hong Kong. Small numbers of some bird species of conservation importance are found in dry agricultural land in FLN and in woodland habitats. Eurasian Hobby has bred on a pylon in shrubland at Crest Hill and is known still to occur in this area during the breeding season. As noted above, Grey Nightjar occurs at Cheung Po Tau and Wa Shan and Eurasian Eagle Owl may occur at Chau Tau, however the area where it may occur will not be affected by the project.
Size/Abundance	Areas of upland grassland, lowland grassland, hillside plantation and roadside and urban plantation and developed land are large, areas of other dryland habitats are low to moderate. Abundance of species of conservation importance is low all habitats.
Duration	Loss of habitat is permanent; disturbance impacts are largely restricted to the construction phase, but some disturbance impacts would be permanent.
Reversibility	Loss of habitat would be irreversible; remedial measures possible to reduce disturbance impacts would be possible during both construction and operational phases.
Magnitude	Magnitude of loss of, and disturbance to, dry agricultural land in FLN is large, but magnitude of impact is low to moderate, as bird species of conservation significance occur in low numbers and this is not their preferred habitat. Magnitude of loss of, and disturbance to, wooded habitats is large, but magnitude of impact is low to moderate, as bird species of conservation significance occur in low numbers. Magnitude of impact on Grey Nightjar at Cheung Po Tau and Wa Shan potentially moderate during construction phase if a breeding site is within a works area and occupied at the time of commencement of construction, but low during operational phase as area of direct habitat loss is small and operational phase disturbance impacts would be low.

Criteria	Assessment
	Magnitude of impact on Eurasian Hobby at Crest Hill potentially moderate to high during construction phase in the relatively unlikely event that a breeding site is close to any works area but low during operational phase as no direct habitat loss and operational phase disturbance impacts would be low. Magnitude of impacts on birds in other habitats low as habitats not regularly utilised by non-wetland bird species of conservation significance.
Overall Impact Severity	Construction phase: Low on species using dry agricultural land in FLN and wooded habitats; Low to Moderate on Grey Nightjar and Low to Moderate on Eurasian Hobby depending upon proximity of any nest location to works areas. Operational phase: Low .

Egretries and Egret Flight-lines

The egretty at Ho Sheung Heung is one of the largest egrettries present in Hong Kong. The Man Kam To Road egretty which was first discovered in 2009, is located near Man Kam To Road, north of the Ng Tung River. Both Egretries are currently located immediately adjacent to open storage areas and subject to some level of disturbance. While no direct impact on Ho Sheung Heung Egretty is envisaged under the NDA development, the Man Kam To Road egretty would be unavoidably and directly impacted by the interchange at the western terminus of the Fanling Bypass. Alternative alignments for the Bypass and roundabout connection were considered, but the constraints imposed by the existing Man Kam To Road alignment, the Boundary Control Point and the Ng Tung River rendered these unfeasible (**Section 13.4.1.3** and **Section 2.4.1.5**). This egretty will thus be unavoidably lost as a consequence of the Project if it is still occupied when site clearance work for the Western Section of the Fanling Bypass commences in August 2025. It may also be indirectly affected by site formation for Advance Works elements of the project which will commence in July 2018 and a new footbridge to the west for which construction is scheduled to commence in August 2024. The size of the egretty was smaller in the early part of the 2013 breeding season, which may have occurred in response to previous damage to the site. Given the transient nature of some egrettries, it is possible that other changes might occur that would result in increase, decrease or relocation of the egretty. For this reason, the impact assessment in respect of this should be reviewed before commencement of works and amendments to mitigation agreed with relevant authorities (see **Section 13.5.4.5**)

Ardeids breeding in both egrettries are required to fly to nearby wetland habitats in order to forage for themselves and their chicks. These birds could be impacted by the loss of wetland habitats within the Project Area or the presence of obstacles along the route between breeding and foraging sites, which may make wetland sites unavailable to foraging birds or reduce foraging efficiency by forcing birds to fly further. In addition, disturbance could occur to breeding or foraging birds as a result of increased human activity in the area.

Flight-line surveys conducted at the egrettries suggest that Long Valley and Sheung Yue River provide important foraging sites for birds breeding at Ho Sheung Heung. The height at which ardeids fly between breeding and foraging sites is also relevant; especially along the flight-line between Ho Sheung Heung Egretty and the Sheung Yue River and Long Valley. Currently, most birds follow routes that take them lower than the overhead electricity wires which intersect the flight-line, and hence any development that reduced or eliminated the airspace between the ground and the wires would present a significant obstacle to birds, especially if it created a wide obstacle around which birds could not easily fly.

Development along the flight-lines between Ho Sheung Heung Egretty and Long Valley and the Sheung Yue River has largely been avoided; however, minor Advance Works elements of the project will be undertaken in the Open Space zone in KTN area C2-1 comprising minor site formation, utility laying and construction of open space. These works will be perpendicular to the flight-lines hence birds using them will have to fly over the works area to reach the Sheung Yue River and Long Valley. In addition, a new pedestrian footbridge will be constructed over the tidal section of the Ng Tung River, albeit this will be located to the east of the major portion of the flight-line. Other flight-lines from this egretty to the north and east will not be affected. Foraging areas to the north and east will also not be affected by the project and the area of Long Valley north and west of the Sheung Yue River will retain its current agricultural zoning, though this area will also be affected by works in KTN area C2-1 as well as pipe laying between this area and the Lo Wu Correctional Institution. In addition to impacts on flight-lines, foraging areas of breeding birds along the Sheung Yue River and, to a smaller degree, those in parts of Long Valley will be disturbed, especially during the construction phase of the Project.

Until the site of Man Kam To Road Egretty is cleared in order to permit construction of the western terminus of the Fanling Bypass, the flight-line from this egretty to Long Valley may be affected by upgrading of a footbridge between FLN area A2-1 and area A1-2 which is scheduled to commence in March 2019. This flight-line will also be affected by the extension to Shek Wu Hui Sewage Treatment Works and associated development within the footprint of the existing Sewage Treatment Works which is scheduled to commence in March 2015 and two new footbridges over the Ng Tung River. The first of these, which will link FLN area A1-3 and A2-3, is scheduled to be constructed between March 2021 and February 2023; construction of the second, which will be located just to the west of FLN area A1-7, will commence in August 2024.

Table 13.121 - Potential Ecological Impacts on egrettries and flight-lines of breeding ardeids in the absence of mitigation measures

Criteria	Impacts on Ho Sheung Heung Egretty	Impacts on Man Kam To Road Egretty
Habitat Quality	The egretty is located in plantation/orchard northeast of	The egretty is located in plantation east of Man Kam To

Criteria	Impacts on Ho Sheung Heung Egret	Impacts on Man Kam To Road Egret
	Ho Sheung Heung. The habitat is of Low intrinsic ecological value but has been assessed as of Moderate to High ecological value because of the egret.	Road. The habitat is of Low intrinsic ecological value but has been assessed as of Low to Moderate ecological value because of the egret. This plantation was disturbed by site clearance works in an adjacent open storage/industrial site in 2012 and this assessment takes this damage, as well as the small size of the habitat into account.
Species	Three species breeding in recent years: Little Egret, Cattle Egret and Chinese Pond Heron. Breeding sites of all three species are of conservation significance.	Two species recorded breeding: Little Egret and Chinese Pond Heron breeding in 2012. Breeding sites of both species are of conservation significance.
Size/Abundance	One of the larger egrets in Hong Kong, with up to 119 active nests since 2007, but declined to 49 nests in 2012. The egret was re-occupied in 2013.	Up to 27 nests (in 2012), since the egret was discovered in 2009. However, the site was partly cleared in 2012, and only nine nests (all of Chinese Pond Herons) were present in April 2013.
Duration	Impacts would occur during the ardeid breeding season (March to July). Construction phase impacts would be temporary; (operational phase impacts would be permanent.	Loss of egret site will be permanent. Disturbance to the egret and to flight-lines will also be permanent as this will continue until the egret site is developed. .
Reversibility	Operational phase impacts would be irreversible; most construction phase impacts would be reversible. Remediation possible during both construction and operational phases.	Irreversible.
Magnitude	Construction phase: magnitude of indirect impacts on egret site would be low as no development is proposed in the vicinity. Magnitude of impacts on flight-lines would be low to moderate. Magnitude of disturbance impacts on foraging areas at Sheung Yue River would be moderate and on foraging areas in Long Valley would be low to moderate during the Advance Works phase and low subsequently. No disturbance impacts on foraging areas to the north and east. Operational phase: magnitude of impacts on egret site would be	Construction phase: until site is cleared magnitude of disturbance impacts and impacts on flight-lines would be low to moderate. Loss of egret site would be a low to moderate impact as egret would be lost but egret is small, heavily disturbed and partly cleared, and egrets could relocate.

Criteria	Impacts on Ho Sheung Heung Egret	Impacts on Man Kam To Road Egret
	low at most; magnitude of impacts on flight-lines to the south would be low, no impacts on other flight-lines. Magnitude of disturbance to foraging areas at Sheung Yue River would be low to moderate, impacts on other foraging areas would be low or not of significance.	
Overall Impact Severity	Low to Moderate during construction phase due to combination of impacts on flight-lines and foraging areas; Low during operational phase for the same reasons.	Low to Moderate severity as egret is relatively small in a Hong Kong context and changes in the location of egretries are not infrequent.

Disturbance impacts on birds from increased levels of lighting and glare

Disturbance impacts arising from increases in lighting and associated glare could have night-time impacts on birds. Experience elsewhere in Hong Kong suggest that ardeids do not avoid roost sites in well-lit urban areas, as can be seen by the examples of year-round roosts at Victoria Park, Penfold Park and Tai Po Market.

Nocturnal or partially nocturnal birds may be adversely impacted if light levels cause them to avoid areas, either because they are more vulnerable to predation or their foraging efficiency is reduced. Conversely, some nocturnal birds, such as nightjars and smaller owls, may forage around light sources as these attract their insect prey. There has been no research on the significance of avoidance or attraction effects in Hong Kong; accordingly, following the precautionary principle, it is assumed that additional light and glare is not beneficial to nocturnal bird species.

Light and glare is also known to adversely affect birds migrating at night, causing them to become disorientated and, in some cases, to be killed if they fly into obstacles or land in inappropriate locations. Rails are particularly prone to such disorientation, but other species that migrate at night, including many passerine birds, may also be affected.

Currently, the urban area of Sheung Shui and Fanling is brightly lit at night, but light levels to the west and north of Long Valley are significantly lower. With the implementation of the Project, brightly lit areas will, potentially, extend to the west and northwest of Long Valley. Migrating birds approaching the Long Valley area from these directions would, therefore, additional disturbance impacts from light and glare in these areas.

Table 13.122 Potential impacts from increased lighting or glare on large waterbirds, nocturnal birds and migratory bird species in the absence of mitigation

Criteria	Assessment
Habitat Quality	Wetlands of high ecological value support high numbers of waterbirds; other habitats are of variable quality but all support some birds.
Species	Large waterbirds, nocturnal birds and migrant birds.
Size/Abundance	Numbers of large waterbirds in Long Valley are high, nocturnal bird numbers are low but include species of conservation significance; numbers of migratory birds in Long Valley are high and most habitats support at least some migrant bird species.
Duration	Construction phase impacts will be short-term but operational phase impacts are long-term.
Reversibility	To some extent reversible via installation of measures to minimise impacts.
Magnitude	Impacts probably of low magnitude in terms of larger waterbirds and nocturnal birds but may be low to moderate for migrant birds.
Impact Severity	Low for waterbirds, probably Low for nocturnal birds, but may be Low to Moderate from the main commercial /business area to the west of Long Valley on migrating birds.

Reptiles

Sixteen reptile species of conservation importance have been recorded in the Study Area: three Chelonians, four lizards and nine snakes.

The record of Three-banded Box Terrapin is of particular significance because the global population of this species is Critically Endangered. This species is associated with hill streams, usually where there is diverse and mature riparian woodland, in which the terrapins spend some of the time. The species could be significantly impacted by impacts on the Ma Tso Lung Stream, including impacts to the stream bed from channelisation, increased pollution load in the stream or damage to the riparian woodland.

Impacts on Reeve's Terrapin are predicted to be low as the habitat where this species has been found (Long Valley) will not be developed and impacts on this habitat are not considered to be of significance for this species. Impacts on Chinese Soft-shelled Turtle are also predicted to be low as the habitats where this species has been found (Long Valley and the downstream tidal section of the Ng Tung River) will not be developed and other impacts on these habitats are not considered to be of significance for this species.

Five-striped Blue-tailed Skink is known from the Study Area on the basis of an observation from a local naturalists group and there is no other information on the status of the species in the Study Area. However, whilst there is no reason to doubt the report, the reported location of the observation (Ma Shi Po) is not typical of the usual forest or upland habitat of this species. Accordingly, any population in this area is likely to be

small and not of significance at a species level. Accordingly, impacts on this species are predicted to be low on a precautionary basis.

Habitat where Burmese Python has been reported in KTN will not be developed, however the site where Burmese Python was recorded in FLN is not certain. As this species is widespread in Hong Kong, a single record of this species is of limited conservation significance, despite this species being of conservation importance. Accordingly, impacts on this species are predicted to be low on a precautionary basis.

Chinese Cobra was reported from active agricultural land in KTN (Maunsell 2003), but the location was not stated. An observation of a single record of this widespread species is of limited conservation significance, despite this species being of conservation importance. Accordingly, impacts on this species are predicted to be low on a precautionary basis.

Single observations of Banded Krait and Indo-chinese Rat Snake and two observations of Common Rat Snake have been made during surveys conducted for this and other projects or studies, and Buff-striped Keelback has been reported by local naturalists, in areas which will be developed under the project. All of these species are widespread in Hong Kong and there are large areas of habitat in the Study Area which are suitable for these species and which will not be affected by the project; however impacts on these species are predicted to be of low severity on a precautionary basis.

Observations of Indian Forest Skink, Copperhead Racer, Many-banded Krait, and King Cobra have been made where no works are proposed and that no significant disturbance impacts on reptiles, are predicted. No significant impacts are predicted on these species.

Records of Tokay Gecko and Common Water Monitor are considered to relate to escaped or released individuals, hence impacts on these species are not considered to be of significance.

Impacts on reptiles which may be of significance are summarized below.

Table 13.123 - Potential ecological impacts to reptiles in the absence of mitigation measures.

Criteria	Assessment
Habitat Quality	Long Valley, habitats around Ma Tso Lung and wooded habitats in the southeast of the Study Area are all of ecological significance to reptiles. Lowland non-wetland habitats support some habitat-generalist species at low densities.

Criteria	Assessment
Species	Reeve's Terrapin, Three-banded Box Terrapin and Chinese Soft-shelled Turtle are of Global Conservation Concern; other species of conservation significance present. Of these species, Three-banded Box Terrapin, Reeve's Terrapin, Chinese Soft-shelled Turtle, Five-striped Blue-tailed Skink, Burmese Python, Common Rat Snake, Banded Krait, Chinese Cobra and Buff-striped Keelback may be affected by the project.
Size/Abundance	Numbers generally low but detection is difficult.
Duration	Operational phase impacts will be permanent; construction phase impacts will be temporary
Reversibility	Operational phase impacts irreversible; some construction phase impacts reversible; some remediation possible in both phases.
Magnitude	Magnitude of impacts moderate as area is large but numbers are small; magnitude of impact on Three-banded Box Terrapin also moderate as impacts on preferred habitat relatively low.
Overall Impact Severity	Impacts on Three-banded Box Terrapin Moderate due to potential impacts on Ma Tso Lung Stream and stream corridor; Impacts on other species Low or not significant.

Amphibians

Amphibians are common in much of the Study Area, especially in wetland habitats and in the lowlands. Most species are common and widespread in Hong Kong and occur in a variety of habitats, though wetland habitats, or wet areas in other habitats are required for breeding and the larval (tadpole) stage of their life cycles. None of these common and widespread species are restricted to a few habitats or sites in the Study Area and in Hong Kong; hence species level impacts from the project are not considered to be significant.

Four amphibian species of conservation significance have been recorded in the Study Area and a fifth species, Short-legged Toad, has been found near Wo Hop Shek Crematorium, either within the Study Area or just outside it. Chinese Bullfrog has been found widely, albeit in low numbers in a variety of habitats both within and outside the Project Area; most observations are from the Ma Tso Lung Stream catchment. This species is relatively common in the northern New Territories. Two-striped Grass Frog has been recorded in Long Valley, and Lesser Spiny Frog and Brown Wood Frog have been found in plantation near Wo Hop Shek. A fifth species, Short-legged Toad has also been found in the Wo Hop Shek area and may occur in the Study Area. No impacts are predicted on habitats and species in this area which is outside and upstream of the Project Area boundary.

Table 13.124 - Potential Ecological Impacts to amphibians in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Long Valley is of High ecological value; other wetland habitats are of lower ecological value. Woodland habitat at Wo Hop Shek supports three species of conservation significance.
Species	Lesser Spiny Frog and Short-legged Toad are of Global Conservation Concern, Chinese Bullfrog is of Potential Regional Concern, Brown Wood frog and Two-striped Grass Frog are of Local Concern. Other species are not of conservation concern.
Size/Abundance	Chinese Bullfrog is widespread, but numbers are low; numbers of other species of conservation concern appear to be small. Species which are not of conservation concern are common in much of the Study Area, especially in lowland wetlands.
Duration	Permanent for operational phase impacts; temporary for construction phase impacts.
Reversibility	Operational phase impacts would be irreversible; some construction phase impacts reversible; remediation possible in both phases.
Magnitude	Magnitude would be low to moderate on Chinese Bullfrog as area of habitat impacted is large, but numbers are small and species is widespread in the New Territories. Magnitude of impact on other species of conservation significance is low or no impact is predicted, as impacts on amphibians in habitats/areas where these species are present are small or no impacts are predicted. Magnitude of impacts on other species is low as species are common and widespread in the Study Area and in Hong Kong
Overall Impact Severity	Impact on Chinese Bullfrog Low to Moderate as relatively common in Hong Kong and number of individuals impacted will be relatively low. Impacts on other species Low or not significant.

Butterflies

Butterfly diversity is relatively high in the Study Area and fifteen species of conservation significance have been found. Most of these have been found in the Ho Sheung Heung area, Crest Hill and in the area around Long Valley (including Tsung Pak Long). Elsewhere in the Study Area there do not appear to be any habitats and areas of particular significance for butterflies; four butterfly species of conservation significance (Pale Palm Dart, Spotted Angle, Danaid Egg-fly and Small Three-ring) have been found in the Ma Tso Lung area in scattered locations. All of these species are largely associated with non-woodland habitats, including grassland and wetlands. The most important habitats for butterflies in the Study Area are woodland and shrubland at Ho Sheung Heung and Crest Hill, which support a high diversity of butterfly species in addition to a high proportion of the species of conservation significance found in the Study Area. This high diversity is likely to be due to the relatively high diversity of plant species found in this habitat, providing food plants for butterfly larvae and nectar sources for adult butterflies. In comparison, agricultural land and lowland grassland are species-poor habitats, but a few species of conservation significance have been recorded in Long Valley and in FLN.

Habitats supporting a high diversity of butterflies, woodland and grassland in the Ho Sheung Heung and Crest Hill areas, will only experience limited impacts from the Project, and impacts on butterflies in these habitats are predicted to be small. Impacts on butterflies from the project in other areas are predicted to be small, as species are not present in numbers of significance in a Hong Kong context.

Of species of conservation significance, one species associated with woodland and orchards, Peacock Royal, was recorded in upland plantation near Fung Kong Shan in KTN. Most of this plantation area will not be directly impacted by the project, though a small area will be lost due to road construction and development in open space zone KTN E1-7. Since little habitat will be lost, impacts on this species are predicted to be low. Another species, Commander, was found in a development area north of Ma Shi Po. This is primarily a species of hillside shrubland and woodland (Lo and Hui 2010); consequently impacts are considered to be low at a species level. Habitat loss for other butterfly species is not predicted to be significant, so impacts on all other species from the project are predicted to be low or insignificant.

Table 13.125 - Potential Ecological Impacts to butterflies in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Woodland and shrubland at Ho Sheung Heung and Crest Hill are of high ecological importance for butterflies. The habitats in the Ma Tso Lung area are of low to moderate ecological importance. Other habitats are of lower quality for this group.
Species	Fifteen species of conservation significance recorded, most in the Ho Sheung Heung area. Of these species, there will be low impacts or no impacts on habitats and areas of significance for these species; hence impacts on these species are predicted to be low or insignificant. One species, Commander, found near Ma Shi Po was found in atypical habitat, species level impacts on this species are predicted to be low. Impacts on all other butterfly species are predicted to be low as habitat loss is not predicted to be of significance for this group.
Size/Abundance	Area of woodland habitat at Ho Sheung Heung is small and area of shrubland at Crest Hill is moderately large. However, areas where impacts will be of significance to butterflies are small. Butterfly numbers in the Study Area as a whole are not considered unusual in a Hong Kong context.
Duration	Construction phase impacts would be temporary but habitat loss would be permanent.
Reversibility	Operational phase impacts would be permanent; some construction phase impacts reversible; remediation possible in both phases.
Magnitude	Magnitude of construction phase impacts small as a small area of habitat would be impacted. Magnitude of operational phase impacts small or very small.
Overall Impact Severity	Construction phase impacts of Low severity, operational phase impacts of Low severity or are not significant.

Dragonflies

Eight dragonfly species of conservation significance have been recorded in the Study Area, Blue Sprite, Orange-backed Threadtail, Dingy Dusk-hawker, Blue Chaser, Ruby Darter, Sapphire Flutterer, Scarlet Basker and Emerald Cascader. Of these, Dingy Dusk Hawker, found in a mitigation wetland in FLN is the only species predicted to be directly impacted by the Project. However, this species is common in Hong Kong and tends to be under-recorded during surveys as it is a crepuscular species and hence impacts of habitat loss on this species are not predicted to be significant. All species may, however, be impacted by run-off or pollution impacts on water bodies utilised for breeding. Such impacts may be of significance on one species, Ruby Darter, which occurs downstream of the section of Ma Tso Lung Stream which will be diverted.

Table 13.126 - Potential Ecological Impacts to dragonflies in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Pond and stream habitats required by dragonflies are widespread but unpolluted streams are few, hence most species present are found in lentic water bodies. Siu Hang San Tsuen Stream, streams in the Kau Lung Hang EIS and Ma Tso Lung Stream are all relatively clean and support dragonfly species of conservation significance. However, the species present at Ma Tso Lung Stream, Ruby Darter, is a species of lotic waters.
Species	Dragonfly species are wetland-dependent for part of their life cycle; wetlands in the Study Area support a moderate diversity of dragonflies; most are species of lotic waters. Eight species of conservation significance are known from the Study Area; two of these species, Dingy Dusk-hawker and Ruby Darter occur in habitats where impacts from the project are predicted in the absence of mitigation. However, Dingy Dusk-hawker is considered to be common in Hong Kong and Ruby Darter is tolerant of sediments and organic pollutants.
Size/Abundance	Areas utilised by species of conservation significance are small, hence number of individuals probably relatively low. In other wetland habitats, dragonflies occur in numbers typical of such habitats in Hong Kong; since wetland habitats are relatively common in the Project Area, it follows that the number of dragonflies in the Project Area is proportionate. However, the area of wetland habitats in the Project Area which will receive impacts of significance to dragonflies is small; a proportionate impact of the project on dragonfly numbers is, therefore, predicted.
Duration	Operational phase impacts would be permanent; construction phase impacts would be permanent.
Reversibility	Operational impacts will be permanent. Construction phase impacts will be permanent and include loss of mitigation wetland; some remediation possible for construction phase impacts.
Magnitude	Small for all species, especially during the operational phase of the project
Overall Impact Severity	Low severity or are not significant during both construction and operational phases of the project.

Aquatic Fauna (including Fish)

Fish and freshwater invertebrates in the Study Area are fairly typical of wetland areas in Hong Kong. As many wetlands in the Study Area are disturbed, and water is lotic or polluted, fish and invertebrate fauna in many of these areas is dominated by species which are tolerant of pollution and/or low oxygen levels. The Siu Hang San Tsuen Stream, streams in the Kau Lung Hang Watercourses and the Ma Tso Lung Stream have relatively good water quality and the fish and invertebrate community in these streams reflects this.

Three species of fish and the crab *Somanniathelphusa zanklon* are the only aquatic fauna of conservation significance that have been recorded in the Study Area. *Somanniathelphusa zanklon* has been found in Ma Tso Lung San Tsuen Stream, Chau Tau Watercourse, Tung Fong Watercourse, Sheung Shui Wa Shan Eastern Watercourse, Tin Ping Shan Tsuen Watercourse and in the Ma Wat Wai Watercourse. Single individuals were found in all these locations except in Ma Tso Lung San Tsuen Stream where a total of five individuals were found at two locations. This species is listed as globally Endangered; however, it is found in a wide variety of lotic water bodies including paddies and is tolerant of organic pollution. Surveys conducted for the LMC Loop Study also found this species at another location outside the area covered by the current study (Hoo Hok Wai); it seems that this species may not be highly restricted in its distribution in Hong Kong.

Tung Fong and Tin Ping Shan Tsuen Watercourses, which are largely engineered, will be lost as a consequence of the project; and Ma Tso Lung San Tsuen Stream may be impacted by run-off from the development of KTN area F1-4 in the absence of mitigation measures. No impacts of relevance to *Somanniathelphusa zanklon* are predicted at Sheung Shui Wa Shan Watercourses and the Ma Wat Wai Watercourse as the locations where it was found in these streams were upstream of the short sections of the lower streamcourses which will be affected by this project. No impacts on the Chau Tau Watercourse, which is outside the boundary of the Project Area, are predicted. However, impacts on *Somanniathelphusa zanklon* due to pollution and potential hydrological disruption on the Ma Tso Lung Stream system during the construction phase may be of Moderate significance in the absence of mitigation.

The fish species, *Acrossocheilus parallens*, Predaceous Chub and Small Snakehead, are all native, though some of the individuals of the last of these species may be of captive origin. Impacts on Small Snakehead in the Ma Tso Lung San Tsuen Stream, due to run-off arising from development of adjacent areas entering the stream, are predicted to be of Moderate significance in the absence of mitigation. *Acrossocheilus parallens* is widespread and Small Snakehead is present in streams in the Kau Lung Hang EIS; while Predaceous Chub is common in the upper reaches of the Siu Hang San Tsuen Watercourse. All locations where these fish species of conservation significance have been found in these

streams are well upstream of locations where impacts from the project are predicted.

Table 13.127 - Potential Ecological Impacts on fish and other aquatic fauna in the absence of mitigation measures

Criteria	Impacts to Fish	Impacts to aquatic fauna
Habitat Quality	Siu Hang San Tsuen Stream (where Predaceous Chub present) is of Moderate ecological value; streams in the Kau Lung Hang Stream Watercourses (where <i>Acrossocheilus parallens</i> and Small Snakehead are present) are of Moderate ecological value and Ma Tso Lung San Tsuen Stream (where Small Snakehead is present) is of Moderate to High value.	Tolerant of pollution and found in streams of varying quality: Ma Tso Lung San Tsuen Stream is of Moderate to High ecological value; Tung Fong and Tin Ping Shan Tsuen Watercourse are of Low ecological value. Sheung Shui Wa Shan Streams and the Ma Wat Wai Watercourses where <i>Somanniathelphusa zanklon</i> was found are all engineered but evaluated as of Low to Moderate ecological value due to the presence of this species.
Species	<i>Acrossocheilus parallens</i> is of Global Concern; Predaceous Chub is of Regional Concern, and Small Snakehead is of Local Concern. Other species are not of conservation significance.	<i>Somanniathelphusa zanklon</i> is listed as Globally Endangered but evidence from this and the LMC Loop Study suggest that this species is fairly widespread in streams in the northern New Territories.
Size/Abundance	Streams where species of conservation significance were found are small; however both the Ma Tso Lung and Kau Lung Hang Stream systems are moderate in size. <i>Acrossocheilus parallens</i> and Predaceous Chub found in large numbers where present; numbers of Small Snakehead are probably small.	Ma Tso Lung Stream system is moderate in size; other streams are small. Single individuals of <i>Somanniathelphusa zanklon</i> at each location except in Ma Tso Lung San Tsuen Stream where several individuals were found and population is likely to be larger.
Duration	Construction phase impacts will be temporary and operational phase impacts will be permanent on the Ma Tso Lung Stream system. No significant impacts are predicted to stream sections occupied by fish species of conservation significance at Siu Hang San Tsuen Stream and streams in the Kau Lung Hang Watercourses.	Tung Fong and Tin Ping San Tsuen Streams will be permanently lost. Construction phase impacts will be temporary and operational phase impacts will be permanent on the Ma Tso Lung Stream system. No impacts of significance are predicted on stream habitat utilised by <i>Somanniathelphusa zanklon</i> at Sheung Shui Wa Shan and Ma Wat Wai Watercourses as all impacts will be downstream of areas which are suitable for this species.

Reversibility	Reversible and remediation measures possible.	Reversible and remediation measures possible at Ma Tso Lung San Tsuen Stream; loss of Tung Fong and Tin Ping San Tsuen Watercourses will be irreversible.
Magnitude	Magnitude on Small Snakehead low as this species is relatively tolerant of sediment load and organic pollution.	Magnitude low to moderate at Tung Fong and Tin Ping San Tsuen Watercourses as these will be lost, however area of suitable habitat for <i>Somanniathelphusa zanklon</i> is small and population of this species appears to be low. Magnitude of indirect impacts on other streams low as this species is tolerant of turbid conditions and organic pollutants.
Overall Impact Severity	Construction phase impact on Small Snakehead at Ma Tso Lung San Tsuen Stream Moderate and Low to Moderate during operational phase, no other significant impacts.	Low at Tung Fong and Tin Ping San Tsuen Streams as number of individuals which may be directly impacted is likely to be small. No impacts of significance are predicted on stream habitat utilised by <i>Somanniathelphusa zanklon</i> at Sheung Shui Wa Shan and Ma Wat Wai Watercourses. Low to Moderate impact at Ma Tso Lung San Tsuen Stream during construction and operational phases, due to potential pollution and hydrological impacts, as population in this stream is very likely larger and of more significance than at the other streams where it may be impacted.

13.7.5 Cumulative Impacts

13.7.5.1 Potential geographical scope of impacts

The Project is entirely within the catchment of the Deep Bay area wetland ecosystem, with which it has direct linkages through the hydrological connection of the Ng Tung River and the Ma Tso Lung Stream via the Shenzhen River. Functional linkages also exist with wetland habitats in the Deep Bay wetland ecosystem for wetland-dependent birds. In addition there are also more localized linkages through the connection of the Ng Tung and the Shenzhen Rivers, through the riparian corridor of the Ma Tso Lung Stream and, perhaps, in the Pak Shek Au area, some of which is within the catchment area of the Eastern Main Drainage Channel for San Tin.

Linkages are also present in respect of terrestrial upland habitats, mainly grassland, to the north and west of the Study Area as far west as Chau Tau, and in grassland, shrubland and plantation/woodland to the east of the Ng Tung River as far north as the HKSAR boundary and as far east as Ping Yuen River. Linkages to the east are much less significant due to the existing developed areas of Fanling.

Linkages to the south are, in general, much less significant as the existing urban area of Sheung Shui, Fanling and the Fanling Highway form a major ecological barrier. The exception to this relates to the extreme southeast of the Study Area, where upland habitats to both the southwest and southeast of Fanling Highway are connected directly with those in upland areas beyond. Linkages for lowland habitats are largely severed by the urban area of Fanling as the riparian corridor is developed; however, the channelised Ma Wat River is directly linked to the ecologically important Kau Lung Hang Streams.

With regard to specific sites of conservation importance outside the Study Area, these are all part of the Deep Bay wetland ecosystem, and are thus covered below in consideration of potential impacts on the latter and its wetland habitats.

13.7.5.2 Significance of Cumulative Impacts

Cumulative impacts are those arising from a development in combination with other developments in the area, and include those that are incremental, synergistic or interactive. The first of these comprises the straightforward, additional marginal impact of further development, while the second involves two impacts for which the whole effect is greater than the sum of its parts. The third involves impacts that arise in other areas, which then have knock-on effects in further areas, or in the original area. Such impacts may or may not reach a new equilibrium depending on the nature of the impacts. In terms of this Project, developments for which the cumulative impacts require to be addressed were detailed in **Section 13.2**.

It is important to note that the existence of other developments in an area means that further developments may impose proportionately greater impacts, as the initial impact already imposes stresses on the ecosystem. For example, should a flight-line have already been impacted by disturbance impacts of a development, the marginal effect of a relatively minor further source of disturbance may be sufficient to cause substantial loss of flight-line function due in large part to the impact of the initial disturbance source.

Cumulative Direct, Indirect Impacts and Fragmentation impacts on Wetland habitats (including the Deep Bay ecosystem) and Fauna

The major residential projects in the Deep Bay area listed in **Section 13.2.3** all have the potential to impact wetland habitats, at least indirectly. These development projects will, however, be guided by the EIAO process and Town Planning Board Planning Guideline No.12B, and direct loss of wetland habitat should not occur. Accordingly, no cumulative impacts of significance are predicted in respect to direct impacts most wetland habitats. The one exception to this is in respect to cumulative loss of seasonally wet grassland arising from the current project and the LMC Loop project at Ma Tso Lung. A loss of 2.86ha of this habitat is predicted under the current project and 0.19ha is predicted to be lost under the LMC Loop project. The significance of the cumulative impact of this loss is evaluated below.

Most indirect impacts of other planned and concurrent projects on wetland habitats are expected to be kept within acceptable levels by the EIA and planning systems and hence cumulative impacts are not predicted to be of significance, especially in view of the geographical distance of most projects, which have the potential to cause indirect impacts on wetland habitats, from the NDA Project Area. This applies, in particular, to disturbance impacts and impacts of hydrological disruption and pollution, most of which are localised to the vicinity of the source of the impact.

However, there are two potential exceptions to this which apply in respect to the current project and the LMC Loop project: the LMC Loop Eastern Connection Road, which is an element of both the current project and the LMC Loop project, which has the potential to result in significant indirect impacts on Ma Tso Lung Stream and ecologically linked riparian wetland habitats and their fauna; and the LMC Loop project as a whole, which has the potential to result in significant hydrological and pollution impacts on the Deep Bay ecosystem - cumulative impacts with the current project may be of significance as both projects are upstream of the ecosystem and are hydrologically linked to it.

In addition, potential cumulative indirect impacts may arise from the current project and the construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung River on Long Valley and the Sheung Yue, Ng Tung and Shek Sheung Rivers.

Potential cumulative indirect impacts may arise from the current project and the Liantang/Heung Yuen Wai Boundary Control Point and Associated Works project on the Ma Wat River and the Kau Lung Hang Stream system.

Lastly, potential cumulative impacts on the Tsung Yuen Watercourse may arise from the current project and the channelization works to this stream proposed to be carried out by Drainage Services Department (DSD).

Fragmentation of linkages between wetland habitats cumulative with the Project is not considered to be of significance in respect to most projects, as the NDAs are at the southeastern limit of the geographical scope of ecological linkages and these projects do not lie between the Project area and the main Deep Bay wetland area. However, the LMC Loop project lies between the NDA Project Area and the main wetland area of Deep Bay, and hence there is the potential for this linkage to be interrupted, either by development within the LMC Loop or to the north of Long Valley.

In this regard, as no significant development north of Long Valley is proposed, the only source of cumulative impact on this linkage appears to be that in relation to birds that fly over the LMC Loop to/from Long Valley. While there are significant linkages for waterbirds between Long Valley and the Deep Bay wetlands, these are primarily to the areas to the east of the LMC Loop and the number of individuals moving between Long Valley and areas to the west of the Loop is unlikely to be large. Although Black-faced Spoonbill is known to be one species which does move between the two areas, the number of individuals visiting Long Valley is small relative to the numbers in Deep Bay and hence any impacts on the Hong Kong wintering population are predicted to be minor.

Cumulative indirect impacts, in particular disturbance to waterbird species of conservation significance, are potentially also of significance should a reduction in numbers occurring in the area of the Project impose greater strain on other parts of the Deep Bay wetland ecosystem. In this respect, disturbance to Long Valley and the Ng Tung, Shek Sheung and Sheung Yue Rivers, which support moderate to large numbers of some of these species in a Deep Bay context, could contribute to cumulative adverse disturbance impacts in the absence of mitigation. Given that the Deep Bay wetland ecosystem is largely undeveloped, as long as effective mitigation for impacts on these large channelised watercourses is put in place by this Project, then cumulative impacts are not predicted to occur elsewhere.

Also of potential cumulative significance is the type of wetland that would be lost. Long Valley is unusual compared to other wetland habitats within the Deep Bay catchment in that it comprises a large contiguous area of managed freshwater wetland habitats, including wet agricultural land, in a complex microhabitat mosaic. As a consequence, while all the species of conservation importance in Long Valley, in particular large waterbirds, are also present and comparatively abundant in Deep Bay wetland habitats, and that the composition of the wetland bird community in Long Valley differs significantly, as the latter is of particular importance for species with a habitat preference for one or more of the freshwater wetland habitats present there. Accordingly, no significant cumulative adverse impacts to these species are anticipated so long as appropriate mitigation measures are in place.

In addition to cumulative fragmentation impacts on linkages for birds between wetland habitats in the Deep Bay ecosystem, cumulative impacts on terrestrial fauna using wetland habitats in the Ma Tso Lung

area may arise from the impacts of the current project and the LMC Loop projects. Such impacts are addressed in the evaluation of cumulative impacts on the Ma Tso Lung Stream and its riparian corridor below.

Cumulative Impacts of the Current Project and the LMC Loop Project on Ma Tso Lung Stream, its riparian corridor and Fauna

Ma Tso Lung Stream and its riparian corridor (including Ma Tso Lung Marsh), support, or potentially support, a number of wetland-dependent or associated species of conservation significance, notably Three-banded Box Terrapin (recorded in its natural upstream/midstream section), and a number of species that have been found in and around the partially channelised downstream section of the stream and its tributaries, and in Ma Tso Lung marsh, just within the northwestern boundary of the Study Area for this project.

However, the section of the Ma Tso Lung Stream and the stream corridor where significant cumulative impacts may occur is not likely to be of major importance to Three-banded Box Terrapin, which favours more wooded riparian areas, but it is possible that it may utilise the area on occasion. Furthermore, the area where significant cumulative impacts are predicted in the absence of mitigation is of importance, or potential importance, for other species of conservation significance. Accordingly, the combined potential adverse cumulative impacts on this area and its fauna from the two projects have the potential to be significant in the absence of mitigation, especially during the construction and operational phases of the road and the construction phase of other elements of the NDAs project.

Potential cumulative impacts on Ma Tso Lung Stream and its corridor are addressed in **Table 13.127a** below.

Table 13.127a – Severity of Cumulative Impacts on Ma Tso Lung Stream and Riparian Habitats in the absence of mitigation measures

Habitat	NDA Project	LMC Loop Project	Cumulative Impact
Ma Tso Lung Stream and tributaries	Disturbance: Low during construction and operation. Run-off and hydrological disruption: Moderate during construction and Low to Moderate during operation. Fragmentation: Moderate during construction and operation.	Disturbance: Low. Run-off: Moderate in lower section during construction and Low to Moderate during operation in lower section. Hydrological disruption: potentially Moderate. Fragmentation: of potential significance for mammals and herpetofauna.	Disturbance: Low during construction and operation. Run-off: Moderate during construction and Low to Moderate during operation as most impacts are partly on different stream sections. Hydrological disruption: Moderate during construction and operation. Fragmentation: Moderate during construction and operation.
Ma Tso Lung Marsh	Disturbance, hydrological disruption and run-off impacts all Low during both construction and operation.	Disturbance, hydrological disruption and run-off impacts all Low during both construction and operation.	Disturbance, hydrological disruption and run-off impacts all Low during both construction and operation.
Seasonally wet grassland	Direct impact: permanent loss of 2.86ha (Low to Moderate). Disturbance, run-off and hydrological disruption: Low to Moderate during construction and Low during operation.	Direct impact: loss of 0.19ha (Low to Moderate). Disturbance, run-off and hydrological disruption: Low during construction and operation.	Direct impact permanent loss of 3.05ha (Low to Moderate as combined area is low). Disturbance, run-off and hydrological disruption: Low to Moderate during construction Low during operation.
Deep Bay Ecosystem	Run-off impacts of Low to Moderate severity during construction and Low during operation. Impacts of most	Combined effect of sedimentation (Low to Moderate) and pollutant run-off (Low to High, depending on nature of event).	Cumulative run-off impacts of Low to Moderate severity during construction and operation. Cumulative impact of pollutant run-off Low to High

Habitat	NDA Project	LMC Loop Project	Cumulative Impact
	<p>pollution events most likely Low to Moderate during construction and Low during operation but dependent on nature and scale of event.</p> <p>Fragmentation impacts on linkages for large waterbirds: Low during construction and not significant during operation.</p>		<p>depending on location of event and type of pollutant.</p> <p>Cumulative fragmentation impacts not of significance as low construction phase impacts on linkage between LMC Loop / Hoo Hok Wai area and Ho Sheung Heung and Long Valley are not cumulative with any fragmentation impacts of the LMC Loop project as different species/birds are involved.</p>
Fauna of conservation significance	<p>Moderate fragmentation impact on fauna using the main stream during construction and operation. Low impact on fauna using the tributaries during construction and operation.</p> <p>Combined impacts on Three-banded Box Terrapin Moderate during construction and operation.</p> <p>Combined impacts on Small Snakehead and <i>Somanniathelphusa zanklon</i> Moderate during construction and Low to Moderate during operation.</p>	<p>Combined impacts on mammals, largely due to fragmentation, Moderate during construction, Low to Moderate during operation.</p> <p>Low to Moderate or Moderate combined impact of fragmentation and habitat loss on herpetofauna during construction; Low to Moderate combined impact of habitat loss and fragmentation on other herpetofauna. Moderate from combined impacts during construction and operational phases on Three-banded Box Terrapin.</p> <p>Combined impacts on Small</p>	<p>Moderate during construction and operation on mammals and herpetofauna, but perhaps Moderate to High on Three-banded Box Terrapin during construction and operation and on Small Snakehead and <i>Somanniathelphusa zanklon</i> during construction</p>

Habitat	NDA Project	LMC Loop Project	Cumulative Impact
		Snakehead and <i>Somanniathelphusa zanklon</i> Moderate during construction and Low to Moderate during operation.	

Cumulative Impacts of the Current Project and the Cycle Tracks and associated supporting facilities from Sha Po Tsuen to Shek Sheung River on Long Valley and the Sheung Yue, Ng Tung and Shek Sheung Rivers and their Fauna

An EIA Report has been approved for the construction of the Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung River project. This project will result in a cycle track being constructed along the west bank of the Sheung Yue River, across the Sheung Yue River (utilising an existing bridge), and along the west bank of the Shek Sheung River. Mitigation measures to address potential impacts of this project, including restrictions on construction phase working during the ardeid (and Greater Painted-snipe) breeding season, and screen planting are included in the Environmental Permit for this project. With the implementation of the recommended mitigation measures, no significant residual impacts are anticipated under the Cycle Track project.

Works under the current project will, therefore, have to be undertaken in such a way that the mitigation measures for the cycle track project are not compromised. In addition, any cumulative increase in disturbance and fragmentation impacts will have to be addressed under the current project. Of most significance in this respect is any increase in disturbance and fragmentation impacts on ardeids breeding at the Ho Sheung Heung Egretty and foraging in Long Valley and on the Sheung Yue River. Other bird species breeding in Long Valley and/or foraging on the Sheung Yue, Shek Sheung and Ng Tung Rivers may also be affected, albeit to a lesser extent.

The Cycle Tracks project is scheduled to be completed well ahead of the commencement of the NDAs project. Accordingly, so long as mitigation measures implemented under the Cycle Tracks project are not impacted by the NDAs project, no significant cumulative impacts are predicted.

Cumulative Impacts of the Current Project and the Liantang/Heung Yuen Wai Boundary Control Point and Associated Works project on the Ma Wat River and Kau Lung Hang Watercourses

Cumulative impacts of hydrological disruption and sedimentation and impacts on stream and riparian fauna could arise during the construction and operational phases of the current project and Liantang/Heung Yuen Wai Boundary Control Point and Associated Works project on the Ma Wat and Kau Lung Hang Watercourses. The ecological value of the sections of these watercourses potentially impacted has been assessed as low in both studies. Ecological impacts of hydrological disruption have been assessed as negligible in the EIA Report for the Liantang/Heung Yuen Wai Boundary Control Point and Associated Works project and as Low to Moderate during construction and Low during operation under the current study. Accordingly, there are no significant cumulative impacts on these channels.

Cumulative Impacts of the Current Project and the DSD Project to Channelise the Tsung Yuen Watercourse

Tsung Yuen Watercourse will not be impacted by the current Project but is scheduled to be channelised by DSD in 2013 to 2016. The section to be channelised is already artificial in that it has been ‘informally’ channelised by residents. There will, therefore, be no cumulative loss of natural watercourses arising from the current Project and the DSD project. Other significant impacts arising from the DSD channelisation works (if identified) will require to be addressed by that project.

Cumulative Impacts on Woodland Habitats

Implementation of the current project will result in a substantial area loss of wooded habitats (93.06ha), albeit much of this comprises roadside plantations of low ecological value (73.43 ha). In addition, however, 8.65ha of hillside plantation of low to moderate ecological value, 10.75ha of mitigation plantation and 0.23ha natural secondary woodland would be lost. Loss of woodland of considerable significance can be mitigated under the Project either by provision of ecological compensation woodland or landscape planting (detailed in Chapter 12). In addition, the consolidation of the proposed ecological compensation woodland into two large blocks will, once sufficient maturity is reached, result in a net ecological benefit as moderately large areas of contiguous secondary woodland are currently absent from the Study Area (see **Section 13.8**).

In terms of cumulative loss in regard to other projects, the LMC Loop Project would lead to very limited woodland loss (1.26ha). This loss will be fully mitigated under the Project via compensatory planting at or near the site of loss.

Loss of woodland arising from other projects in the area is of relatively low magnitude, and is compensated by replacement planting. Loss associated with Construction of Cycle Tracks and associated supporting facilities from Sha Po Tsuen to Shek Sheung River, and at Nam Sang Wai, Yuen Long (Atkins China 2008) comprises a total of 1.15ha of plantation and woodland (0.78ha of which is mitigation plantation along the Sheung Yue and Shek Sheung Rivers). This will also be compensated by replacement planting under relevant projects.

Total loss arising from development of the Liantang/Heung Yuen Wai Boundary Control Point and associated works is 6.2ha, the majority of which is located 170m away from the NDA Project boundary, while woodland compensation comprises 18.6ha (Mott MacDonald 2010). In regard to the Provision of Cremators at Wo Hop Shek Crematorium, total woodland loss is 0.25ha, while compensation constitutes 0.28ha (Hyder 2008). No significant residual impacts are envisaged under these concurrent projects.

In summary, combined woodland loss from the other projects is small and will be fully mitigated. Accordingly, cumulative loss of woodland with other projects is evaluated as acceptable with mitigation.

Cumulative impacts on Upland Grassland and Shrubland

Both upland grassland and shrubland are very common and widespread habitats in the northern New Territories. None of the concurrent and planned projects will have more than a low quantitative and quantitative impact on these habitats individually, and the cumulative loss is likewise small relative to the overall habitat area. Accordingly, cumulative impact on these habitats is not considered to be of significance.

Cumulative impacts on Eurasian Otter

The Hong Kong population of globally-threatened Eurasian Otter is likely to be of regional significance. Although there is only a single observation of Eurasian Otter within the Study Area for the Project (at Sandy Ridge, distant from the development footprint), and no direct, indirect or fragmentation impacts on the species are predicted from the Project on the area where the sighting was made, Eurasian Otter has regularly been recorded at Hoo Hok Wai, and it may occasionally occur in the Ma Tso Lung valley as it has been seen in similar closed wetland habitats of marsh or vegetation-choked watercourse elsewhere in the northern New Territories (Study Team pers. obs.).

Accordingly, cumulative impacts of loss of habitat and disturbance impacts on Eurasian Otter are not predicted, as the additional habitat loss and potential disturbance arising from this Project will be insignificant. Direct mortality as a consequence of Eurasian Otters being killed on any at-grade sections of the Eastern Connection Road within the NDA project area is possible. However, in view of the lack of open water habitats in

the Ma Tso Lung area, both otter abundance and frequency of occurrence are likely to be low; hence the potential impact of direct mortality is predicted to be of low severity.

No significant cumulative impacts on other habitats or other fauna are predicted to arise from the current project and other planned or concurrent projects.

Cumulative impacts on *Sommaniathelphusa zanklon*

Impacts on this species that might be cumulative are relevant only in respect of the LMC Loop Project, under which study the species was recorded. However, the impacts on the species were assessed as of low significance, as they are under this Study. Consequently, it is not predicted that significant cumulative impacts will result.

13.8 Mitigation of Impacts

13.8.1 Summary of Ecological Impacts

In **Section 13.7** potential ecological impacts were presented and categorised as to whether these were impacts to habitats or species. Assessment of potential impacts to habitats took into account which species or species groups were found to be associated with, or dependent on, these habitats. Likewise, assessment of potential impacts to species took into account the habitats in which these species were found and their association with or dependence on these habitats and their connectivities.

In this section, the total impacts of all elements (except cumulative impacts which were addressed in **Section 13.7.5**) are presented (quantitatively where possible), and their severity is assessed in the absence of mitigation.

Table 13.128 - Potential Total Direct, Indirect and Fragmentation and Impacts on Habitats and their severity in the absence of mitigation measures

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
Long Valley	<ul style="list-style-type: none"> No direct impact. 	<ul style="list-style-type: none"> Disturbance of Long Valley habitats (Low Severity during construction and operation). Dust deposition, increased sediment and nutrient load: construction phase Low during construction and operational phase. Hydrological disruption of Long Valley habitats (Low to High during both construction and

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
		<p>operational phases depending on duration and season).</p> <ul style="list-style-type: none"> • Pollution of Long Valley habitats dependent upon type, but most likely Low to Moderate during construction and Low during operation. • Fragmentation impact on Long Valley Low to Moderate during construction and Low during Operation except on some waterbirds in the southwestern part of Long Valley which is closest to proposed development areas where impact severity will remain Low to Moderate. • Combined disturbance and fragmentation impacts Low to Moderate during construction and Low during operation.
Wet Agricultural land	<ul style="list-style-type: none"> • Permanent loss of 0.58ha (Low to Moderate) 	<ul style="list-style-type: none"> • Low during construction/operation.
Dry Agricultural Land	<ul style="list-style-type: none"> • Permanent loss of 9.33ha (Low). 	<ul style="list-style-type: none"> • Low during construction/operation.
Pond	<ul style="list-style-type: none"> • Permanent loss of 3.08ha. Low for small fragmented ponds (0.82ha) and Low to Moderate (0.59ha) and Moderate (0.37ha) for larger ponds and/or with significant ecological linkages. 	<ul style="list-style-type: none"> • Disturbance of pond (Low to Moderate during construction and Low during operation. • Run-off, hydrological disruption and fragmentation (Low during construction and operation. • Combined impacts Low to Moderate during construction and Low during operation.
Marsh at Ma Tso Lung	<ul style="list-style-type: none"> • No direct impact. 	<ul style="list-style-type: none"> • Disturbance (Low during construction and operation). • Run-off and hydrological disruption (Low during construction and operation. • Combined impacts Low during construction and operation.
Mitigation Wetland (other than area in Long Valley)	<ul style="list-style-type: none"> • Loss of 2.75ha (Low to Moderate). 	<ul style="list-style-type: none"> • Disturbance on FLN area A1-7 (Low during construction and operation). • Run-off, hydrological disruption and pollution on FLN area A1-7: Low during construction and not significant during operation. • Fragmentation impacts on FLN area A1-7) Low to Moderate during construction; Low during

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
		operation. • Combined impacts Low to Moderate during construction and Low during operation.
Major Channelised Watercourse	<ul style="list-style-type: none"> • Permanent loss of < 0.02ha (Low severity); construction phase loss due to cofferdam construction also of Low severity as area will be small relative to the size of the rivers. 	<ul style="list-style-type: none"> • Disturbance impacts on Sheung Yue River (3300m): Moderate during construction, Low during operation. • Disturbance impacts on non-tidal Ng Tung River (4000m): Low to Moderate during construction and Low during operation. • Disturbance impacts on tidal Ng Tung River (650m): Low during construction and not significant during operation. • Disturbance impacts on Shek Sheung River (2300m): Low during construction and not significant operation. • Fragmentation impact between non-tidal Ng Tung River and Long Valley Low to Moderate during construction and Low during operation; Low on tidal section during construction but not significant during operation; fragmentation impacts on other rivers not of significance. • Hydrological impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers (Low severity); • Run-off and pollution impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers (Low during construction and operation for most events but certain construction stage pollution events could be of Moderate severity). • Combined impacts on Sheung Yue River Moderate during construction and Low to Moderate during operation. • Combined impacts on tidal section of the Ng Tung River Low during construction and not significant during operation. • Combined impacts on non-tidal Ng Tung River Low to Moderate during construction and Low during operation. • Combined impacts on Shek Sheung River Low during construction and operation and

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
		not significant during operation.
Ma Tso Lung Stream and tributaries and riparian corridor (including fragmentation impacts on marsh and seasonally wet grassland)	<ul style="list-style-type: none"> • Diversion of 130m of Ma Tso Lung Stream in its lower reaches (Moderate) and 120m of tributaries in their upper reaches (Low). 	<ul style="list-style-type: none"> • Disturbance impacts on Ma Tso Lung Stream: Low during construction and operation. • Run-off and hydrological impacts on Ma Tso Lung Stream Moderate during construction and Low to Moderate during operation. • Fragmentation impact on Ma Tso Lung Stream and riparian corridor (Moderate during construction and operation). • Low fragmentation impact for minor upper tributaries. • Combined impacts Moderate during construction and operation.
Pak Shek Au Watercourse	<ul style="list-style-type: none"> • Re-channelisation (Low). 	<ul style="list-style-type: none"> • No significant indirect impacts.
Tung Fong/Shek Tsai Ling Watercourse & Kwu Tung Watercourse	<ul style="list-style-type: none"> • Re-channelisation (Low). 	<ul style="list-style-type: none"> • No significant indirect impacts.
Fung Kong & Ho Sheung Heung Watercourses	<ul style="list-style-type: none"> • Re-channelisation (Low). 	<ul style="list-style-type: none"> • No significant indirect impacts.
Long Valley Watercourse	<ul style="list-style-type: none"> • Re-channelisation (Low). 	<ul style="list-style-type: none"> • Run-off and hydrological impacts on Long Valley: most likely Low during construction and operation but could be Moderate if hydrological disruption is prolonged and during the dry season.
Cheung Po Tau & Fu Tei Au Watercourse	<ul style="list-style-type: none"> • Re-channelisation (Low). 	<ul style="list-style-type: none"> • No significant indirect impacts.
Sheung Shui Wa Shan Watercourses	<ul style="list-style-type: none"> • Re-channelisation of approx. 80m length of both watercourses (lowest reaches) (Low). 	<ul style="list-style-type: none"> • No significant indirect impacts.
Siu Hang San Tsuen Watercourse	<ul style="list-style-type: none"> • Re-channelisation of approx. 180m length of lowest reaches (Low). 	<ul style="list-style-type: none"> • Disturbance impacts not significant during construction and operation). • Run-off and hydrological impacts (Low during construction). • Combined impacts Low to Moderate during construction and Low during operation.
Man Kok Village, Tin Ping Shan Tsuen, Shek Wu San Tsuen & Ma Shi Po Watercourses	<ul style="list-style-type: none"> • Re-channelisation (Low). 	<ul style="list-style-type: none"> • No significant indirect impacts.

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
Ma Wat River	<ul style="list-style-type: none"> Re-channelisation of approx. 700m of lower stream course (Low). 	<ul style="list-style-type: none"> Disturbance impacts on approx. 3000m of channelised stream course (Low during construction and operation). Run-off and hydrological impacts on channelised stream course (Low to Moderate during construction and Low during operation). Combined impacts Low to Moderate during construction and Low during operation.
San Uk Tsuen, Ma Wat Wai & Tong Hang Watercourses	<ul style="list-style-type: none"> No direct impact. 	<ul style="list-style-type: none"> Disturbance impacts on approx. 100m of Tong Hang Watercourse during construction of Fanling Bypass (Low). No significant impacts on other watercourses.
Kau Lung Hang Watercourses	<ul style="list-style-type: none"> No direct impact. 	<ul style="list-style-type: none"> Disturbance impacts on approx. 50m during construction of Fanling Bypass (Low).
Upland Grassland	<ul style="list-style-type: none"> Loss of 6.95ha (Low). 	<ul style="list-style-type: none"> Disturbance (Low during construction and operation).
Lowland Grassland	<ul style="list-style-type: none"> Loss of 53.21ha (Low). 	<ul style="list-style-type: none"> Disturbance during construction and operation (Low).
Seasonally Wet Grassland	<ul style="list-style-type: none"> Loss of 2.86ha near lower stream reaches of Ma Tso Lung Stream (Low to Moderate) and elsewhere 1.21ha (Low). 	<ul style="list-style-type: none"> Disturbance, run-off and hydrological disruption impacts on seasonally wet grassland at Ma Tso Lung (Low to Moderate during construction and Low during operation).
Grassland/Shrubland	<ul style="list-style-type: none"> Loss of 1.63ha (Low). 	<ul style="list-style-type: none"> Disturbance during construction and operation (Low).
Shrubland	<ul style="list-style-type: none"> Loss of 1.11ha (Low). 	<ul style="list-style-type: none"> Disturbance impacts on shrubland at Crest Hill (most likely Low but Low to Moderate during construction in the unlikely event that a Eurasian Hobby nest site is within or close to the works area for KTN area G1-5 and Low during operation); Low during construction and operation elsewhere.
Ho Sheung Heung <i>Fung Shui</i> Woodland & Secondary Woodland	<ul style="list-style-type: none"> Loss of 0.23ha of secondary woodland (Low to Moderate). 	<ul style="list-style-type: none"> Disturbance of <i>fung shui</i> and secondary woodland (Low to Moderate, mainly on mammals, during construction and Low during operation). Dust deposition on vegetation during construction (Low). Fragmentation impact on woodland (Low during construction and operation). Combined impacts (Low to

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
		Moderate during construction and Low during operation).
Secondary Woodland west of Siu Hang San Tsuen	<ul style="list-style-type: none"> No direct impact. 	<ul style="list-style-type: none"> Disturbance (Low during construction and operation). Dust deposition on vegetation (Low during construction and operation). Combined impacts (Low during construction and operation).
Other Secondary Woodland	<ul style="list-style-type: none"> No direct impact. 	<ul style="list-style-type: none"> Disturbance and dust deposition during construction, and disturbance during operation (Low).
Hillside Plantation	<ul style="list-style-type: none"> Loss of 8.65ha (Low). 	<ul style="list-style-type: none"> Disturbance during construction and operation (Low to Moderate). Fragmentation impacts on hillside plantation during construction and operation (Low). Combined impacts on hillside plantation Low to Moderate during construction and operation.
Roadside and Urban Plantation	<ul style="list-style-type: none"> Loss of 73.43ha Low. (Loss of 0.27ha of plantation supporting Man Kam To Egretty is addressed under 'Egrettries and Egretty flight-lines' below, Low to Moderate due its functional value as egretty site) 	<ul style="list-style-type: none"> Disturbance during construction and operation (Low).
Mitigation Plantation	<ul style="list-style-type: none"> Loss of 10.75ha (Low). 	<ul style="list-style-type: none"> Disturbance impacts on mitigation plantation (Low). Fragmentation impacts on mitigation plantation (Low). Combined impacts Low to Moderate during construction and operation.
Orchard	<ul style="list-style-type: none"> Loss of 7.38ha (Low). 	<ul style="list-style-type: none"> Disturbance impacts on orchard (Low).
Golf Course	<ul style="list-style-type: none"> No direct impact 	<ul style="list-style-type: none"> None.
Village, Urban/Residential Areas & Waste Ground	<ul style="list-style-type: none"> Habitat is of low ecological value (Low). 	<ul style="list-style-type: none"> Disturbance impacts on developed areas will not increase significantly.
Deep Bay Wetland Ecosystem	No direct impacts.	<ul style="list-style-type: none"> Run-off and pollution impacts on Deep Bay ecosystem likely to be Low to Moderate severity during construction and Low in operation phase. Although impact of pollution events on Deep Bay ecosystem

Habitat	Direct Impacts	Indirect and Fragmentation Impacts
		<p>are dependent on nature and scale, there is the potential for High severity; however, most events likely to be of Low to Moderate severity during construction and Low severity during operation.</p> <ul style="list-style-type: none"> • Combined impacts Low to High, depending on nature and scale.

Table 13.129 - Potential Total Direct, Indirect and Fragmentation Impacts of the Project on Species Groups and Species, and their severity in the absence of Mitigation Measures

Note: in the table below the severity of impacts are presented hierarchically and inclusively, but repetition has been avoided for the purposes of clarity. For example, the severity of combined impacts on Three-banded Box Terrapin is predicted to be Moderate: the severity of this combined impact has been predicted by combining the severities of relevant impacts on all fauna, herpetofauna, reptiles and this species.

Sensitive Receiver	Severity of Impact
All flora and fauna	<ul style="list-style-type: none"> • Direct and indirect loss of habitats in the Project Area as a whole of Low Severity.
Flora of conservation significance	<ul style="list-style-type: none"> • Construction phase impacts at Ho Sheung Heung <i>fung shui</i> and secondary woodland: dust deposition of Low Severity, damage or death of species of conservation significance and protected species of Low to Moderate Severity.
Mammals	<ul style="list-style-type: none"> • Mortality impacts: Low in the Project Area as a whole but Low to Moderate in Ma Tso Lung area..
Bat Roosts	<ul style="list-style-type: none"> • Roost destruction during site clearance works: Low.
Birds	<ul style="list-style-type: none"> • Mortality impacts on breeding birds during site clearance works: generally Low, but Moderate if an egretty site was to be cleared during the breeding season. • Mortality impacts arising from collision: Low, largely smaller birds. • Increase in lighting and glare: probably Low for most species but may be Low to Moderate on migrating birds from the commercial/business district in KTN on migrating birds. • Combined impacts: Low (except as noted above).
Wetland-dependent bird species	<ul style="list-style-type: none"> • Direct loss of wetland habitats: Low. • Indirect loss of wetland habitats: Low to Moderate on bird species using Sheung Yue River, but Moderate on Little Egret and Chinese Pond Heron; Low to Moderate on bird species using Long Valley and the non-tidal Ng Tung River, but Low elsewhere during construction phase, Low on birds using Sheung Yue and non-tidal Ng Tung Rivers, but not significant elsewhere during operational phase. • Fragmentation impact: impact on linkage between Long

Sensitive Receiver	Severity of Impact
	<p>Valley and non-tidal Ng Tung River Low to Moderate during construction and operation; impact on linkage between Long Valley and the Deep Bay wetland ecosystem along the non-tidal Ng Tung River of Low severity during construction and not significant during operation; no other significant fragmentation impacts.</p> <ul style="list-style-type: none"> Combined impacts: Low overall, but Low to Moderate for freshwater wetland/wet agricultural land habitat-specialist species and species using Sheung Yue River in significant numbers).
Non wetland-dependent bird species	<ul style="list-style-type: none"> Direct loss of habitats: Low. Indirect loss of habitats: Low. Fragmentation impact: Low. Combined impacts: Low.
Bird species utilising dry agricultural land and woodland	<ul style="list-style-type: none"> Direct loss of habitats: Low. Indirect loss of habitats: Low. Fragmentation impact: Low. Combined impacts: Low.
Eurasian Hobby	<ul style="list-style-type: none"> Combined impacts: Low to Moderate depending on proximity of any nest site in Crest Hill area to works areas.
Grey Nightjar	<ul style="list-style-type: none"> Combined impacts: Low to Moderate depending on proximity of any nest site area to works areas.
Egrettries and Egretty Flight-lines	<ul style="list-style-type: none"> Direct loss of Man Kam To Road Egretty: Low to Moderate. Disturbance impacts on Ho Sheung Heung Egretty: Low. Disturbance and fragmentation impacts on Man Kam To Road Egretty and flight-lines: Low to Moderate prior to clearance of egretty site then not relevant. Disturbance and fragmentation impacts on flight-lines between Ho Sheung Heung Egretty and foraging areas: Low to Moderate during construction phase and Low during operational phase. Combined impact on egrettries: Moderate during construction and Low during operation.
Herpetofauna	<ul style="list-style-type: none"> Mortality impacts: Low to Moderate in Ma Tso Lung area and Moderate to High for Three-banded Box Terrapin; Low elsewhere.
Reptile species	<ul style="list-style-type: none"> Direct loss of habitats: Low. Indirect loss of habitats: Low. Fragmentation impact: Low. Combined impacts: Low.
Three-banded Box Terrapin	<ul style="list-style-type: none"> Combined impacts: Moderate.
Amphibian species	<ul style="list-style-type: none"> Combined impacts: Low.
Chinese Bullfrog	<ul style="list-style-type: none"> Combined impacts: Low to Moderate.
Butterflies	<ul style="list-style-type: none"> Combined impacts: Low.
Dragonflies	<ul style="list-style-type: none"> Combined impacts: Low.
Fish	<ul style="list-style-type: none"> Combined impacts: Low.

Sensitive Receiver	Severity of Impact
Small Snakehead	<ul style="list-style-type: none"> Combined impacts: Moderate during construction phase and Low to Moderate during operational phase of Ma Tso Lung Stream diversion works, Lok Ma Chau Eastern Connection Road and other developments in the Ma Tso Lung area; otherwise Low.
<i>Somanniathelphusa zanklon</i>	<ul style="list-style-type: none"> Combined impacts: Moderate and Low to Moderate during construction and operational phases of Ma Tso Lung Stream diversion works, Lok Ma Chau Eastern Connection Road and other developments in the Ma Tso Lung area; otherwise Low.

13.8.2 Proposed Mitigation Measures

Mitigation measures to avoid, minimise or compensate for the potential significant ecological impacts identified in **Tables 13.128 – 13.129** are detailed below. As stated in the EIAO-TM, proposed mitigation should give priority to avoidance of impacts. For the NDA project, avoidance of impacts was followed wherever possible during the study process. Alternatives that were considered and addressed during the study process in accordance with Section 3.4.14.4(x) of the Study Brief are described in **Section 13.1.4**. The principal planning and design alternatives adopted are summarized below, together with the outcomes of this consideration and assessment.

Alternatives to safeguard the conservation value of Long Valley: it is proposed to designate the area of highest ecological value (37.17ha), the largely wetland area south and east of the Sheung Yue River and south and west of the Shek Sheung River, as Other Uses (OU) Nature Park (area C1-9 in KTN) and retain the agricultural (AGR) zonings of the area west and north of the Ng Tung and Sheung Yue Rivers and east of Ho Sheung Heung (C2-2), and the area south and east of area C1-9 and east of Yin Kong (C1-6) (**Section 13.1.4.1**);

Alternatives to avoid potential impacts of the Kwu Tung Interchange on Long Valley: it is proposed to locate the new grade-separated interchange, proposed as the major access from the Fanling Highway to the KTN NDA at about 400m east of the Sheung Yue River, thus avoiding Long Valley (**Section 2.5.1.2 and 13.1.4.2**)

Alternatives to avoid potential impacts of the Fanling Bypass on habitats of ecological significance: it is proposed that the western terminus of the Fanling Bypass will be at the point where it meets Man Kam To Road in FLN, and the road network of KTN and FLN will be designed and constructed in such a way that a bypass west of this point is not required, and hence has avoided habitats of ecological significance including Long Valley and Ho Sheung Heung *fung shui* wood (**Section 13.1.4.3**);

Alternatives to avoid, minimise and compensate for potential impacts to Man Kam To Road Egret: alternative alignments for the Fanling Bypass and its interchange with Man Kam To Road were

considered but were found to be impractical due to engineering constraints and requirements (**Sections 2.5.2.9 and 13.1.4.4**). Mitigation measures to compensate for this loss are therefore proposed;

Alternatives to avoid, minimise and compensate for potential impacts to the Ma Tso Lung Stream and marsh, its riparian corridor and fauna of conservation significance: avoidance of all significant impacts proved impractical due to engineering constraints and requirements (**Sections 2.4.1.8 and 13.1.4.5**). Mitigation measures to minimise and compensate for unavoidable impacts are therefore proposed.

Alternatives to avoid, minimise and compensate for potential impacts to the main river channels: the main river channels are almost entirely avoided in terms of habitat loss, the only direct impact constituting a loss of less than 0.02ha for bridge piers; areas adjacent to the river channels have been largely avoided by development, especially the tidal section of the Ng Tung River, which is bordered by Long Valley Nature Park or Open Space zoning. With regard to non-tidal sections of the Ng Tung River, Open Space zones occur along the channel.

Figure 13.12 shows the areas where the revised RODP has avoided impacts on habitats and species of conservation significance through avoidance, either by exclusion from the NDA boundaries or by zoning that would afford protection from development (Other Uses (Nature Park), Conservation Area, Green Belt and Agriculture).

Where avoidance is not possible, the EIAO-TM states that it is preferable to mitigate for impacts ‘on-site’ wherever possible. As discussed in **Section 13.1.4.7**, alternatives for the identification of mitigation sites were considered, and it was resolved that in many cases *in situ* compensation at the exact site where the identified impact has been predicted was not appropriate, both because of the large scale of the development areas involved and because this would result in compensation areas being ecologically fragmented and of limited ecological value. In these cases the consolidation of mitigation measures at locations elsewhere within the Project Area was chosen as the most practical, feasible and effective alternative.

13.8.2.1 Mitigation for Direct Loss of Habitats of Ecological Importance

Direct loss of habitat of ecological significance (i.e. habitat areas identified as being of at least low to moderate ecological value) for which compensation for direct habitat loss is required is detailed in **Table 13.130** below. Mitigation for permanent loss of a very small area (<0.02ha of main channelised river and temporary construction stage loss of a small area of this habitat is addressed along with mitigation for disturbance and fragmentation impacts on this habitat

Table 13.130 - Direct Habitat loss arising from the Project requiring mitigation measures.

Habitat	Area (ha)
Wet Agricultural Land	0.58
Pond	2.49
Mitigation Wetland	2.75
Seasonally wet grassland at Ma Tso Lung	2.86
Main River Channel	<0.02
Total Wetland Loss requiring mitigation	8.70
Secondary Woodland	0.23
Hillside Plantation	8.65
Total Woodland Loss requiring mitigation	8.88

Mitigation for loss of wetland habitats (wet agricultural land, pond and mitigation wetland)

A total of 5.82ha of wet agricultural land, pond and mitigation wetland, (0.58ha of wet agricultural land and 2.12ha of ponds of Low to Moderate ecological value, 0.37ha of ponds of Moderate ecological value and 2.75ha of mitigation wetland of Low to Moderate ecological value) of ecological significance will be directly impacted by the Project. As is discussed in **Section 13.1.4.6**, an outcome of the review of alternatives for compensation of habitat loss arising from the Project was the decision to consolidate compensatory wetland habitat provision in LVNP.

The area of Long Valley proposed to be zoned as LVNP and shown in **Figure 13.13** has been assessed as of High to Very High ecological value; however, it has been demonstrated from monitoring of bird diversity and distribution undertaken under the previous and current MAs that management with nature conservation objectives has the potential to increase both numbers and diversity of fauna (**Table 13.131 and Appendix 13.10**).

Table 13.131 - Ratios of bird numbers in managed to unmanaged fields in the Long Valley and Ho Sheung Heung Priority Site, 2007 to 2011. (Source: Hong Kong Bird Watching Society³)

Year	Spring	Summer	Autumn	Winter*
2007	0.7	1.6	0.9	1.5
2008	2.3	5.6	3.8	3.3
2009	1.9	2.3	3.6	2.4
2010	2.10	1.3	2.1	2.9
2011	1.8	1.5	2.4	2.2
Mean	1.7	2.5	2.6	2.5

*Note that seasons are as follows: Spring (March to May), Summer (June to August), Autumn (September to November) and Winter (December to January) Thus Winter 2007 in the table refers to the period from December 2007 to February 2008.

At the present time MAs in Long Valley are voluntary and do not cover the whole of Long Valley; the managed area within the boundary of the proposed LVNP is approximately 10ha. There is, therefore, considerable scope to increase the extent of the managed area, approximately 70% currently not being under conservation management.

In addition, however, studies undertaken by CA and HKBWS have shown that of the different cultivation treatments adopted, less intensively managed wet agricultural land and shallow ponds have higher species richness than other habitats. Survey findings have also shown that, at least in shallow pond habitat, the attractiveness of such habitat to birds begins to decline after about four years; thus rotation of habitats is an important ongoing element of conservation management (see **Appendix 13.10**).

Accordingly, long-term and strategic management (i.e. provision of specific wetland types, periodic habitat changes and adoption of crop rotation) will be required to maintain and enhance the wetland function. These management issues are discussed further in the Preliminary Management Plan for the LVNP (**Appendix 13.10**).

Designation of the LVNP will offer an appropriate location for measures to mitigate for wetland loss and will secure the long term future of this important area. In the Hong Kong context, this achieves a valuable conservation objective, and allows the management of Hong Kong's largest continuous and contiguous area of freshwater wetland habitats for the purposes of nature conservation. While the MAs grant considerable conservation/ecological benefits, the opportunity to manage the entire 37ha to the south of the Sheung Yue and Shek Sheung Rivers for nature conservation will considerably add to the achievable enhancements of ecological function. This benefits both flora and fauna, and particularly those wetland-dependent species which distinguish Long Valley from

³ <http://www.hkbws.org.hk/BBS/viewthread.php?tid=12044&extra=page%3D1>

other Hong Kong areas managed for nature conservation.

The boundary of the LVNP corresponds to area defined in **Section 13.6.1.1** of this report as Long Valley south and east of the Sheung Yue River and includes all areas of more or less continuous and contiguous wetland in this location. Except for the plantations around the periphery, all of this area is currently wetland or is topographically similar (hence could easily be flooded) but is currently occupied by dryland habitats.

Mitigation for loss of seasonally wet grassland at Ma Tso Lung

An area of 2.86ha of seasonally wet grassland adjoining the lower reaches of Ma Tso Lung Stream will be lost as a consequence of the Project. Mitigation for loss of this area will be incorporated in the habitat restoration measures proposed for the Ma Tso Lung Stream corridor, which will be required following diversion of the stream to permit construction of the LMC Loop Eastern Connection Road (see below).

Mitigation for loss of woodland habitats

It is proposed that loss of woodland and hillside plantation of considerably value be compensated by planting of native tree and shrub species. In accordance with the principles adopted for mitigation habitat provision described in **Section 13.1.4.7**, suitable locations to consolidate compensatory habitat provision were identified within the Project Area boundary. Consideration was also given to the locations of habitat loss (largely in KTN). Based on these principles, areas currently of low habitat value on hillside (grassland and grassland/shrubland) were reviewed and suitable sites identified (see **Figure 13.14** and plates in **Appendix 13.11**). In accordance with this principle, appropriate locations (currently upland grassland of low ecological value) as shown on **Figure 13.14** and areas are detailed in **Table 13.132**.

Table 13.132 – Proposed Areas for Compensatory Planting in NDAs (Site Locations for the revised RODP)

Site Location	KTN (ha)
E1-8	7.75
G1-3 (south)	3.28
G1-3 (north)	5.00
Total	16.03

The area of 16.03ha allocated for compensatory woodland planting is almost twice the area to be lost. In part, this extra provision allows for the fact that it will take some time for the compensatory planting to achieve the ecological function and value of the area to be lost. In addition, it allows for the fact that not all of the areas identified for planting will prove

to be suitable, by virtue of topography and ground conditions, or other site constraints such as poor soil conditions. In addition, localised areas within the proposed planting areas already show evidence of natural regeneration, and it would clearly be inappropriate to damage such areas by cultivation.

Although areas where fires have occurred in the past, including existing permitted burial grounds, were avoided when identifying the compensation areas, fire control measures shall be incorporated in the woodland management plan. There are many examples around Hong Kong to demonstrate that so long as active management is undertaken, fire risk can be reduced considerably. Within the Study Area the successful establishment of plantation around Wo Hop Shek, which now supports woodland dependent amphibian species of conservation significance, provides an example of the feasibility and benefits of woodland restoration; adequate resources for management and maintenance are, however, an essential prerequisite.

Species proposed for planting are pioneer native tree and shrub species often present in natural woodlands in Hong Kong, including a number of shrub species known to be of value in providing fruit for native fauna, in particular birds. Details of the compensatory planting plan including the planting materials would be formulated during the detailed design stage and included in the Woodland Planting and Management Plan (**Section 13.9.3**).

Table 13.133 – Native Tree and Shrub Species for Compensatory Planting Areas

Trees	Shrubs
<i>Ailanthus fordii</i>	<i>Diospyros vaccinioides</i>
<i>Bischofia javanica</i>	<i>Gardenia jasminoides</i>
<i>Castanopsis fissa</i>	<i>Ixora chinensis</i>
<i>Celtis sinensis</i>	<i>Ligustrum sinense</i>
<i>Cinnamomum burmannii</i>	<i>Litsea rotundifolia</i>
<i>Cinnamomum camphora</i>	<i>Melastoma malabathricum</i>
<i>Xanthoxylum avicennae</i>	<i>Melastoma dodecandrum</i>
<i>Liquidambar formosana</i>	<i>Atalantia buxifolia</i>
<i>Sapium discolor</i>	<i>Rhodomyrtus tomentosa</i>
<i>Schefflera heptaphylla</i>	<i>Rhaphiolepis indica</i>
<i>Ilex rotunda</i>	<i>Rhododendron simsii</i>

In addition, it is recommended that the layout and development footprint of KTN area D1-11a should be reviewed at the detailed design stage in order to avoid or minimise loss of secondary woodland arising from the development of this area.

Mitigation for loss of mitigation plantation

This habitat largely comprises strips along the main river channels and is dominated by exotic species, though some native species are present. It has limited intrinsic ecological value for fauna; however, certain areas have a role in buffering areas of ecological importance (the river channels and habitats around Long Valley) from disturbance, and hence has been assessed as of Moderate ecological value. Mitigation for loss of this habitat serving as screen planting along the main river channels is, therefore, addressed in the following sections.

13.8.2.2 Mitigation for Indirect Impacts on Habitats of Ecological Importance

In addition to direct habitat loss, indirect impacts to habitats will occur as a consequence of the Project. Habitat or site-specific mitigation requirements to avoid or minimise disturbance to habitats are proposed below.

Measures to avoid or minimise disturbance and hydrological impacts on Long Valley and on fauna of conservation significance, in particular disturbance-sensitive bird species of conservation significance

The ecological function of parts of Long Valley may be affected by the development which is proposed to the southwest of Long Valley and on, and alongside, the main river channels, especially in areas abutting the Sheung Yue River (**Section 13.7.3.3** and **Figure 13.11a**). It is predicted that the numbers of the more disturbance-sensitive bird species utilising this part of Long Valley will be reduced in the absence of mitigation measures, as these species might avoid this area in response to visual and aural disturbance. The species most sensitive to such disturbance are large waterbird species, of which the most sensitive regularly occurring in Long Valley are Grey Heron and Great Egret. However, the species for which disturbance impacts are potentially most significant are species for which Long Valley supports a significant proportion of the Hong Kong population (in particular Greater Painted-snipe, albeit this species is not particularly disturbance-sensitive) and/or breeding species for which Long Valley is an important breeding site or foraging area (again including Greater Painted-snipe, but also Little Egrets, Cattle Egrets and Chinese Pond Herons breeding at the Ho Sheung Heung Egretty and, in the case of Little Egrets and Chinese Pond Herons, the Man Kam To Road Egretty).

In addition, these species, and ardeids using the flight-line between Ho Sheung Heung Egretty and Long Valley, would potentially be disturbed by construction phase works in Open Space areas along Sheung Yue River (i.e. C2-1 in KTN). Such disturbance, although not of significant magnitude in view of the minor scale of works in the Open Space areas, will be greatest during the construction phase of the project, and will continue at a lower magnitude during the operational phase. Other birds and most other fauna will not be affected significantly, but there may be some disturbance impact on mammals, again as a consequence of their avoiding areas where construction is underway and human activity is higher than at present as a consequence of the project.

Possible measures to minimise construction phase impacts were considered, and the following were feasible and effective. Accordingly, it is recommended to minimise construction phase disturbance impacts by erection of noise/visual barriers along the frontage of any development zone abutting or within line of sight at ground level of Long Valley and only carry out works in KTN area C2-1 during 1st August to 28th/29th February, outside the ardeid and Greater Painted-snipe breeding seasons. Disturbance impacts on these and other species outside the breeding season are considered to be of lower significance as non-breeding birds have a greater ability to change their foraging areas in response to disturbance. Further, in respect to ardeids, all species occurring in Long Valley also occur in the Deep Bay area in larger numbers, hence impacts on the wintering populations in Long Valley are of lower significance at a Hong Kong level than impacts on the breeding population, for which Ho Sheung Heung Egretty is of significance at a Hong Kong level.

In order to minimise construction and operational phase impacts, it is recommended that development above ground level in area B3-12 (Commercial, Research and Development) adjoining Long Valley Nature Park (LVNP) should be set back 30m from the LVNP boundary. Similarly, it is recommended that a bund should be formed along the northern and northeastern boundaries of KTN area C1-1 (Open Space) and planted with trees and that any structures should be set back 15m from these boundaries.

In addition, it is recommended that the working hours for construction of the new pedestrian bridge over the Sheung Yue River south of KTN area D1-1 should be restricted to 09.00 to 17.30 during 1st March to 31st July (the ardeid breeding season).

In addition, as soon as is practical and before any works other than those required under the advance works phase (which are relatively minor, as noted below), visitor numbers in LVNP should be controlled by fencing the site and managing visitor numbers and access prior to the commencement of any construction activities which may result in disturbance impacts on Long Valley and the main river channels (see **Appendix 13.10**).

Further, as an element of the adaptive management of Long Valley (see **Appendix 13.10**) it is recommended to give consideration to redistribution of habitats in Long Valley by increasing the area of open water habitat suitable for foraging ardeids in those parts of Long Valley which will be less disturbed by construction and other human activity and increasing the area of closed habitats (such as marsh and reed marsh) which would be suitable for less disturbance-sensitive birds and other fauna in the more disturbed areas.

Although relatively minor in scale, the Advance Works Phase of the project will result in some disturbance impacts on large waterbirds foraging in Long Valley before its full operation (see **Figure 13.11a**). It is recommended to stock suitable areas of Long Valley during the advanced works phase with fish fry and or 'trash fish' (unwanted by-catch of fish of low commercial value) to provide additional food for ardeids and other piscivorous species as an advanced mitigation measure. Depending upon the progress of land resumption for the Project, the mitigation meanders within Long Valley and ponds along river channels on government land and other suitable areas could be used as stocking locations in the event that other areas were not yet available for this purpose. Details of the above would be further formulated and implemented before commencement of Advanced Works Phase. It is recommended to minimise operational phase impacts to LVNP by erecting a solid noise/visual barrier along the interface between LVNP and adjacent areas on the southeast side of the Sheung Yue River. In addition, the detailed Habitat Creation and Management Plan (HCMP) for LVNP will examine the need for additional buffer planting along the fringes of the LVNP, taking into account the need to avoid loss of wetland area.

In order to mitigate for cumulative impacts of this project and the Construction of Cycle Tracks and the Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung River and at Nam Sang Wai, Yuen Long project on Long Valley, it is recommended that screen planting areas implemented as mitigation measures for landscape impacts of the cycle track project should be preserved as far as practicable. Should unavoidable felling of the screen planting under the current Project be identified at the detailed design stage, measures to mitigate for any impacts of such interference should be formulated and incorporated in the design and implementation of the relevant NDA project elements.

In order to minimise constructional and operational phase impacts on fauna in the area of Long Valley north and west of the Sheung Yue River; this area (KTN area C2-2) will retain its agricultural zoning. The area south and east of Long Valley and east of Yin Kong (KTN area C1-6) will also retain its agricultural zoning. In order to minimise disturbance impacts on these areas, and fragmentation impacts on the flight-line between Ho Sheung Heung Egretty and Long Valley and the Sheung Yue River and the flight-line between Long Valley and Hoo Hok Wai and the Deep Bay wetland ecosystem along the Ng Tung River, it is

recommended that more stringent planning control be exercised in this area and that this intention should be clearly stated in the Explanatory Statement of the relevant Layout Plan.

The Long Valley Watercourse will be rechannelised under the Project as far north as the northeastern corner of KTN area C1-4. Since this watercourse is one of the principal sources of water for Long Valley, it is recommended that construction and operational phase hydrological impacts are avoided by ensuring that there is no reduction in the quality and quantity of water supplied to Long Valley during the construction period for the rechannelisation works. Accordingly, it is recommended that the detailed design for the rechannelisation works should incorporate measures to ensure and monitor the continuity of the water supply to Long Valley, in particular for the duration of the rechannelisation works. In addition, the HCMP for the LVNP should incorporate a contingency plan to prepare for any unexpected or planned hydrological disruption to the water supply to the LVNP. The preparation of this contingency plan should include a review of options available to secure an alternative water source and if such a source is found to be feasible, the measures required to secure such a source should be detailed and implemented if appropriate.

Measures to minimise disturbance and fragmentation impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers, and to minimise fragmentation impacts on ecological linkages with the Deep Bay wetland ecosystem

A number of wetland-dependent bird species of conservation importance forage in the Sheung Yue, Shek Sheung and Ng Tung Rivers (**Section 13.6.1.6**). The Sheung Yue River, in particular, is an important foraging area for these species and is regularly utilised by ardeids (especially Little Egrets) breeding at Ho Sheung Heung Egrettry. The tidal Ng Tung River is also a flight-line corridor between Long Valley and Ho Sheung Heung Egrettries and the Deep Bay wetland ecosystem, while the non-tidal section of the river provides a flight-line linkage between the Man Kam To Road Egrettry and Long Valley and elsewhere.

While these rivers are currently somewhat disturbed by users of their access roads, a significant increase in disturbance impacts on larger waterbirds foraging in these rivers and on fragmentation impacts on larger waterbirds using the flight-line corridors is predicted in the absence of mitigation, especially during the construction phase of the Project (**Figure 13.11a**). As is the case with regard to impacts on large waterbirds using Long Valley, it is considered that impacts on foraging ardeids breeding at the Ho Sheung Heung Egrettry (and to a lesser extent, due to the much smaller numbers involved) the Man Kam To Road Egrettry, are of relative significance. Impacts on other species, and on species outside the breeding season, are of lower significance as these species occur in lower numbers and/or are not present during the breeding season. Accordingly, the birds which may be displaced elsewhere are likely to be less dependent on the rivers and the foraging opportunities which they provide.

After consideration of those that are both practical and effective, it is recommended that the mitigation measures described below are implemented in order to avoid, minimise and mitigate for construction phase impacts on larger waterbirds foraging in the Sheung Yue, Shek Sheung and Ng Tung River and using the flight-line along the Ng Tung River towards Hoo Hok Wai and Deep Bay.

It is recommended that noise/visual barriers be erected and maintained throughout the construction period along the boundaries of all works areas adjacent to these rivers (**Figure 13.15**).

It is recommended that the working hours for construction of the new pedestrian bridge over the Sheung Yue River south of KTN area D1-1 should be restricted to 09.00 to 17.30 during 1st March to 31st July (the ardeid breeding season). A temporary halt of works was considered, but proved impractical.

Similarly, it is recommended that the working hours for construction of the new pedestrian bridge over the tidal Ng Tung River between KTN C2-1

and FLN A2-1 should be restricted to 09.00 to 17.30 during 1st March to 31st July (the ardeid breeding season). Avoidance of works entirely during the breeding season did not prove feasible.

In order to mitigate for cumulative impacts of this project and the Construction of Cycle Tracks and the Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung River and at Nam Sang Wai, Yuen Long project on Long Valley, it is recommended that construction activities and works of the NDAs project should avoid clearance or interference with any mitigation measures (including screen planting areas) implemented as mitigation measures for impacts of the cycle track project. Should the need for such works under the current project be identified at the detailed design stage of the NDAs project, additional measures to mitigate for any impacts of such interference should be formulated and incorporated in the design and implementation of the relevant element of the NDA project.

Further, as an element of the adaptive management of Long Valley (see **Appendix 13.10**) it has been recommended to give consideration to redistribution of habitats in Long Valley by increasing the area of open water habitat suitable for foraging ardeids in those parts of Long Valley which will be less disturbed by construction and other human activity. These measures would also serve to provide compensatory habitat for habitat lost to large waterbirds on the main river channels due to the project.

Although relatively minor in scale, Advance Works Phase of the project will result in some disturbance impacts on Long Valley before its full operation (see **Figure 13.11a**). In order to mitigate for loss of foraging habitat arising from this source, it is recommended to stock suitable areas in LVNP with fish fry and or 'trash fish' (unwanted by-catch of fish of low commercial value) to provide food for ardeids and other piscivorous species. Depending upon the progress of land resumption for the project, the mitigation meanders currently managed by AFCD could be used as stocking locations in the event that other areas were not yet available for this purpose. It is proposed that the area of Long Valley north and west of the Sheung Yue River and east of the tidal section of the Ng Tung River (KTN area C2-2) will retain its agricultural zoning. In order to minimise disturbance impacts on this area, and fragmentation impacts on the flight-line between Ho Sheung Heung Egret and Long Valley and the Sheung Yue River and the flight-line between Long Valley and Hoo Hok Wai and the Deep Bay wetland ecosystem along the Ng Tung River, it is recommended that more stringent planning control be exercised in this area and that this intention should be clearly stated in the Explanatory Statement of the relevant Layout Plan.

In addition, it is recommended that the design of new bridges should be reviewed at the detailed design stage of the project to determine the optimum design to minimise construction and operational phase impacts on the rivers and on large waterbirds and other fauna using the rivers.

Design and construction parameters should be reviewed to address the following requirements and objectives:

- Minimisation of the height of bridges especially along those sections of river which are movement corridors of relative significance for birds: the tidal Ng Tung River and the non-tidal Ng Tung River west of the Man Kam To Road;
- Minimisation of the need form cofferdams to form bridge piers;
- Avoidance and minimisation of changes to the hydrological regime of the rivers; including avoidance of changes to flow of rivers, the tidal regime, and the level of impounded river sections;

Minimisation of the duration of construction phase impacts, especially for the footbridges over the Sheung Yue and Ng Tung Rivers, by giving consideration to off-site prefabrication of bridges and bridge elements. Further, construction of each bridge will be scheduled so as there is no overlap, in order to reduce disturbance impacts. As noted above, as well as mitigating for disturbance impacts on the rivers, the proposed measures are also necessary to minimise fragmentation impacts on ecological linkages for birds, especially waterbirds and ardeids breeding at Ho Sheung Heung Egrettry, along the Ng Tung River corridor with the Hoo Hok Wai area and areas elsewhere within the Deep Bay wetland ecosystem.

In addition, it is recommended that all wetland bird species of conservation significance using the river on a regular basis in significant numbers (including Little Egret, Chinese Pond Heron, Black-winged Stilt, Little Ringed Plover and Wood Sandpiper and any other bird species found to be using the rivers in significant numbers during pre-construction phase monitoring (see **Section 13.11**)) be included as target species for the design and management of LVNP. Although Grey Heron regularly occurs, the numbers are not significant in a Hong Kong context. As noted above, it is considered that species breeding in the Study Area (in particular breeding Little Egrets and Chinese Pond Herons) should be regarded as a priority in the design and implementation of mitigation measures. All species of conservation importance regularly utilising the rivers also regularly use habitats in Long Valley, with the exception of Great Cormorant (which only occurs regularly on the tidal section of the Ng Tung River north of the confluence with the Sheung Yue). However, impacts of the project on Great Cormorant are not considered significant even in the absence of mitigation as numbers of this species in the Study Area are very small relative to the large population in Deep Bay.

Finally, it is recommended that detailed design of the Open Space zones along the Ng Tung, Sheung Yue, Ng Tung and Shek Sheung Rivers should include, where practical and consistent with other design parameters and operational constraints, planting buffers between the rivers and areas that will be used intensively by people and/or are located

between such areas and the rivers. This recommendation applies, in particular, to the southwestern section of the Sheung Yue River and the south side of the Ng Tung River between FLN area B2-2 and B3-7 where the river corridors and likely to be most heavily disturbed. Greening opportunities and the proposed provision of building set-back along the river channels would be optimized during the detailed design stage by further refinement of the development layout. Where feasible, existing trees should be retained and incorporated into the detailed design of these areas.

Measures to avoid disturbance and hydrological impacts on Ma Tso Lung Stream, tributaries and riparian corridor habitats

As was noted in **Section 13.1.4.5** and **Section 2.4.1.8**, alternatives to minimise impacts to Ma Tso Lung Stream to find the optimum balance between minimising impacts on the stream and minimising impacts on the riparian corridor have been considered. Protection of the integrity of the natural stream and surrounding riparian vegetation at Ma Tso Lung Stream and its tributary the Ma Tso Lung San Tsuen Stream is important in protecting this habitat and stream corridor of moderate to high ecological importance and the fauna of conservation significance, including the globally critically endangered Three-banded Box Terrapin. Studies in North America have recommended the use of development buffers around streams to protect riparian habitat for freshwater turtles. The proposed buffer width varies according to site and species: proposed values from North America include 150m (Bodie 2001), 275m (Burke & Gibbons 1995) and 123 – 287m (Semlitsch & Bodie 2003). The width of riparian woodland at Ma Tso Lung Stream is not as wide or as continuous as the sites which were the subject of these recommendations, so these estimates are not appropriate in this case.

Other reviews of the optimum width of stream buffers for a diversity of wildlife have recommended buffer widths of approximately 30m to 195m (Robins 2002) and approximately 18 to 33 meters (Klapproth & Johnson 2001). For trapping and removing pollutants, recommended buffers include approximately 22m (Robins 2002) and 30m (Haycock & Muscutt 1995). Based on these, a 30m buffer is recommended for Ma Tso Lung Stream and its tributaries within the Project Area. In some areas development already exists within this distance from the stream; this is not inconsistent with the concept of a buffer, but further development or deterioration of the habitat should be prevented to protect the terrapin.

The most important part of Ma Tso Lung Stream corridor is the middle and upper section, where the woodland favoured by Three-banded Box Terrapin in the corridor is more extensive. This area will be protected by Green Belt zoning, with a presumption against development. However, the downstream section of the stream is also of moderate to high ecological importance due to its wetland-dependent fauna of

conservation importance, although the ecological value of the riparian corridor vegetation (seasonally-wet grassland and Ma Tso Lung marsh) is low to moderate.

Accordingly, it is recommended to protect the stream corridor by designating a buffer zone on each side of the stream in that part of the Project Area where the riparian corridor is not protected by the Green Belt zoning, subject to the constraint that the buffer zone and stream will be crossed by the proposed LMC Loop Eastern Connection Road. In this location, a section of stream approximately 130m in length will be diverted and a buffer zone of minimum 15m width on the western side of the stream and 30m width on the eastern side of the stream is recommended.

It is proposed that the areas of the buffer zone further from the stream in this section be planted with native riparian tree and shrub species in order to increase its suitability as a corridor for fauna species of conservation significance and other fauna. Meanwhile, the section of the restored stream corridor closest to the diverted stream will be profiled such that an area of marsh habitat with shallow pools can be formed adjacent to the stream, thus compensating for the loss of the seasonally wet grassland by creation of a habitat with similar characteristics but higher ecological function than the area lost, further enhancing connectivity of riparian habitats, and ensuring that the requirement to minimise flooding risk is satisfied.

Vehicles using the at-grade section of the LMC Connection Road may cause mortality impacts on terrestrial fauna and these are predicted to be of low to moderate severity if impacts are on species of conservation significance, and of moderate to high severity if impacts are on Three-banded Box Terrapin. In order to minimise such impacts a permanent solid barrier 1.2m in height with a lip projecting outwards from the road is proposed. Barriers of this type and height have been demonstrated to be highly effective in minimising mortality of herpetofauna, especially testudines (Dodd *et al.* (2004).

An indicative cross-section and plan of the diverted section of stream following restoration are shown in **Figure 13.16a-b**.

It is recommended that construction-phase impacts to the stream are minimised by ensuring that the hydrological linkage between sections of the stream is maintained and a buffer zone on either side of the stream is designated and protected by a solid barrier, 2m in height, to prevent any construction or other materials being deposited in the stream. The solid barrier should be placed 30m from the stream or at the edge of the essential works area, whichever distance is the greater. In addition to minimising impacts on the riparian corridor, the barrier will also serve to minimise mortality of terrestrial fauna in the works area. Measures to avoid construction phase impacts from run-off and drainage are detailed in **Sections 5.7.1.1 and 5.7.1.2**.

Run-off and pollution impacts on the stream will be minimised in the following ways during the operational period. Run-off from the LMC Loop Eastern Connection Road will be collected and piped to a discharge point downstream where no significant impacts (including cumulative impacts with the LMC Loop project) are predicted. Meanwhile surface-water run-off from the Sports Ground/ Sports Complex in KTN area F1-1 and the Research and Development Facility in F1-3 be collected, sediment will be trapped and the clean water will be discharged into the stream in area F1-3. No significant pollution and hydrological impacts are predicted to the stream or the Deep Bay catchment (see **Section 5.7.2.3**). There will be a small net ecological benefit in that the surface water run-off can be incorporated into the design of the restored wetland, where it will add microhabitat diversity (see **Figure 13.16b**).

Connectivity of the riparian corridor for terrestrial fauna will be maintained by virtue of the fact that the road will cross Ma Tso Lung Stream on viaduct to the south of the section of stream to be diverted. In addition to spanning the stream the viaduct section will be of sufficient width for a faunal underpass to be formed alongside the stream (**Figure 13.16b**). The viaduct abutment would be approximately 30m north of the point at which it crosses the stream; the road would then continue at-grade to beyond the Project Area to the north. Potential impacts of the road in this area on fauna linkages are reviewed in **Section 13.8.2.8** below.

Detailed design of the restored stream corridor as well as the barrier and underpass design should be submitted to and agreed by the relevant government departments during the detailed design stage of the project.

Measures to avoid disturbance and hydrological impacts on Siu Hang San Tsuen Watercourse

Siu Hang San Tsuen Watercourse, which flows into the Ng Tung River, is channelised, but the upstream section, which flows through agricultural land, has banks and bed of natural materials. One fish species of conservation significance, Predaceous Chub has been found in this stream section and three further wetland-dependent fauna species have been found in the riparian zone. Within the Project Area the watercourse is modified and evaluated as of low to moderate ecological value. Much of the stream course would be located underneath the viaduct for the proposed Fanling Bypass.

It is recommended that construction-phase impacts to the stream are minimised by ensuring that the hydrological linkage between the stream and the Ng Tung River is maintained and a 10m wide buffer zone on either side of the stream is designated and protected by a 2m-high solid barrier to prevent any construction or other materials being deposited in the stream. A 10m wide buffer zone on either side of a stream to ensure that pollution of the stream course is avoided follows recommended international best practice (e.g. Gilliam *et al.* 2001, Harris and Foster 2001, Uusi-Kamppa *et al.* (2001)).

It is currently proposed that the clear headroom under the bypass will be at least 5.1m, while the width is proposed to be 20m. However, the design (including the headroom) has not yet been finalized. The resulting height/width ratio of 0.25 would result in a significant reduction in the light levels under the bridge (Clements 2003). Accordingly, it is recommended that replanting with shade-tolerant native shrub and herb species is undertaken, with details to be formulated at the detailed design stage.

It is further recommended that following completion of the Fanling Bypass, a 10m wide buffer zone is designated throughout the stream (see **Figure 13.17**).

Measures to minimise disturbance impacts on Ma Wat River

A section of the Ma Wat River between will be re-channelised by the Project. This section is of Low ecological value and standard measures to minimise impacts to the watercourse will be sufficient to meet ecological mitigation requirements (see **13.8.2.4** below).

Measures to minimise disturbance impacts on areas of ecological importance

Where not otherwise addressed above, disturbance to all habitats/areas identified as being of ecological importance as habitats or of importance to species should be minimised by erecting solid dull green faunal barriers at least 2m high between such sites and any construction stage works areas. Locations where such barriers should be erected prior to the commencement of construction phase and maintained for the duration of the works period are detailed in **Figure 13.15**. Where feasible, barriers should be erected in phases to minimise fragmentation impacts. A phasing plan for barrier erection and dismantling should be designed at the detailed design stage of the relevant project element.

While no significant impacts are predicted to these streams arising from the Project, any such impacts should be avoided by avoiding construction works within the streambeds, minimising any works within the streambeds and preventing pollutants or other construction materials from entering the streams.

Direct encroachment upon areas of ecological significance will be further avoided and minimized during the detailed design stage. Any temporarily works area, particularly those on natural habitats, would be reinstated upon completion of works.

13.8.2.3 Mitigation for Impacts of Dust Deposition on Habitats, Flora and Fauna

Impacts of dust deposition on habitats, flora and fauna are generally localised and reversed naturally by rainfall. However, dust deposition can

adversely affect plant growth and hence availability of shelter and food for fauna and directly impact specimens of plant species of conservation significance/protected plant species. Good construction site practice to minimise dust generation should therefore be followed on all construction sites. Measures to avoid, minimise and mitigate for impacts on air and water quality are detailed in Sections 4, 5 and 15 of this report.

13.8.2.4 Mitigation for Impacts of Construction Run-off on water bodies in the Study Area and in the Deep Bay Catchment

Impacts during the construction phase of the Project could impact water bodies in the Study Area and also downstream in the Deep Bay Catchment. Construction run-off is potentially destructive to aquatic communities.

Construction work for this Project could generate surface run-off containing lubricants, chemicals and pollutants. In order to prevent these contaminants entering water bodies, a standard drainage system along with silt traps, oil traps and gullies should be installed at required sites, and collection to proper receivers should occur. Drainage systems should be maintained routinely to prevent blockage. Sewage from construction areas should be properly collected to treatment facilities.

The following measures are adopted by most local projects to mitigate the impacts of construction run-off, and are recommended as mitigation for this Project.

- Temporary sewerage and drainage to be designed and installed to collect wastewater and prevent it from entering water bodies;
- Proper locations well away from nearby water bodies should be used for temporary storage of materials (i.e. equipment, filling materials, chemicals and fuel) and temporary stockpiles of construction debris and spoil, and these should be identified before commencement of works;
- To prevent muddy water entering nearby water bodies, work sites close to nearby water bodies should be isolated, using such items as sandbags or silt curtains with lead edge at bottom and properly supported props. Other protective measures should also be taken to ensure that no pollution or siltation occurs to the water gathering grounds of the work sites;
- If temporary access along a riverbed is unavoidable, this should be kept to the minimum in width and length. Temporary river crossings should be supported on stilts above the river bed;
- Stockpiles of construction materials, if necessary, should be properly covered and located away from nearby water bodies;

- Construction debris and spoil should be covered and/or properly disposed of as soon as possible to avoid these being washed into nearby water bodies;
- Construction effluent, site run-off and sewage should be properly collected and/or treated. Wastewater from any construction site should be minimised via the following, in descending order: reuse, recycling and treatment;
- Proper locations for discharge outlets of wastewater treatment facilities well away from sensitive receivers should be identified (i.e. treated wastewater should not be discharged into natural streams, other streams of ecological significance, marsh, mitigation meanders, wet agricultural land, and active or inactive fish ponds);
- Adequate lateral support should be erected where necessary in order to prevent soil/mud from slipping into water bodies;
- Site boundaries should be clearly marked and any works beyond the boundary strictly prohibited;
- Regular water monitoring and site audit should be carried out at adequate points along any watercourses where construction works are underway upstream within their catchments and also on the Ng Tung, Sheung Yue and Shek Sheung Rivers. If the monitoring and audit results show that pollution occurs, adequate measures including temporarily cessation of works should be considered;
- Excavation profiles should be properly designed and executed with attention to the relevant requirements for environment, health and safety;
- Where soil to be excavated is situated beneath the groundwater table, it may be necessary to lower the groundwater table by installing well points or similar means;
- Excavation should be carried out during the dry season as far as possible to minimise contaminated runoff from contaminated soils;
- Stockpiling sites should be lined with impermeable sheeting and bunded. Stockpiles should be properly covered by impermeable sheeting to reduce dust emission during dry season or contaminated run-off during rainy season. Watering should be avoided on stockpiles of contaminated soil to minimise contaminated runoff;
- Supply of suitable clean backfill material after excavation, if require;

- Vehicles containing any excavated materials should be suitably covered to limit potential dust emissions or contaminated run-off, and truck bodies and tailgates should be sealed to prevent any discharge during transport or during wet season;
- Speed control for the trucks carrying contaminated materials should be enforced; and
- Vehicle wheel washing facilities at construction sites' exit points should be established and used.

Operational phase run-off should be minimised by the use of modern road drainage systems. Should there be any discharge to watercourses, appropriate use of oil interceptors and silt traps should be made so as to minimise potential impacts on water quality.

Measures to avoid, minimise and mitigate for impacts on water quality are detailed in **Section 5** and **Section 15** (EM&A Manual) of this report.

13.8.2.5 Mitigation for Impacts of Pollution in the Study Area and in the Deep Bay Catchment

Accidental spillage events, whether during the construction or operational phases of the Project, could potentially have a large impact on nearby habitats and habitats downstream including the ecologically highly important Deep Bay ecosystem. Therefore, an emergency contingency plan should be established and implemented by the Project Proponent or its delegate prior to the commencement of any construction. This should then be in place at all times during the construction and operational phases. The plan should include, but need not be limited to, the following:

- Potential emergency situations;
- Chemicals or hazardous materials used on sites (and their location);
- Emergency response team;
- Emergency response procedures;
- List of emergency telephone hotlines;
- Locations and types of emergency response equipment;
- Training plan and testing for effectiveness.

Detailed plans should be prepared and implemented by the Project Proponent or its delegate at later stages during both construction and operational phases.

Surface runoff during the operational phase from developed areas within Project Area could also affect nearby and downstream habitats. Modern

drainage systems along with silt traps, oil traps and gullies should be installed at required sites, and collection to proper receivers should take place. Drainage system should be maintained routinely to prevent blockages. With such systems in place, surface runoff is unlikely to affect nearby or downstream habitats significantly.

Measures to avoid, minimise and mitigate for impacts on water quality are detailed in **Section 5** and **Section 15** (EM&A Manual) of this report.

13.8.2.6 Mitigation for Impacts on Species

Mitigation for impacts on all fauna and flora

Where not otherwise stated, mitigation measures described in **Sections 13.8.2.1 to 13.8.2.6** should be applied, where relevant and appropriate, as mitigation of impacts of the Project on flora and fauna, and areas/habitats utilised by flora and fauna of conservation significance. Proposed mitigation measures are recommended below to supplement these measures in respect to potential impacts on species and species groups.

Mitigation for impacts on flora species of conservation significance

Flora specimens of conservation significance/protected plant species *Aquilaria sinensis*, *Ailanthus fordii*, *Pavetta hongkongensis* and *Gnetum luofuense* (albeit this species is common in Hong Kong) found in *fung shui* and secondary woodland at Ho Sheung Heung may be indirectly impacted during the construction phase of the Project. Measures to mitigate for disturbance, dust deposition, run-off and other pollution described above should be applied at construction sites adjacent to Ho Sheung Heung *fung shui* and secondary woodland should be applied to minimise impacts on protected plant species in these woodlands.

Additional measures should be adopted in consultation with AFCD should individuals of flora species of conservation significance, particularly any mature specimens, be identified during the course of the NDA project.

With the implementation of the above, flora specimens of conservation significance/protected plant species found at other locations in the Study Area are not predicted to be directly impacted or indirectly impacted significantly by the Project.

Mitigation for mortality and fragmentation impacts on terrestrial fauna mammal species

Low mortality and fragmentation impacts on mammals and herpetofauna are predicted over the Project Area as a whole, but low to moderate combined mortality and fragmentation impacts on mammals and herpetofauna are predicted in the Ma Tso Lung and Ho Sheung Heung

wooded areas in the absence of mitigation. Measures to mitigate for potential construction phase impacts on habitats/areas of ecological importance and construction and operational phase impacts on Ma Tso Lung Stream, tributaries and riparian corridor habitats should be applied to mitigate for mortality impacts on terrestrial fauna. These measures include habitat restoration and provision of a faunal barrier and underpass at Ma Tso Lung Stream in accordance with international best practice for minimising mortality impacts and maintaining connectivity for terrestrial meso-fauna (e.g. Clevenger *et al.* (2001) and, more specifically, follow the recommendation of Smith (2003) that the maximum recommended distance between crossing structures to maintain connectivity for meso-mammals, carnivores, herpetofauna, and small mammals should not be more than 325m in 'core conservation areas and habitat corridors'. This distance is achievable here, so long as an underpass is located immediately to the north of the Project Area in the section of the LMC Loop Eastern Connection Road to be constructed under that project.

Mitigation for mortality impacts on bats

Bats are vulnerable to mortality at roosts, especially if the roosts are being utilised by nursing females. Some insectivorous bat species utilise abandoned buildings as roost sites, whilst Short-nosed Fruit Bats often form roosts in *Livistona chinensis* in village areas.

Mortality impacts on bats are predicted to be low in the absence of mitigation. However, as bats are a relatively little known group and identification is difficult, it is recommended that on a precautionary basis, prior to the demolition of buildings or felling or transplanting of trees, sites should be checked for the presence of bat roosts by a suitably qualified ecologist. If roosts are found to be occupied by nursing females or winter roosts (where bats are also particularly sensitive to disturbance) are found, a review should be carried by a suitably-qualified ecologist, in consultation with AFCD, to determine the most appropriate course of action. For example, it might be possible to avoid and cordon off the roost site and continue works in surrounding areas.

Mitigation for mortality impacts on birds

The scale of mortality impacts on birds are primarily related to size and whether species utilise closed or open habitats. Accordingly, the measures detailed below apply to all bird species, and are not related to whether species are wetland-dependent or not.

The siting of noise barriers alongside roads has already been identified as a contributor to avian mortality in Hong Kong, and the magnitude of this impact is inevitably greater should these structures be placed in otherwise largely rural areas. In view of evidence to suggest that the placing of predator images on transparent surfaces may not be effective in reducing avian mortality (Klem 1990) and that barriers that appear to

be transparent at even short distances are not effective (Martin 2011), potential impacts of collision mortality will be minimised by the use of opaque noise barriers, through which it is obvious there is no passage, and in which no reflection of the surrounding environment is created.

In terms of non-residential building design the following design guidelines for glass and façades should be noted during the detailed design process.

Glass should provide as low a degree of reflectivity as possible, in order that surrounding natural environments are not replicated, thereby enticing birds to fly into the building exterior. Further, careful consideration should be given at the design stage as to whether the appearance of unobstructed passage is imparted by any glass feature of a building or other structure. If so, design should be amended.

Appropriate glass and facade treatments should be used to minimise collision mortality, especially in areas where the glass façade faces natural vegetation. These include the following:

- i. Fritting, or the placement of ceramic lines or dots on glass, which has little effect on the human-perceived transparency of the window but creates a visual barrier to birds outside. This treatment also has the advantage of reducing air conditioning loads by lowering heat gain, while still allowing light transmission for interior spaces. It is most successful when the frits are applied on the outside surface. Frosted glass has similar effects;
- ii. Angled glass should be used only for smaller panes in buildings with a limited amount of glass;
- iii. Use of glass that reflects UV light (primarily visible to birds, but not to humans) acts to reduce collision and should be used where possible;
- iv. Use of lightweight external screens added to windows or as a façade element of larger buildings are suitable where non-operable windows are prevalent, which is often the case in modern buildings in Hong Kong. Use of such screens should be considered where appropriate.

In terms of reducing night-time mortality impacts, eliminating unnecessary lighting is one of the easiest methods, and has the added advantage of saving energy and expense. Potential impacts of nocturnal avian collision with buildings should be minimised by not creating sky glow from the use of night-time lighting at or near the top of buildings or other structures. In addition to avoiding uplighting, light spillage should be minimised, while green and blue lights should be used where possible. As far as possible, building operations should be managed in such a way as reduce or eliminate night-lighting near windows. The potential

advantages of removing unnecessary lighting in terms of reducing the carbon footprint of the NDAs development are obvious.

Mitigation for impacts on wetland-dependent bird species

All but one wetland-dependent bird species of conservation significance recorded regularly in the Study and Project Areas occur regularly in Long Valley. Mitigation measures to address impacts on these species will be addressed as an element of the mitigation measures proposed for that area described above. The one species of conservation significance that does not occur regularly is Great Cormorant. In the Study Area this species occurs regularly only on the tidal downstream section of the Ng Tung River. Numbers using this section are small (typically fewer than 10 individuals) relative to the population of approximately 10,000 birds of this species which occurs in Deep Bay in winter. Furthermore, much of this section of the Ng Tung River will not be disturbed by the Project. Accordingly, potential impacts on this species are not considered to be significant.

Mitigation for impacts on non-wetland dependent bird species

Direct, indirect and fragmentation impacts on non-wetland dependent bird species are predicted to be Low in the absence of mitigation, but combined impacts are predicted to be Low to Moderate. Such impacts as will arise are largely a consequence of predicted impacts on wooded habitats, including loss of secondary woodland and plantation and construction phase disturbance to secondary woodland and plantation at Ho Sheung Heung and Crest Hill.

Impacts on these species will thus be addressed as an element of measures to mitigate for impacts described above.

Some open country bird species are predicted to be impacted by loss of such habitats, especially dry agricultural land in FLN. Many of these species occur in larger numbers in wetland habitats and hence impacts on these species will be addressed as an element of mitigation measures to compensate for wetland habitat loss. Mitigation for impacts on those few species that require or prefer dryland habitats will be addressed as an element of the enhancement of dryland habitats in the LVNP habitat mosaic.

Mitigation for impacts on Eurasian Hobby

In the event that Eurasian Hobby should nest at a location on Crest Hill, it may be disturbed significantly, depending upon the proximity of any nest to a Project works area. Distance from any works area, the height of any nest site and proximity to other disturbance sources would all be relevant: birds using a nest high on a pylon (the site known to have been used in the past at Crest Hill) may tolerate disturbance relatively close to a nest

site, whilst many raptor species are relatively tolerant of disturbance that was present when nest site was selected but are intolerant of new sources of disturbance.

Measures to mitigate for potential disturbance to Crest Hill habitats will mitigate for most potential additional disturbance to the potential breeding area. Pre-construction phase monitoring should be undertaken in the breeding season (April to August) to check for presence and identify any nest site if present. If such a site is found and/or Eurasian Hobbies are found and behave in a fashion that breeding activity is in progress, a review should be carried by a suitably-qualified ecologist, in consultation with AFCD, to determine the most appropriate course of action; such review should include the option to postpone works or some types of works or works in some locations until after the completion of breeding activity. Remedial actions should then be formulated and implemented.

Furthermore, Eurasian Hobby is a migratory species and is absent from Hong Kong in the dry season. Site clearance during the early dry season (October to January) would not have a significant impact on this species, so it is recommended that site clearance works in the area be scheduled for these months.

Mitigation for impacts on Grey Nightjar

Grey Nightjar was found in the breeding season close to the proposed Freshwater Service Area in FLN area A3-1. This species nests on the ground in grassland and grassland/shrubland and may have a preference for regenerating burnt areas, as many of the observations have come from such areas (M.R. Leven pers. obs.). It is a nocturnal species and roosts/rests during the day. It relies on camouflage when roosting and nesting and will tolerate close approach by people during the day.

In view of the large area of habitat present, it is unlikely that a nest site will be selected that is within or very close to the Project works area. Pre-construction phase monitoring should be undertaken in the early breeding season (March to May), and if a nest site is found any site clearance works should be postponed. Furthermore, this is known to be a migratory species and may not be present, or present in low numbers, in the dry season. Site clearance during the early dry season (October to February) would not have a significant impact on this species, so it is recommended that site clearance works in the area be scheduled for these months.

Mitigation for impacts on egrettries

Man Kam To Egrettry is located in plantation in the northern part of the FLN NDA. The site of the egrettry would be impacted directly by the proposed Fanling Bypass and roundabout connection to Man Kam To Road. Avoidance of impacts to the egrettry has been considered by realignment of the Bypass, but the road design is constrained by existing

infrastructure (roads and Ng Tung River channel) and it is not possible to realign the Bypass to avoid the egret.

Currently, the Man Kam To Road Egret is subject to heavy disturbance and suitable nesting substrate was partly cleared in 2012. The unavoidable loss of this breeding site is therefore evaluated of low to moderate significance.

Unavoidable clearance of Man Kam To Road Egret and construction of Fanling Bypass roundabout (western section) should be scheduled outside the breeding season.

Loss of this breeding site would be significant. It is proposed therefore that loss of the egret should be mitigated by appropriate planting of trees and bamboo to provide compensatory habitat for breeding ardeids, with the intention that this could provide an alternative nesting site for birds from the Man Kam To Road Egret.

Relocation of an egret has not previously been successfully achieved in Hong Kong. Creation of egrets has been successful overseas, however (Hafner 2000, White *et al.* 2008), and there is no apparent reason to suppose that this approach should not also be possible in Hong Kong. Trees and bamboo have been planted at the wetland mitigation area provided for MTRC Lok Ma Chau Spur Line Extension and at Mai Po Nature Reserve with the intention of attracting breeding ardeids to these sites.

Provision of compensatory planting aiming to attract breeding egrets requires that a suitable location should be found. This should have low levels of direct human disturbance, be close to suitable foraging locations and preferably also close to the site of the existing egret. It is considered that the most suitable location for this would be in area A1-7 in FLN NDA. This land contains a former meander that was isolated from the Ng Tung River during channelisation of the river. The meander is currently maintained by AFCD and DSD as mitigation for the ecological impacts of river channelisation. The area is proposed to be zoned as Conservation Area (CA) under in the revised RODP. Both of the adjacent areas (A1-3 and A1-9) are zoned for Agriculture in the revised RODP.

The landform and hydrological regime of the proposed compensation site is broadly suitable for the creation of a tree and bamboo clump in the centre of the former meander (see **Appendix 13.10 Plate 19**), however some earthmoving works will be required to create appropriate conditions for planting of trees and bamboos. During the design process it is recommended to consider the merits and disadvantages of adjusting levels such that the central planting area, which is currently surrounded on three sides by the oxbow of the former meander, is turned into an island. DSD should be consulted regarding the technical feasibility.

As mentioned above, there are no previous examples of the successful provision of an artificial egret in Hong Kong. Reprovision of potential

nesting locations should follow overseas practice for the creation of artificial nesting sites (for example Hafner 2000, White *et al.* 2008). It is likely to take several years after planting before the vegetation is of sufficient maturity to be suitable for breeding egrets. In principle, the provision of suitable nesting locations should be relatively easy to achieve through planting appropriate species of trees and, especially, bamboo (*Bambusa eutuldoides* particularly favoured by breeding egrets).

Avoidance of human (and other) disturbance is of great importance, either through fencing of the area to prevent human access or by surrounding the site with water.

Judging from flight-line observations, the main foraging sites for Chinese Pond Herons breeding at Man Kam To Road are apparently in the wetland habitats in and around Long Valley. Birds from the egretty were often observed flying along Ng Tung River in the direction of the proposed location for compensatory planting in A1-7, which is closer to the foraging sites than the existing egretty. Measures to minimise disturbance to Ng Tung, Sheung Yue and Shek Sheung Rivers and other areas described in **Section 13.8.2.2** should be applied to this site and the flight-line corridor between it and Long Valley.

A detailed plan covering all aspects of design and implementation and monitoring requirements of these measures should be prepared in consultation with AFCD and implementation of site preparation, planting and commencement of habitat management should be included as an element of the Advance Works Package of the First Phase of Infrastructure and Development of the project (see also **Section 13.9** and **Section 13.11**).

Mitigation for disturbance and fragmentation impacts on Ho Sheung Heung Egretty were addressed as an element of required measures to mitigate for impacts on habitats of ecological importance, above.

The possibility that egretty locations may change and that new egrettries may be established before or during the construction phase of the project should be taken into account. If any new egretty, or partially or wholly relocated egretty, is identified before or during the construction phase, measures required to avoid, minimise and compensate for impacts on the egretty should be formulated and implemented, as appropriate. The appropriate measures will vary depending on the location of the egretty relative to predicted sources of direct, indirect and fragmentation impacts and the time at which the egretty is found relative to the project construction programme. However, the relevant measures detailed in **Table 13.144** (Mitigation of impacts on wetland-dependent bird species of conservation significance) and **Table 13.147** (Mitigation of impacts on egrettries and egretty flight-lines), together with whichever other mitigation measures are necessary in order to mitigate for any unacceptable impacts on the egretty and the ardeids using it, should be implemented as required.

Mitigation for impacts on herpetofauna

Mitigation for mortality impacts on herpetofauna has been addressed above.

Low to Moderate impacts on reptile species of conservation significance are predicted as a consequence of loss of habitat and habitat fragmentation, and Low impacts are predicted due to disturbance; combined impacts are predicted to be Low to Moderate. Impacts to amphibians from all sources are predicted to be Low, except for impacts on Chinese Bullfrog, impacts on which from all sources are predicted to be Low to Moderate.

Measures to mitigate for loss of wetland and woodland habitats and minimise indirect impacts to Long Valley, woodland habitats, habitats in Ma Tso Lung and habitats of ecological importance will address impacts on herpetofauna utilising these habitats/areas.

A small number of reptile and amphibian species of conservation significance, of which Chinese Bullfrog is the most frequently detected species, are known to be present (or have been reported in the past) in farmland and other habitats in the area between the urban area of Sheung Shui and Fanling and the Ng Tung River. Whilst this area, and habitats in this area, are not considered to be of importance or contain preferred habitats of any of these species, on a precautionary basis it is recommended that these areas be surveyed by a suitably qualified ecologist prior to the commencement of any building demolition or site clearance, and any individuals of species of conservation importance found should be caught if possible and relocated to suitable receptor sites within LVNP or outside the development areas of the Project, depending on the habitat requirements of the species (see **Section 13.9** and **Section 13.11**).

The above recommendation also applies in respect to works in the Ma Tso Lung Stream area. However, in this area consideration should be given as to whether immediate relocation to a suitable location within the Ma Tso Lung Stream catchment would be appropriate, taking into account the habitat and other ecological requirements of the species, their vagility, and whether release locally would still leave the individuals exposed to impacts from the project and/or sources. In such instances the individuals should be held temporarily in captivity, pending consultation with AFCD as to whether relocation to a protected area, such as a Country Park, would be more appropriate. This consideration applies, especially, should any individuals of Three-banded Box Terrapin be found (see **Section 13.9** and **Section 13.11**).

Mitigation for impacts on butterflies

Impacts on butterflies are predicted to be of low severity in the absence of mitigation. However, butterflies may be affected slightly by the indirect consequences of dust deposition on larval food plants. Measures to avoid

and minimise impacts of dust deposition on *fung shui* and secondary woodland at Ho Sheung Heung would serve to reduce such impacts in this area of importance to butterflies.

In addition, adjustments to the development footprint and works areas should be considered in order to avoid or minimise encroachment onto shrubland on Crest Hill during the detailed design stage for project elements in this area. Any temporary works areas should be restored by planting native shrub species, species selection should be made by a suitably qualified plant ecologist/botanist.

While it is not considered that impacts on any butterfly species are of significance, it is recommended to consider inclusion of the grass species *Ischaemum barbatum* and *Miscanthus sinensis* (the larval food plants of Small Three-ring and Pale Palm Dart, which are butterfly species of conservation significance which have been found in wetlands in the area) in the restoration planting of the Ma Tso Lung Stream riparian corridor in order to benefit these species. The other larval food plant of Pale Palm Dart, *Pennisetum purpureum* is not recommended as it is an exotic species, though it may well colonise without assistance.

Mitigation for impacts on dragonflies

Combined impacts on dragonflies are predicted to be Low during both construction and operational phases, and no specific measures are required to address impacts on dragonfly species in addition to measures to address impacts to wetland habitats described above.

Mitigation for impacts on stream fauna (fish and invertebrates)

Impacts on most fish and stream invertebrates are predicted to be of Low severity. However, these will be addressed by measures to avoid stream habitats or minimise disturbance and pollution impacts on stream habitats by described above.

Construction phase impacts on Small Snakehead are predicted to be Moderate in the absence of mitigation; due to impacts arising from the diversion of a section of Ma Tso Lung Stream and disturbance to adjacent riparian habitats. Measures to minimise impacts to this species are addressed as an element of the measures to avoid, minimise and compensate for impacts on this stream and stream fauna.

Impacts from the project are predicted on the crab, *Sommaniathelphusa zanklon*, in Ma Tso Lung San Tsuen Stream, and Tung Fong and Tin Ping Shan Tsuen Watercourses. Only single individuals were found in Tung Fong and Tin Ping San Tsuen Streams, both of which will be rechannelised. There is very limited suitable habitat for these species in these streams, and it is most unlikely that it is present in significant numbers. Further, surveys for this and the LMC Loop Study and

observations in the area south of Yuen Long and near Ngong Ping, Lantau (Study Team pers. obs.) suggest that this species is relatively widespread in the New Territories and it is tolerant of pollution. Impacts on this species from the Project are, therefore, predicted to be Low, except for those in Ma Tso Lung San Tsuen Stream (see below).

However, since Tung Fong and Tin Ping San Tsuen Streams will be replaced by drainage systems, there will be no habitat for displaced individuals in these streams following completion of construction works. Accordingly, it is recommended that both of these streams are searched by an appropriately qualified ecologist, prior to the commencement of construction works. Any specimens of *Sommaniathelphusa zanklon* found should be caught and translocated to an appropriate relocation site, such as Ma Tso Lung San Tsuen Stream where this species is known to be present. In addition, consideration could be given to translocation to the LVNP, where conditions in the watercourse are not dissimilar to other locations where this species has been found.

Capture and field identification of this species is not problematic, when undertaken by an appropriately qualified ecologist (Study Team pers. obs.).

As noted above in respect of mitigation measures to address impacts of the project on Small Snakehead, measures are proposed to address impacts of the project on Ma Tso Lung San Tsuen Stream and stream fauna, including *Sommaniathelphusa zanklon*.

Mitigation for cumulative impacts

Cumulative impacts on wetland dependent bird species of conservation significance that require, or are associated with, freshwater wetland habitats are addressed as an element of the measures to compensate for wetland habitat loss and to avoid, minimise and compensate for disturbance and fragmentation impacts on waterbirds using Long Valley.

Likewise cumulative impacts on habitats and fauna in the Ma Tso Lung area are addressed as an element of the measures to compensate for loss of wetland and riparian habitats and disturbance and fragmentation impacts to fauna in this area described above. There are no other cumulative impacts of significance arising from the Project.

13.8.2.7 Impacts of Mitigation Provision

Proposed wetland habitat enhancement measures in LVNP will have some impact on habitats and species in Long Valley. However, the enhancement measures proposed will be similar in nature and scale to those which are currently undertaken on a regular basis under the MA and, furthermore, are similar to those which regularly occur in all agricultural areas. Accordingly, significant adverse impacts are not predicted.

Faunal barriers to minimise disturbance and other impacts to Long Valley, the main river channels and other sites of ecological importance may act as barriers which increase fragmentation impacts on terrestrial fauna.

Such impacts will largely be avoided as in most cases barriers are proposed to be erected along the edge of works areas; not around areas of ecological importance. Where barriers are required between works areas and areas of ecological importance, the areas of ecological importance will not be completely surrounded by works areas, and hence will not be surrounded by barriers (thus retaining connectivity with other areas/habitats); in particular, barriers will not be required between Ho Sheung Heung woodland and Crest Hill and between the LVNP and KTN areas C1-4 (village) and C1-6 (Agriculture) or between the part of Long Valley north and west of the Sheung Yue River and areas to the north and west. Detailed design and deposition of the barriers with a view to minimize impacts on animal movements are to be reviewed during the detailed design stage.

Mortality to terrestrial fauna can be minimised by ensuring that there are periodic gaps in barriers or sections where a space is left under the barrier. In practice, it is rare for such barriers to be continuous for long distances; however, it is recommended that measures to permit one-way fauna movement in locations where mortality or disruption to life cycles might occur should be included at the detailed design stage of the Project.

Barriers to prevent disturbance to fauna will not result in fragmentation impacts on birds as their height will be much less than other habitat elements, notably trees. However, mortality impacts on birds may increase if they collide with barriers. Such mortality can largely be avoided by ensuring that barriers are bird-friendly and of non-transparent material of subdued or neutral tones (dull green or dull brown).

Permanent faunal barriers proposed to be formed along the at-grade section of the LMC Loop Eastern Connection Road at Ma Tso Lung will be designed in order to ensure that terrestrial fauna is not killed by vehicles on the road, and so will act as a barrier to movement. The most significant linkages are along the riparian corridor; these will not be fragmented within the Project Area during the operational phase of the Project, as the road will cross the stream on viaduct and will not directly impact the stream and its banks which will remain.

However, for some fauna, linkages with habitats further from the stream may be of some significance. Accordingly, it is proposed to provide an underpass at Ma Tso Lung Stream in accordance with international best practice for minimising mortality impacts and maintaining connectivity for terrestrial meso-fauna (e.g. Clevenger *et al.* (2001) and, more specifically, follow the recommendation of Smith (2003) that the maximum recommended distance between crossing structures to

maintain connectivity for meso-mammals, carnivores, herpetofauna, and small mammals should not be more than 325m in 'core conservation areas and habitat corridors'. This distance will be achieved so long as the most southerly underpass beneath the LMC Loop Eastern Connection Road proposed as a mitigation measure of the LMC Loop project is located immediately to the north of the NDA Project Area boundary.

During the construction stage of the road, temporary faunal barriers are proposed to minimise disturbance and fragmentation impacts to fauna during the construction period. As these will be orientated in parallel with the riparian corridor, the most important linkages will not be fragmented, but some construction phase impact to linkages with habitats further from the stream will take place.

Construction and operational phase impacts of measures to mitigate for indirect impacts and fragmentation impacts on the Ma Tso Lung riparian corridor and fauna are evaluated below. Impacts of faunal barriers in other locations and other impacts of mitigation measures are not considered to be significant.

Table 13.134 - Potential indirect and fragmentation impacts on the Ma Tsung Lung Stream corridor from construction and operational phase faunal barriers in the absence of mitigation measures

Criteria	Assessment
Habitat Quality	Ma Tso Lung Stream and tributaries are of Moderate to High ecological value. The riparian corridor, while containing a variety of habitats of varying ecological value is mainly of importance in maintaining linkages for fauna of conservation importance using habitats in along the stream.
Species	Flora diversity is low but fauna includes wetland-dependent species of conservation significance in or near the stream including the globally Critically Endangered Three-banded Box Terrapin (though the latter is unlikely to utilise the area of stream which will be impacted on a regular basis as it favours wooded habitats).
Size/Abundance	The length of stream along which fragmentation will take place is relatively short and the barriers will be parallel to the movement corridor along the stream, but some fragmentation impact on movement of fauna perpendicular to the corridor will occur.
Duration	Construction phase only, mitigated at operational stage by underpasses proposed as mitigation measures for this project and the LMC Loop project.
Reversibility	Impacts mostly reversible in operational phase.
Magnitude	Low as movement perpendicular to the riparian corridor is unlikely to involve many species or individuals
Impact Severity	Low during construction phase, mitigated at operational stage by underpasses.

13.9 Implementation, management and maintenance of mitigation measures

This section addresses 3.4.14.4 (xi) of the Study Brief, which requires the evaluation of the feasibility and effectiveness of the recommended mitigation measures and definition of the scope, location, implementation arrangement, subsequent management and maintenance of such measures.

13.9.1 Guiding principles for mitigation measures

13.9.1.1 Guiding principles for mitigation measures in the LVNP

The guiding principles upon which the mitigation proposals in the LVNP have been created are as follows:

- Protection and enhancement of 37ha of Long Valley to have it managed as a whole to provide on-site mitigation measures to compensate for the wetland loss due to the project and to mitigate for some impacts on fauna which will not be mitigated *in situ*;
- Recognition that faunal targets for the mitigation areas should be based upon clear conservation objectives and the need to mitigate for any potential adverse impacts of any development on habitats, flora or fauna of conservation importance and any broader ecological enhancement opportunities presented;
- Need to maintain the integrity of existing ecological linkages between the LVNP and adjacent wetland habitats;
- Need to ensure that there is no net loss of wetland function in the LVNP as a consequence of the mitigation measures proposed and/or as a consequence of the project;
- Recognition of the success of the current and past MAs in Long Valley in increasing both the numbers of and diversity of wetland bird species, and the importance of mitigation flexibility and the need for active management of the habitat mosaic in order to achieve this success;
- Recognition of the importance of active management of agricultural land (including active management of ponds) and the important role of current stakeholders in the management of Long Valley (including farmers, the CA and HKBWS) in achieving this success, and recognition of their continuing role in the plan preparation process and in potential future implementation management and maintenance;

- Recognition that wetland enhancement has a proven track record both in Long Valley and elsewhere in Hong Kong (relevant examples here include wetland rehabilitation or enhancement for the Lok Ma Chau Spur Line, West Rail, the Hong Kong Wetland Park and the Yuen Long Bypass Floodway).;
- Recognition of the importance of sustainability and environmental stability;
- Recognition of the importance of maintenance of a continuous water supply, especially during the dry season;
- Requirement that hydrological changes as part of the wetland enhancement must not increase the flood risk to other basin users;
- Acknowledgement of the importance of an understanding of the habitat requirements of target species, the feasibility of the provision of the required habitats and a realistic assessment of the likelihood that the habitats will be utilised once they are created;
- Recognition of the ecological value of any existing habitats on site, whilst acknowledging that wetland restoration may require significant alterations to other habitats that are of lower ecological value at present;
- Recognition that monitoring is essential in order to assess the success or otherwise of the mitigation measures and to guide management decisions.

13.9.1.2 Guiding Principles for Other Mitigation Measures

The guiding principles upon which other mitigation proposals have been designed are as follows:

- Recognition that the mitigation measures should be feasible and effective in meeting the need to mitigate for any potential adverse impacts of any development on habitats, flora or fauna of conservation importance;
- Requirement that mitigation measures involving hydrological changes must not increase the flood risk to other basin users;
- Requirement that mitigation measures involving the provision of compensatory habitats should be largely self-sustaining: once the compensatory habitats are established, management should largely be limited to maintenance work. This should still allow for adaptive management, whereby management practices change in response to on-site conditions (especially in response to any failures to meet mitigation objectives);

- Recognition that monitoring is essential, in order to assess the success or otherwise of the rehabilitated wetlands, and to guide management decisions.

Habitats, areas of habitats and fauna and flora groups that primarily determine and define the scope, type and location of proposed mitigation measures were described in **Section 13.8**; key species, and groups of species that are targets of mitigation measures are detailed below.

13.9.2 Key Mitigation for Target Species

Following a review of the baseline data, the key species (and groups of species) for which mitigation measures are required in order avoid, minimise and compensate for impacts of the project were identified. It is these key species (and groups of species) for which mitigation measures will be primarily designed and which will form the basis for determination of construction and operational phase targets for the project.

Key Species, and groups of species, are those which fulfill the following requirements:

- Species of conservation significance based upon criteria detailed in **Section 13.4.3.8** that have been reported in the impacted areas/habitats in numbers considered to be of significance since 1998; or
- Any species that, although not of conservation significance, has been recorded in the impacted areas/habitats in numbers sufficiently high to indicate that the distribution and abundance in Hong Kong or assessment area as a whole would be significantly impacted by the proposed development.

During the assessment process the baseline ecological data were reviewed and the species that meet these requirements were identified. Reasons for the identification of key species, the areas where these species will be impacted significantly and the locations where mitigation measures will be applied, together where these species are present and the mitigation measures required to meet these impacts are included in **Table 13.135**.

Table 13.135 – Key species and groups of species requiring mitigation measures

Species and Species Groups	Basis of qualification	Area where significant impacts predicted	Area for mitigation for which species is a Key Target	Mitigation measures for Key Target species/ Habitat requirements
Larger Ardeids (Eastern Cattle Egret, Grey Heron, Great Egret, Intermediate Egret, Little Egret, Chinese Pond Heron, and Black-crowned	All are species of conservation significance occurring in the Study Area in significant numbers; Eastern Cattle Egret, Little Egret and	Long Valley foraging areas; flight-lines from Ho Sheung Heung egretty to foraging areas, foraging areas along main river channels; also Man	Long Valley foraging areas; flight-lines from Ho Sheung Heung egretty; FLN area A1-7.	Early provision or enhancement of foraging ground before and during the advance stage work. Enhancement of wetland habitats and

Species and Species Groups	Basis of qualification	Area where significant impacts predicted	Area for mitigation for which species is a Key Target	Mitigation measures for Key Target species/ Habitat requirements
Night Heron).	Chinese Pond Heron breed at Ho Sheung Heung Egret, the latter two species also breed at Man Kam To Road egret.	Kam To egret in respect to Little Egret and Chinese Pond Heron.		non-wetland habitats in Long Valley; compensatory egret habitat provision at FLN area A1-7 for Little Egret and Chinese Pond Heron. Measures to minimize disturbance impacts Open and lightly vegetated wetland habitats.
Smaller Ardeids (Yellow Bittern, Von Schrenck's Bittern, Cinnamon Bittern, and Ruddy Crake) This last species is not an ardeid but is included here due to a shared requirement for well-vegetated wetlands	All are species of conservation significance occurring in the Study Area in significant numbers.	Long Valley.	Long Valley.	Enhancement of wetland habitats and non-wetland habitats in Long Valley. Measures to minimize disturbance impacts Well-vegetated wetland habitats.
Eurasian Teal	Species of conservation significance occurring in the Study Area in significant numbers.	Long Valley.	Long Valley.	Enhancement of wetland habitats and non-wetland habitats in Long Valley. Measures to minimize disturbance impacts Open wetland habitats (night)/ secure areas (day)
Japanese Quail	Species of conservation significance occurring in the Study Area in significant numbers.	Long Valley.	Long Valley.	Enhancement of non-wetland habitats in Long Valley. Measures to minimize disturbance impacts Dry agriculture.
Shorebirds, especially species associated with freshwater wetlands (Pheasant-tailed Jacana, Black-winged Stilt, Pied Avocet, Greater Painted-snipe, Oriental Pratincole, Pacific Golden Plover, Little Ringed Plover, Marsh Sandpiper, Common Greenshank, Wood Sandpiper, Swinhoe's Snipe, Temminck's Stint, Long-toed Stint)	All species of conservation significance occurring in the Study Area in significant numbers; except Little Ringed Plover which occurs in the Study Area in numbers of significance in a Hong Kong context.	Long Valley, some in Sheung Yue River.	Long Valley.	Enhancement of wetland habitats in Long Valley. Measures to minimize disturbance impacts Open and well-vegetated wetland habitats (also dry agriculture in the case of Little Ringed Plover).

Species and Species Groups	Basis of qualification	Area where significant impacts predicted	Area for mitigation for which species is a Key Target	Mitigation measures for Key Target species/ Habitat requirements
Pied & White-throated Kingfishers	Species of conservation significance occurring in the Study Area in significant numbers.	Long Valley.	Long Valley.	Enhancement of wetland habitats in Long Valley. Measures to minimize disturbance impacts Open wetland habitats.
Wetland-dependent passerine birds (Citrine Wagtail, Red-throated Pipit, Pechora Pipit, Buff-bellied Pipit, Bluethroat, Pallas's Grasshopper Warbler, Zitting Cisticola, Golden-headed Cisticola)	Species of conservation significance occurring in Long Valley significant numbers.	Long Valley.	Long Valley.	Enhancement of wetland habitats in Long Valley. Measures to minimize disturbance impacts Wet agricultural land and other vegetated wetland habitats ,
Passerine birds occurring in wet and dryland habitats in Long Valley (Chestnut-eared Bunting, Yellow-breasted Bunting, Japanese Yellow Bunting)	Species of conservation significance occurring in Long valley in significant numbers.	Long Valley.	Long Valley.	Enhancement of non-wetland habitats in Long Valley. Measures to minimize disturbance impacts Wet agricultural land and other vegetated wetland habitats, Dry agricultural land, bunds.
Reptiles recorded from Long Valley (Buff-striped Keelback, Many-banded Krait, Chinese Cobra, King Cobra)	Species of conservation significance recorded in Long Valley.	Long Valley.	Long Valley.	Enhancement of habitats in Long Valley. Relocation prior to works, if required. Well-vegetated habitats; cover.
Three-banded Box Terrapin	Species of conservation significance; only one individual identified but threat status and potential global significance of Hong Kong population warrants inclusion as a key species.	Ma Tso Lung Stream catchment.	Ma Tso Lung Stream catchment.	Habitat restoration and enhancement along lower section of Ma Tso Lung Stream. Relocation prior to works, if required. Clean streams in wooded areas.
Chinese Bullfrog	Species of conservation significance, widespread in the Study Area, albeit not in large numbers. Present in a number of locations where direct or indirect impacts are predicted.	Long Valley; Ma Tso Lung; development areas in KTN and FLN.	Long Valley (including translocation from elsewhere); Ma Tso Lung (where <i>in situ</i> mitigation measures are proposed.	Enhancement of wetland habitats in Long Valley. Relocation prior to works, if required. Well-vegetated wetland habitats.

Species and Species Groups	Basis of qualification	Area where significant impacts predicted	Area for mitigation for which species is a Key Target	Mitigation measures for Key Target species/ Habitat requirements
Two-striped Grass Frog	Local Concern; uncommon and restricted to a few sites in Hong Kong.	Long Valley.	Long Valley.	Enhancement of wetland habitats in Long Valley. Relocation prior to works, if required. Well-vegetated wetland habitats.
<i>Sommaniathelphusa zanklon</i>	Global Concern; has not been found outside Hong Kong.	Ma Tso Lung San Tsuen Stream, Tung Fong Watercourse, Tin Ping Shan Tsuen Watercourse.	Ma Tso Lung Stream, consider translocation to Long Valley	Set-back from and maintenance of hydrological continuity of Ma Tso Lung and Ma Tso Lung San Tsuen Stream, and restoration as natural stream course. Lotic wetland habitats, tolerant of organic pollution. Relocation prior to works, if required.

13.9.3 Habitat Creation and Management Plans

A Habitat Creation and Management Plan (HCMP) in respect of the LVNP should be drawn up by the Project Proponent, or designate, in advance of the commencement of the Project. This HCMP should address, but need not be limited to, final determination of target species and monitoring protocol; and the objectives, detailed design, implementation, maintenance, management and monitoring requirements for the LVNP.

To facilitate and inform preparation of this HCMP, measurement of the current levels of target species using wetland habitats of importance, or potential importance, for species or species groups of conservation significance that will be impacted by the Project, other than those only using wetland habitats or areas (for example Ma Tso Lung Stream and riparian corridor) for which other site or area-specific mitigation measures are proposed, will be required.

These habitats include wet agricultural land, marsh, pond, and mitigation wetland. In addition, in recognition that there is often a relatively rapid change in the areas of these habitats relative to dry agricultural land and lowland dry grassland and seasonally wet grassland, and in recognition of the use of some of these areas by small numbers of species of conservation significance, any areas of the latter habitats predicted to be impacted by the Project should also be surveyed.

The Preliminary Habitat Creation and Management Plan (HCMP) (**Appendix 13.10**) will provide the basis for preparation of the HCMP.

The Preliminary HCMP also provides additional details of the habitat enhancement mechanism and current conditions in Long Valley relevant to the future management objectives, in particular the experience that has been gained under the current and past MAs and discusses options for management of visitor access, while noting that all these matters require to be considered in more detail at a later stage, as well as explored via engagement with relevant stakeholders.

A Woodland Planting and Management Plan (WPMP) should be prepared for the proposed areas of compensatory woodland in advance of the commencement of the NDAs project by the Project Proponent, or designate, in advance of the commencement of the Project. This WPMP should address the objectives, detailed design, implementation, maintenance, management and monitoring requirements for the compensatory habitat provision.

An Egret Habitat Creation and Management Plan (EHCMP) for the creation and management of compensatory habitat required for the proposed area of compensatory egret habitat in the mitigation wetland at FLN area A1-7 by the Project Proponent, or designate, in advance of the commencement of the Project. This EHCMP should address monitoring protocol, objectives, detailed design, implementation, maintenance and management and monitoring requirements for the compensatory habitat provision and for any egrets existing before or during construction works.

The habitat to be created and enhanced in FLN area A1-7 will also be designed and managed to provide suitable habitat for Dingy Dusk Hawker, a dragonfly species only known in the Study Area from another mitigation wetland in FLN, which will be developed under the project. Measures to be undertaken in respect of this species should also be included in the scope of the EHCMP.

Site specific plans for possible relocation of fauna species of conservation concern and for additional mitigation for flora of species of concern identified before and during the construction phase.

13.9.4 Implementation, management and maintenance of recommended mitigation measures to avoid, minimise and compensate for ecological impacts

The tables below address the Study Brief requirement to define the scope, type, location, implementation arrangement, subsequent management and maintenance of measures required in order to avoid, minimise and compensate for the ecological impacts due to the implementation of the project. Cross-reference is made back to where this measure is proposed in **Section 13.8** of the EIA and forward to the EM&A Log Ref. (Project Implementation Schedule (PIS) Reference) in the Common Mitigation Measures Schedule of the **EM&A Manual Appendix 2.2**. Locations where construction phase barriers are required

to mitigate for disturbance impacts are shown in **Figure 13.15** and are also specified, with reference to the revised RODP areas, in the **EM&A Manual Appendix 2.2**.

Note that where 'N/A' is stated in this table, this refers to the measure not been of relevance to the applicable stage of the project; maintenance and management agents are identified wherever these are required.

Measures to minimise hydrological, dust and water pollution impacts are dealt with in the relevant sections of the EIA Report.

13.9.4.1 Impacts on habitats of ecological importance

Table 13.136 - Mitigation for direct loss of wetland and woodland habitats

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
1.1/13.8.2.1	Mitigation for direct loss of wetland habitats				
1.1.1/ 13.8.2.1/ E4	Long Valley Nature Park (LVNP) designation, design, and implementation.	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan (LVNP HCMP)).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	N/A.	N/A.
1.1.2/ 13.8.2.1/ E15, E25	Enhancement of wetland habitats in LVNP.	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan LVNP HCMP).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	Project proponent /contractor (implementation of design of mitigation measures).	AFCD (management, maintenance and monitoring).
1.2.3/ 13.8.2.1/ E2, E14	Compensation for loss of seasonally wet grassland at Ma Tso Lung by habitat restoration and enhancement along diverted section of Ma Tso Lung Stream.	Project proponent (design of Ma Tso Lung Stream diversion and buffer zone habitat restoration measures).	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	Government land allocatee.
1.2/13.8.2.1	Mitigation for direct loss of woodland habitats				
1.2.1/ 13.8.2.1/ E1, E18, E27	Compensatory woodland planting.	Project proponent (Woodland Planting and Management Plan WPMP).	Project proponent pre-construction baseline data collection and evaluation; WPMP review).	Project proponent / contractor (implementation of mitigation measures) for 2 years.	AFCD (management and maintenance) for 9 years, after which the woodland will be handed over to LandsD for <i>ad</i>

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
					<i>hoc</i> maintenance.

13.9.4.2 Indirect, fragmentation and cumulative impacts on habitats of ecological importance

Table 13.137 - Mitigation for indirect, fragmentation and cumulative impacts on Long Valley

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
2.1.1 13.8.2.2/ E15, E25	Long Valley Nature Park (LVNP) designation, design, and implementation including measures to redistribute wetland habitats in LVNP to concentrate closed wetland habitats (marsh and reed marsh) in areas closest to disturbance sources; and to stock fish as food to compensate for disturbance to foraging areas in main river channels and elsewhere.	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan (LVNP HCMP)).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	Project proponent /contractor (implementation of design of mitigation measures and monitoring prior to handover to AFCD).	AFCD (management, maintenance and monitoring).
2.1.2/ 13.8.2.2/ E5	Stringent planning control requirements in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung Egrettry.	PlanD (guidelines for stringent planning control detailed and explained in Layout Plan).	N/A.	N/A.	N/A.
2.1.3/ 13.8.2.2/ E7	Building setback from Long Valley (30m setback from Road D3 in KTN area B3-12) and mounding and planting in KTN area C1-1.	PlanD/ LandsD (detailed and explained in Layout Plan)).	N/A.	N/A.	N/A.
2.1.4/ 13.8.2.2/ E13	No construction during ardeid breeding season (1 st March to 31 st July) along Sheung Yue River north and east of KTN area D1-5 and east of D1-9 and C2-3, including no works under this project within KTN areas C2-1 and C1-8 (Open	N/A.	N/A.	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	Space), including any works on or to the bridge over the Sheung Yue River between areas C2-1 and C1-8, and restriction of working hours on new pedestrian bridge over the Sheung Yue River to 09.00 to 17.30 during the ardeid breeding season.				
2.1.5/ 13.8.2.2/ E16, E17	Erection of 2m high solid dull green site barrier fence between works areas and LVNP and Long Valley north and west of the Sheung Yue River.	Project proponent detailed design consultant (formulation of detailed design of the fence)	N/A.	Contractor.	N/A.
2.1.6/ 13.8.2.2/ E11	Review design and construction methods for all bridges especially those on the Sheung Yue and tidal Ng Tung Rivers and adopt methods which minimise impacts on Long Valley and disturbance and fragmentation impacts on fauna.	Project proponent/ detailed design consultant (detailed design of bridges).	N/A.	N/A.	N/A.
2.1.7/ 13.8.2.2/ E11	Avoid removal or interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung project.	Project proponent/ Detailed design consultant.	N/A.	Contractor.	N/A.

Table 13.138 - Measures to minimise disturbance and fragmentation impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers and to minimise fragmentation impacts on linkages with the Deep Bay wetland ecosystem

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
2.2.1/ 13.8.2.2/ E5	Stringent planning control in Long Valley north and east of the Sheung Yue River to minimise disturbance and fragmentation impacts on large waterbirds foraging and using the flight-line along the non-tidal	PlanD (guidelines for stringent planning control detailed and explained in Layout Plan).	N/A.	N/A.	N/A

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	section of the Ng Tung River.				
2.2.2/ 13.8.2.2/ E6	Planning for retention of existing trees in Open Space zones along the Sheung Yue, Ng Tung and Shek Sheung Rivers and incorporation of these in screen planting along the rivers in the detailed design of these Open Space zones.	Project proponent/ detailed design consultant (detailed design of Green Corridors along watercourses and detailed design of Open Space areas and development areas along river corridors.	Project proponent (pre-construction baseline data collection and evaluation).	Contractor.	Government land allocatee/ contractor
2.2.3/ 13.8.2.2 E16	Erection of 2m high solid dull green site barrier fence between river channel and any active works area along or adjacent to Ng Tung, Sheung Yue and Shek Sheung Rivers.	Project proponent detailed design consultant (formulation of detailed design of the fence)	N/A.	Contractor.	N/A.
2.2.4/ 13.8.2.2/ E7	Building setback from Long Valley (30m setback from road D3 in KTN area B-12), will also reduce disturbance impact on Sheung Yue River.	PlanD/Lands D (detailed and explained in Layout Plan).	N/A.	N/A.	N/A.
2.2.5/ 13.8.2.2/ E13	No construction during ardeid breeding season (1 st March to 31 st July) along Sheung Yue River north and east of KTN area D1-5 and east of D1-9 and C2-3 and restriction of working hours on new pedestrian bridges over the Sheung Yue River and tidal Ng Tung River to 09.00 to 17.30 during the ardeid breeding season (1 st March to 31 st July).	N/A.	N/A.	Contractor.	N/A.
2.2.6/ 13.8.2.2/ E11	Review design and construction methods for all bridges especially those on the Sheung Yue and tidal Ng Tung Rivers and adopt methods which minimise impacts on rivers and disturbance	Project proponent/ detailed design consultant (detailed design of bridges).	N/A.	N/A.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	and fragmentation impacts on fauna				
2.2.7/ 13.8.2.2/ E11	Avoid removal or interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung project.	Project proponent/ Detailed design consultant.	N/A.	Contractor.	N/A.

Table 13.139 - Measures to avoid disturbance, fragmentation, hydrological and cumulative impacts on Ma Tso Lung Stream and stream corridor habitats

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
2.3.1/ 13.8.2.2, 13.8.2.7/ E2	Detailed design of development along lower reaches of Ma Tso Lung Stream in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road).	Project proponent/ detailed design consultant.	N/A.	N/A.	N/A.
2.3.2/ 13.8.2.2/ E14	Buffer zone of 15-30m as appropriate on both sides of Ma Tso Lung Stream north of the point where it is crossed by the LMC Loop Eastern Connection Road, and Ma Tso Lung Stream diversion during construction of the LMC Loop Eastern Connection Road; development along lower reaches of Ma Tso Lung Stream and Ma Tso Lung Tsuen Stream in OU zones in KTN areas F1-2 and F1-3 to be set back beyond buffer.	PlanD (detailed and explained in Layout Plan)/ Project proponent/ Detailed design consultant/ building designer.	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	N/A.
2.3.3/ 13.8.2.2/ E14	Construction and maintenance of permanent 1.2m high solid faunal barrier at all at-grade sections of LMC Loop Eastern Connection Road north of junction with road D4 within 15-30m as appropriate of Ma Tso Lung Stream buffer and construction of faunal underpass beneath road.	Project proponent/ Detailed design consultant.	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	N/A.
2.3.4/ 13.8.2.2/ E14	Erection of a 2m high dull green site barrier fence at	N/A.	N/A	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
E17	interface between active works areas and riparian corridor of Ma Tso Lung Stream and tributaries.				

Table 13.140 - Measures to avoid disturbance and hydrological impacts on Siu Hang San Tsuen Watercourse, Mitigation of Impacts on Ma Wat River and Measures to Avoid Hydrological Impacts on Long Valley due to rechannelisation of Long Valley Watercourse

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
2.4	Measures to avoid disturbance and hydrological impacts on Siu Hang San Tsuen Watercourse				
2.4.1/ 13.8.2.2/ E3	Detailed design of works in lower section of Siu Hang San Tsuen Stream to have 10m wide vegetated buffer in Open Space zone in FLN area D1-3, Fanling Bypass to cross stream on viaduct, all stream within NDAs to have permanent buffer on either side of stream.	PlanD, Project proponent / Detailed design consultant (explained in Layout Plan/ incorporated in detailed design).	N/A.	Contractor.	Maintenance authorities.
2.5	Mitigation of Impacts on Ma Wat River				
2.5.1/ 13.8.2.2/ E21	Pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of any protected flora and fauna and flora of conservation significance and bat roosts. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, transplantation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.	N/A	Project Proponent/ Contractor/ Ecologist.	Contractor.	N/A.
2.5a	Avoidance of Hydrological Disruption to Long Valley Watercourse				
2.5a.1/	Measures to ensure no	Project	N/A.	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
13.8.2.2/ E11	hydrological disruption to Long Valley Watercourse and water supply to Long Valley to be designed at the detailed design stage for the rechannelisation of the Long Valley Watercourse and the development of areas through which it passes, including KTN area B3-12. Contingency plan to address any disruption to be included in LVNP HCMF	proponent/ Detailed design consultant.			

Table 13.141 – Mitigation of Impacts on Habitats of Ecological Importance

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
2.6	Avoidance and minimization of habitat loss; mitigation of disturbance impacts on habitats of ecological importance not specified above (including ponds along the Ng Tung River in KTN and FLN; mitigation wetland at FLN area; shrubland at Crest Hill; <i>fung shui</i> and secondary woodland at Ho Sheung Heung; secondary woodland at Siu Hang San Tsuen; hillside plantation; mitigation plantation)				
2.6.1/ 13.8.2.2/ E17	Erection of 2m high solid green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including any roads adjacent to or penetrating into areas/habitats of ecological importance.	Project proponent/ detailed design consultant (detailed design of barrier)	N/A.	Contractor.	N/A.
2.6.2/ 13.8.2.2/ E6	Retention of existing mitigation plantation trees in Open Space zones along the Sheung Yue, Ng Tung and Shek Sheung Rivers and incorporation of these in screen planting along the rivers in the detailed design of these Open Space zones.	Project proponent/ detailed design consultant (detailed design of Green Corridors along watercourses and detailed design of Open Space areas and development areas along river corridors).	Project proponent (pre-construction baseline data collection and evaluation).	Contractor.	Government land allocatee/ contractor
2.6.3/	Review development	Project	N/A.	N/A.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
13.8.2.1/ E10	footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland at Ho Sheung Heung and Crest Hill.	proponent/ Detailed design consultant.			
3.1	Mitigation of ecological impacts of loss of village, urban/residential areas and waste ground habitats				
3.1.1/ 13.8.2.3/ LV7, LV11, LV12.	As no significant ecological impact predicted, ecological mitigation is not required. However, planning for compensation for landscape and visual impact of loss of trees, woodland and shrubland by compensatory planting in open spaces, amenity areas, open areas in streetscapes and open areas in development lots (LV7); screen planting (LV11) and road greening (LV12).	Project proponent/ detailed design consultant.	N/A.	N/A.	N/A.
4.1	Mitigation of impacts of dust, construction run-off and pollution impacts on habitats/areas of ecological significance, watercourses and the Deep Bay Catchment				
4.1.1/ 13.8.2.5, 13.8.2.6/ E22; D1-4, W1-4.	Prevention of dust, run-off and pollutants entering watercourses and Deep Bay Catchment	N/A.	N/A.	Contractor.	N/A.

13.9.4.3 Impacts on fauna and flora

Table 13.142 – Mitigation of impacts to flora of conservation significance at Ho Sheung Heung *fung shui* and secondary woodland and elsewhere in the Study Area

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.1.1/ 13.8.2.6/ E17	Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance.	Project proponent/ detailed design consultant (detailed design of barrier).	N/A.	Contractor.	N/A.
5.1.2/ 13.8.2.6/	Pre-site clearance check on all construction sites	N/A.	Project Proponent/	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
E20	and pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of protected plant species/ specimens of conservation significance. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.		Contractor/ ecologist		
5.1.3/ 13.8.2.6/ E10	Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland at Ho Sheung Heung and Crest Hill.	Project proponent/ Detailed design consultant.	N/A.	N/A.	N/A.

Table 13.143 – Mitigation of mortality impacts on fauna.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.2	Mitigation of mortality impacts on mammals and herpetofauna				
5.2.1/ E17	Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance.	Project proponent/ detailed design consultant (detailed design of barrier)	N/A.	Contractor.	N/A.
5.2.2/ 13.8.2.6/ E20, E21	Pre-site clearance check on all construction sites and pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of mammals and	N/A.	Project Proponent/ Contractor/ Ecologist.	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	herpetofauna of conservation significance. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.				
5.2.3/ 13.8.2.6/ E14	Construction of permanent 1.2m high solid faunal barrier at all at-grade sections of LMC Loop Eastern Connection Road north of junction with road D4 within 15-30m as appropriate of Ma Tso Lung Stream buffer and construction of faunal underpass beneath road.	Project proponent/ Detailed design consultant	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	N/A.
5.2.4/ 13.8.2.2/ E17	Erection of a 2m high dull green site barrier fence at interface between active works areas and riparian corridor of Ma Tso Lung Stream and tributaries.	Project proponent/ detailed design consultant (detailed design of barrier)	N/A	Contractor.	N/A.
5.3	Mitigation of mortality impacts on bats				
5.3.1/ 13.8.2.6/ E20, E21	Pre-site clearance check on all construction sites for presence of bat roosts. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.	N/A.	Project Proponent/ Contractor/ Ecologist.	Contractor.	N/A.
5.4	Mitigation of mortality impacts on birds				
5.4.1/ 13.8.2.6/ E8	Preparation and implementation of Guidelines for building design measures to minimise mortality and light and glare impacts to fauna. Guidelines to address the following measures: Use opaque, non-transparent, non-reflective noise barriers for all developments associated with the Project. Measures to include the following:	PlanD/ Project proponent (roads)/ Detailed design consultant / building designer.			

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	<ul style="list-style-type: none"> • Fritting, or the placement of ceramic lines or dots on glass, which has little effect on the human-perceived transparency of the window but creates a visual barrier to birds outside. This treatment also has the advantage of reducing air conditioning loads by lowering heat gain, while still allowing light transmission for interior spaces. It is most successful when the frits are applied on the outside surface. Frosted glass has similar effects; • Angled glass to be used only for smaller panes in buildings with a limited amount of glass; • The use of glass that reflects UV light (primarily visible to birds, but not to humans) to reduce collisions; • Film and art treatment allow glass surfaces to be used a medium of expression, often related to the nature and use of the building, as well indicating to birds their impenetrability; • Lightweight external screens can be added to windows or become a façade element of larger buildings, and are suitable where non-operable windows are prevalent. 				
5.4.2/ 13.8.2.6/ E28	Use opaque, non-transparent, non-reflective noise barriers for all roads. Unnecessary lighting should be avoided. Potential impacts of nocturnal avian collision with buildings should be minimised by not creating sky glow from the use of night-time lighting at or near the top of buildings or other structures. In addition to avoiding uplighting, light spillage should be minimised, while green and blue lights should be used where possible. As far as possible, building operations should be managed in such a way as reduce or eliminate night lighting near windows.	N/A.	N/A.	N/A.	Maintenance authorities/ operator.
5.4.3/ 13.8.2.6/ E20, E21.	Pre-site clearance check on all construction sites and pre-works commencement check	N/A.	Project Proponent/ Contractor/	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	on watercourses to be physically and/or hydrologically impacted by construction activities for presence of birds of conservation significance. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.		ecologist		

Table 13.144 – Mitigation of impacts on wetland-dependent bird species of conservation significance

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.5.1/ 13.8.2.6 E4, E15, E25	Long Valley Nature Park (LVNP) designation, design, and implementation including measures to redistribute wetland habitats in LVNP to concentrate closed wetland habitats (marsh and reed marsh) in areas closest to disturbance sources; and to stock fish as food to compensate for disturbance to foraging areas in main river channels and elsewhere..	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan LVNP HCMP).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	Project proponent/ Contractor.	AFCD/ Contractor (if required).
5.5.2/ 13.8.2.6/ E5	Stringent planning control requirements in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung Egret.	PlanD (guidelines for stringent planning control detailed and explained in Layout Plan).	N/A.	N/A.	N/A.
5.5.3/ 13.8.2.2/ E7	Building setback from Long Valley (30m setback from Road D3 in KTN area B3-12) and mounding and planting in KTN area C1-1.	PlanD/ LandsD (detailed and explained in Layout Plan).	N/A.	N/A.	N/A.
5.5.4/ 13.8.2.2/ E13	No construction during ardeid breeding season (1 st March to 31 st July) along Sheung Yue River north and east of KTN area D1-5 and east of D1-9 and C2-3 and restriction of	N/A.	N/A.	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	working hours on new pedestrian bridge over the Sheung Yue River and non-tidal section of the Ng Tung River to 09.00 to 17.30 during the ardeid breeding season (1 st March to 31 st July).				
5.5.5/ 13.8.2.7/ E6	Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development areas along river corridors to provide screening of rivers.	Project proponent/ detailed design consultant.	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	N/A.	N/A.
5.5.6/ 13.8.2.6/ E16	Erection of 2m high solid dull green site barrier fence between river channel and any active works area along or adjacent to Ng Tung, Sheung Yue and Shek Sheung Rivers.	Project proponent/ detailed design consultant (detailed design of barrier)	N/A.	Contractor.	N/A.
5.5.7/ 13.8.2.6/ E17	Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance.	Project proponent/ detailed design consultant (detailed design of barrier)	N/A.	Contractor.	N/A.
5.5.8/ 13.8.2.6/ E21	Pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of wetland bird species of conservation significance. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.	N/A.	Project Proponent/ Contractor/ ecologist	Contractor.	N/A.
5.5.9/ 13.8.2.6/ E11	Review design and construction methods for all bridges especially those on the Sheung Yue and tidal Ng Tung Rivers and adopt methods which minimise impacts on rivers and disturbance and	Project proponent/ detailed design consultant (detailed design of	N/A.	N/A.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	fragmentation impacts on fauna.	bridges).			
5.5.10/ 13.8.2.2/ E11	Avoid removal or interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung project.	Project proponent/ Detailed design consultant.	N/A.	Contractor.	N/A.
5.5.11/13.8.2.2/E11	Scheduling to avoid overlap in construction of bridges over rivers.	Project proponent/ Detailed design consultant.	N/A	Contractor	N/A

Table 13.145 – Mitigation of impacts on non wetland-dependent bird species of conservation significance

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.6.1/ 13.8.2.6 E4, E15, E25	Long Valley Nature Park (LVNP) designation, design, implementation and design.	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan (LVNP HCMP) will include formulation of enhancement measures for non-wetland habitats).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	N/A.	N/A.
5.6.2/ 13.8.2.6/ E5	Stringent planning control requirements in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung Egretty.	PlanD (guidelines for stringent planning control detailed and explained in Layout Plan).	N/A.	N/A.	N/A.
5.6.3/ 13.8.2.7/ E6	Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development	Project proponent/ detailed design consultant.	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP	N/A.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	areas along river corridors to provide screening of rivers.		review).		
5.6.4/ 13.8.2.6/ E4, E15, E25	Enhancement of non-wetland habitats in LVNP.	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan LVNP HCMP).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	Project proponent /contractor (implementation of design of mitigation measures).	AFCD (management, maintenance and monitoring).
5.6.5/ 13.8.2.6/ E18, E27	Compensatory native woodland planting, management and maintenance.	Project proponent (formulation of woodland planting and management plan.	N/A	Project proponent/ Contractor for 2 years.	AFCD (management and maintenance) for 9 years, after which the woodland will be handed over to LandsD for <i>ad hoc</i> maintenance).
5.6.6/ 13.8.2.6/ E16, E17	Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance.	Project proponent/ detailed design consultant (detailed design of barrier	N/A.	Contractor	N/A.
5.6.7/ 13.8.2.2/ E11	Avoid removal or interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung project.	Project proponent/ Detailed design consultant.	N/A.	Contractor.	N/A.
5.6.8/ 13.8.2.6/ E10	Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland at Ho Sheung Heung and Crest Hill.	Project proponent/ Detailed design consultant.	N/A.	N/A.	N/A.

Table 13.146 – Mitigation of impacts on Eurasian Hobby and Grey Nightjar

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.7	Mitigation of impacts on Eurasian Hobby				
5.7.1/ 13.8.2.6/ E20	Pre-site clearance of construction sites in Crest Hill area (KTN areas D1-7, D1-11 and G1-5) for presence of any breeding birds/breeding site. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.	N/A.	Project Proponent/	Pre-site clearance check on all construction sites for presence of species of conservation significance.	N/A.
5.7.2/ 13.8.2.6/ E17	Erection of 2m high solid dull green site barrier fence between active works areas sites in KTN areas D1-7, D1-11 and G1-5 and all areas/habitats of natural habitat.	Project proponent/ detailed design consultant (detailed design of barrier	N/A.	Contractor	N/A.
5.8	Mitigation of impacts on Grey Nightjar				
5.8.1/ 13.8.2.6/ E20	Pre-site clearance of construction site on Cheung Po Tau (FLN area A3-1) for presence of any breeding birds/breeding site. If any of these are found consider adjustments to avoid, minimise and compensate for impacts; including adjustments to design, timing of works, translocation and translocation. Seek agreement of AFCD in respect of proposed measures then implement.	N/A.	Project Proponent/	Pre-site clearance check on all construction sites for presence of species of conservation significance.	N/A.
5.8.2/ 13.8.2.6/ E17	Erection of 2m high solid dull green site barrier fence between active works areas in FLN area A3-1 and all areas/habitats of natural habitat.	Project proponent/ detailed design consultant (detailed design of barrier	N/A.	Contractor	N/A.

Table 13.147 – Mitigation of impacts on Egrettries and Egretty Flight-lines

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.9.1/	Egretty Habitat Creation &	Project	Project	Contractor.	Maintenance

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
13.8.2.6/ E1, E12, E23	Management Plan (EHCMP) and compensatory egret habitat provision in FLN area A1-7.	proponent/ Detailed design consultant (EHCMP)	proponent/ detailed design consultant.		authority.
5.9.2/ 13.8.2.6/ E5	Stringent planning control requirements in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung Egret.	PlanD (guidelines for stringent planning control detailed and explained in Layout Plan).	N/A.	N/A.	N/A.
5.9.3/ 13.8.2.6/ E6	Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development areas along river corridors.	Project proponent/ detailed design consultant.	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	N/A.	N/A.
5.9.4/ 13.8.2.6/ E13	No construction during ardeid breeding season (1 st March to 31 st July) along Sheung Yue River north or east of KTN D1-5 and east of D1-9 and C2-3 and restriction of working hours on new pedestrian bridges over the Sheung Yue and Ng Tung Rivers to 09.00 to 17.30 during this period.	N/A.	N/A.	Contractor.	N/A.
5.9.5/ 13.8.2.6/ E11	Review design and construction methods for all bridges especially those on the Sheung Yue and tidal Ng Tung Rivers and adopt methods which minimise impacts on rivers and disturbance and fragmentation impacts on fauna. Phasing of so that there is no overlap in construction timing.	Project proponent/ detailed design consultant (detailed design of bridges).	N/A.	N/A.	N/A.
5.9.6/ 13.8.2.6/ E4, E15, E25	Long Valley Nature Park (LVNP) designation, design, and implementation including measures to redistribute wetland habitats in LVNP to concentrate closed wetland habitats (marsh and reed marsh) in areas closest to disturbance sources; and to stock fish as food to compensate for disturbance to foraging	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan LVNP HCMP).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	Project proponent/ Contractor.	AFCD/ Contractor (if required).

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	areas in main river channels and elsewhere..				
5.9.7/ 13.8.2.6/ E16	Erection of 2m high solid dull green site barrier fence between river channel and any active works area along or adjacent to Ng Tung, Sheung Yue and Shek Sheung Rivers.	N/A.	N/A.	Contractor.	N/A.
5.9.8/ 13.8.2.2/ E11	Avoid removal or interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung project.	Project proponent/ Detailed design consultant.	N/A.	Contractor.	N/A.

Table 13.148 – Mitigation of impacts on Three-banded Box Terrapin, Chinese Bullfrog and other herpetofauna

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.10	Mitigation for impacts on herpetofauna				
5.10.1/ 13.8.2.6/ E17	Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance.	Project proponent/ detailed design consultant (detailed design of barrier	N/A.	Contractor	N/A.
5.10.2/ 13.8.2.6/ E21	Pre-site clearance check on all construction sites for presence of reptile species of conservation significance, capture and translocate to receptor site; review translocation options in respect to species in Ma Tso Lung area and determine whether release locally or elsewhere is appropriate. Seek agreement of AFCD in respect of proposed measures then implement.	N/A.	Project Proponent/ Contractor/ ecologist	Contractor.	N/A.
5.11	Mitigation for impacts on Three-banded Box Terrapin and other reptiles using Ma Tso Lung Stream				

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.11.1/ 13.8.2.2, 13.8.2.7/ E2	Detailed design of development along lower reaches of Ma Tso Lung Stream in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road.	Project proponent/ detailed design consultant.	N/A.	N/A.	N/A.
5.11.2/ 13.8.2.2/ E14	Buffer zone of 15-30m as appropriate on both sides of Ma Tso Lung Stream north of the point where it is crossed by LMC Loop Eastern Connection Road, and Ma Tso Lung Stream diversion during construction of the LMC Loop Eastern Connection Road; development along lower reaches of Ma Tso Lung and Ma Tso Lung San Tsuen Streams in OU zones in KTN areas F1-2 and F1-3 to be set back beyond buffer.	PlanD (detailed and explained in Layout Plan)/ Project proponent/ Detailed design consultant/ building designer.	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	N/A.
5.11.3/ 13.8.2.2/ E14, E25	Construction and maintenance of permanent 1.2m high solid faunal barrier at all at-grade sections of LMC Loop Road north of junction with road D4 within 15-30m as appropriate of Ma Tso Lung Stream buffer and construction of faunal underpass beneath LMC Loop Eastern Connection Road.	Project proponent/ Detailed design consultant.	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	Maintenance Authorities.
5.11.4/ 13.8.2.2/ E17	Erection of a 2m high dull green site barrier fence at the edge of the works area or 30m from the Ma Tso Lung Stream and tributaries, whichever distance is the greater.	Project proponent/ detailed design consultant (detailed design of barrier	N/A	Contractor.	N/A.
5.12	Mitigation for impacts on Chinese Bullfrog				
5.12.1/ 13.8.2.6/ E4, E15, E25	Creation and operation of Long Valley Nature Park and creation and enhancement of wetland within LVNP.	Project proponent (formulation of Long Valley Nature Park Habitat Creation & Management Plan LVNP HCMP).	Project proponent (pre-construction baseline data collection and evaluation; LVNP HCMP review).	Contractor.	AFCD.
5.12.2/	Pre-site clearance check	N/A.	Project	Contractor.	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
13.8.2.6/ E20	on all construction sites for presence of Chinese Bullfrog, translocation to LVNP.		Proponent/ Contractor/ ecologist		

Table 13.149 – Mitigation for impacts on butterflies

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.13	Butterflies				
5.13.1/ 13.8.2.6/ E17; D1-4	Prevention of dust impact from active works areas from sites adjacent to Ho Sheung Heung and Crest Hill woodland and shrubland in KTN areas D1-7, D1-11 and G1-3.	N/A.	N/A.	Contractor	N/A.
5.13.2/ 13.8.2.6/ E10	Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland at Ho Sheung Heung and Crest Hill.	Project proponent/ Detailed design consultant.	N/A.	N/A.	N/A.

Table 13.150 – Mitigation for impacts on Small Snakehead and *Sommaniathelphusa zanklon*

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
5.15.1/ 13.8.2.2, 13.8.2.7/ E2	Detailed design of development along lower reaches of Ma Tso Lung Stream in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road.	Project proponent/ detailed design consultant.	N/A.	N/A.	N/A.
5.15.2/ 13.8.2.2/ E14	Buffer zone of 15-30m as appropriate on both sides of Ma Tso Lung Stream north of the point where it is crossed by the LMC Loop Eastern Connection Road, and Ma Tso Lung Stream diversion during construction of the LMC Loop Eastern Connection Road; development along lower reaches of Ma Tso Lung and Ma Tso Lung San Tsuen Streams in OU zones in KTN areas F1-2	PlanD (detailed and explained in Layout Plan)/ Project proponent/ Detailed design consultant/ building designer.	Project proponent (pre-construction baseline data collection and evaluation).	Project proponent /contractor (implementation of mitigation measures).	N/A.

Mitigation Measure No./ Section Ref./PIS Ref	Proposed mitigation measure	Detailed design stage	Pre-construction Stage	Construction Stage	Operational Stage
	and F1-3 to be set back beyond buffer.				
5.15.3/ 13.8.2.6/ E21	Pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of Small Snakehead and <i>Sommaniathelphusa zanklon</i> . Capture any <i>Sommaniathelphusa zanklon</i> found and translocate to Ma Tso Lung Stream/ consider option to translocate to LVNP.	N/A.	Project Proponent/ Contractor/ ecologist	Contractor.	N/A.

13.10 Residual Impacts

This section addresses the requirements of Section 3.4.14.4(xi) and (xii) of the Study Brief. As described in the TM-EIAO, in evaluating residual impacts, more weight is given to adverse impacts that occur in areas that are ecologically fragile and/or rare or undisturbed, or which have little resilience to imposed stresses.

Mitigation measures and predicted residual impacts are summarised below in accordance with Section 5.4.5(b) and (c) of Annex 16 of the EIAO TM, residual impacts with on-site mitigation measures are defined, quantified, where possible, and evaluated.

Table 13.151 - Potential Total Residual Direct, Indirect, Fragmentation and Cumulative Impacts on Habitats and their severity

Habitat/ Impact	Mitigation	Residual Impacts
<p>Long Valley</p> <p>Disturbance of Long Valley habitats (Low Severity during construction, lower, but still significant during operation).</p> <p>Dust deposition, increased sediment and nutrient load: Low in construction phase, not significant in operational phase.</p> <p>Hydrological disruption of Long Valley habitats (Low to High)</p> <p>Pollution of Long Valley habitats dependent upon type, but most likely Low to Moderate during construction and Low during operation.</p> <p>Fragmentation impact on Long Valley Low to Moderate during construction and Low during Operation, except on some waterbirds in the southwestern part of Long Valley closest to proposed development areas where impact severity will remain Low to Moderate.</p> <p>Combined disturbance and fragmentation impacts Low to Moderate during construction and Low during operation.</p> <p>Cumulative disturbance and fragmentation impacts with the Sha Po Tsuen to Shek Sheung River Cycle track project Low during construction and operation with the proper implementation of mitigation measures.</p>	<p>Permanent:</p> <p>Designation of area south and east of the Sheung Yue River as LVNP (37ha); preparation and implementation of HCMP to enhance wetland and non-wetland habitats (1.1.1 & 1.1.2).</p> <p>Enhancement of wetland habitats in LVNP, redistribution of wetland habitats to place closed habitats (marsh and reed marsh) in areas closest to disturbance sources; fish stocking to compensate for disturbance to foraging areas (1.1.2 & 2.2.1).</p> <p>Screen planting to be enhanced along river channels, subject to constraint of need to avoid loss of wetland area or function (2.2.2).</p> <p>Avoidance of interference with screen planting undertaken by the Sha Po Tsuen to Shek Sheung River Cycle track project (2.1.7).</p> <p>Visitor management in LVNP (1.1.2).</p> <p>Stringent planning requirements in Long Valley north and west of the Sheung Yue River to be detailed in Layout Plan (2.1.2).</p> <p>Building setback of 30m from road D3 in KTN area B13-12 and mounding and planting in KTN area C1-1 (2.1.3). Review of design and construction methods for all bridges especially those on the</p>	<p>With the designation and management of LVNP, the area in Long Valley under active conservation management will increase from 12ha to 37.17ha. In addition, integrated management of the area as a whole will significantly increase the effectiveness and value of conservation management measures. Accordingly, there will be a positive residual impact on the LVNP area during the operational phase of the Project.</p> <p>Long Valley north and west of the Sheung Yue River will retain its current ecological function and value and this will increase once planning measures take effect and if more land is brought under MAs. Accordingly, there will be a net positive residual impact on Long Valley during the operational phase of the project.</p> <p>With measures to mitigate for construction phase impacts from dust, pollution or hydrological disruption, these will not be of significance during either construction or operation of the Project.</p> <p>With measures to mitigate for construction phase disturbance impacts in place there may be some redistribution of large waterbirds away from the southwest of Long Valley. Accordingly there may be a Low residual construction phase impact on larger waterbird species in this part of Long Valley. Such an impact is considered to be acceptable as there will be no impact on more disturbance-sensitive species in Long Valley as a whole and no significant impact on the ecological function of Long Valley habitat arising from the project.</p> <p>(To further reduce potential impacts</p>

Habitat/ Impact	Mitigation	Residual Impacts
	<p>Sheung Yue River and adoption of methods which will minimise impacts on Long Valley and disturbance and fragmentation impacts on fauna in Long Valley and using flight-lines between Long Valley and elsewhere (2.1.6).</p> <p>Measures to ensure no disruption to Long Valley Watercourse to be designed at detailed design stage for rechannelisation of Long Valley Watercourse and areas through which it flows including KTN area B3-12 and contingency plan to address any disruption to be included in LVNP HCMP (2.5a.1).</p> <p>Construction:</p> <p>Measures to prevent dust impact on sensitive receivers (4.1.1).</p> <p>Measures to control construction run-off and pollution (4.1.1).</p> <p>Measures to ensure reliable water supply to be required under LVNP HCMP (1.1.1 and 1.1.2) and to minimise water quality impact due to stream diversion (4.1.1).</p> <p>No works permitted in ardeid breeding season (1st March to 31st July) north or east of KTN area D1-5 and of D1-9 and C2-3 and restriction of working hours on new pedestrian bridge over Sheung Yue River during ardeid breeding season (2.1.4).</p> <p>Erection of 2m high dull green site boundary fence between Long Valley and any works areas (2.1.5).</p> <p>Enhancement of wetland habitats in LVNP, redistribution of wetland habitats to place closed habitats (marsh and reed marsh) in areas closest to disturbance, fish stocking as supplementary management measure available if required to ensure that there is no reduction in ecological function for large waterbirds during the construction phase (1.1.2 & 5.5.1).</p> <p>Review of bridge design and construction methods during</p>	<p>and to strengthen the carrying capacity of Long Valley area for large waterbirds potentially affected during the advance works stage before full establishment of the LVNP, supplementary fish stocking to provide food for the most disturbance-sensitive species which occur in Long Valley in significant numbers is available as a management tool)</p>

Habitat/ Impact	Mitigation	Residual Impacts
	detailed design phase to ensure that disturbance impacts from these sources are minimised (2.2.6).	
<u>Wet Agricultural land</u> Permanent loss of 0.58ha (Low to Moderate). Disturbance (Low during construction/operation).	Permanent Loss of wet agricultural land would be mitigated by enhancement of wetland habitats (including wet agricultural land) in LVNP (1.1.1 & 1.1.2).	With provision of on-site mitigation measures, the diversity of wet agricultural crops in LVNP will be increased and the ecological value of wet agricultural land will increase; no significant residual impact is predicted.
<u>Dry Agricultural Land</u> Permanent loss of 9.33ha (Low). Disturbance (Low during construction/operation).	Permanent No mitigation required. However dry agricultural land will be enhanced in LVNP (1.1.1 & 1.1.2). Construction Phase Erection of 2m high dull green site boundary fence between dry agricultural land north of the Ng Tung River and any works areas (2.6.1).	With provision of mitigation measures, the diversity of dry agricultural crops in LVNP will be increased and the ecological value of dry agricultural land will increase; creating a positive residual impact.
<u>Pond</u> Permanent loss of 3.08ha (Low for small fragmented ponds (0.59ha) and Low to Moderate (2.12ha) and Moderate (0.37ha) for larger ponds and/or with significant ecological linkages). The total loss requiring mitigation is 2.49ha. Disturbance of pond (Low to Moderate during construction and operation). Run-off and hydrological disruption (Low during construction and operation). Combined impacts Low to Moderate during construction and Low during operation.	Permanent Loss of pond would be mitigated by enhancement of wetland habitats (including pond) in LVNP (1.1.1 & 1.1.2). Construction Phase Erection of 2m high dull green site boundary fence between ponds along Ng Tung River and any works areas (2.2.3). Measures to control hydrological disruption, construction run-off and pollution (4.1.1).	With provision of on-site mitigation measures, the ecological value of pond habitat in LVNP will increase; creating a positive residual impact. With provision of on-site mitigation measures, adverse residual indirect impacts on the small areas of pond habitat are not considered to be of significance and any residual impact is considered to be acceptable. However, In view of the small size of the area where residual impacts are predicted, residual impacts on this habitat in the Study Area as a whole are not of significance.
<u>Marsh at Ma Tso Lung</u> Disturbance (Low during construction/operation). Run-off and hydrological disruption (Low during construction and operation). Combined impacts Low during construction and operation. Cumulative impact with LMC Loop Project Low during construction and operation.	Construction Phase Detailed design, implementation and maintenance of buffer zone along lower reaches of Ma Tso Lung Stream (2.3.1 & 2.3.2) Measures to control hydrological disruption, construction run-off and pollution (4.1.1). Pre-works commencement check on watercourses to be physically or hydrologically impacted by construction activities (2.5.1).	With provision of mitigation measures at source (upstream, where there will be direct and indirect impacts on Ma Tso Lung Stream), adverse residual impacts will be of Low significance during the construction period and there will be no significant residual operational phase impacts. Mitigation measures proposed will also ensure that there are no significant cumulative residual impacts with the LMC Loop project.

Habitat/ Impact	Mitigation	Residual Impacts
<p><u>Mitigation Wetland (other than area in Long Valley)</u></p> <p>Loss of 2.75ha (Low to Moderate. Disturbance in FLN area A1-7 (Low during construction and operation).</p> <p>Run-off and hydrological disruption: Low during construction and not significant during operation.</p> <p>Fragmentation impacts on FLN area A1-7) Low to Moderate during construction; Low during operation.</p> <p>Combined impacts Moderate during construction and Low during operation.</p>	<p>Permanent</p> <p>Loss of mitigation wetlands would be mitigated by enhancement of wetland habitats (including mitigation wetland, marsh and pond) in LVNP.</p> <p>Preparation and implementation of EHCMP in mitigation wetland at FLN area A1-7 (5.9.1).</p> <p>Construction Phase</p> <p>Measures to control hydrological disruption, construction run-off and pollution (4.1.1).</p> <p>Erection of 2m high solid green site boundary fence between active works areas and the mitigation wetland (2.2.3).</p>	<p>With provision of on-site mitigation measures, the ecological value of mitigation wetland habitat in LVNP will increase; creating a positive residual impact.</p> <p>The mitigation wetland at FLN area A1-7 will be enhanced as a compensatory egret habitat; implementation of design, management and maintenance measures will increase the ecological function of this area for ardeids; no adverse residual impacts on other ecological functions of this area are predicted. I</p>
<p><u>Major Channelised Watercourse</u></p> <p>Permanent loss of <0.02ha and construction phase loss of areas required for construction of coffer dams: Low during construction and not significant during operation.</p> <p>Disturbance of Sheung Yue River (3300m): Moderate during construction, Low during operation.</p> <p>Disturbance of non-tidal Ng Tung River (4000m): Low to Moderate during construction and Low during operation.</p> <p>Disturbance of tidal Ng Tung River (650m): Low during construction and not significant during operation. Disturbance of Shek Sheung River (2300m): Low during construction and not significant during operation.</p> <p>Fragmentation impact on non-tidal Ng Tung River: Low to Moderate during construction and operation.</p> <p>Fragmentation impact on tidal Ng Tung River: Low during construction and not of significance during operation.</p> <p>Run-off and pollution impacts on Ng Tung, Sheung Yue and Shek Sheung Rivers (Low during construction and operation for most events but certain construction phase pollution events could be of Moderate severity).</p> <p>Combined impacts on Sheung Yue</p>	<p>Permanent</p> <p>Stringent planning control in area north and east of the Sheung Yue River (2.2.1).</p> <p>Planning for retention of existing trees in Open Space zones along the Sheung Yue, Ng Tung and Shek Sheung Rivers and incorporation of these in the screen planting will reduce disturbance and fragmentation impacts on rivers and fauna using them (2.2.2).</p> <p>Building setback from Long Valley (30m setback from road D3 in KTN area B3-12 will setback from part of Sheung Yue River (2.2.4).</p> <p>Maximisation of building setback and provision of screen planting along main river channels during the detailed design stage.</p> <p>Review of design and construction methods for all bridges especially those on the Sheung Yue and tidal Ng Tung Rivers and adoption of methods which will minimise impacts on rivers and disturbance and fragmentation impacts on fauna (2.2.6).</p> <p>Provision of alternative foraging site for waterbirds by establishment of LVNP and stocking of fish at suitable ponds on government land</p>	<p>With provision of mitigation measures, there will be no significant adverse residual impacts to main river channels during the construction phase and no impact during the operational phase.</p> <p>With the proposed mitigation measures in place the combined construction phase residual impacts on waterbird flight-lines will be mitigated to an acceptable level due to the small number of birds involved, all of which are common and widespread species in Hong Kong wetlands.</p> <p>Mitigation measures proposed will also ensure that there are no significant cumulative residual impacts with the Construction of Cycle tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung project.</p>

Habitat/ Impact	Mitigation	Residual Impacts
<p>River Moderate during construction and Low to Moderate during operation.</p> <p>Combined impacts on non-tidal Ng Tung River Low to Moderate during construction and Low during operation.</p> <p>Combined impacts on tidal Ng Tung River Low during construction and not significant during operation.</p> <p>Combined impacts on Shek Sheung River Low during construction and operation.</p> <p>With mitigation measures in place, cumulative impacts on Sheung Yue river with the Sha Po Tsuen to Shek Sheung River Cycle track project Low during construction and operation.</p>	<p>along river channels and in LVNP during the advanced works stage.</p> <p>Construction Phase</p> <p>No construction during ardeid breeding season (1st March to 31st July) along Sheung Yue River north and east of KTN area D1-5 and east of D1-9 and C2-3 and restriction of working hours on new pedestrian bridges over the Sheung Yue River and tidal Ng Tung River to 09.00 to 17.30 during the ardeid breeding season (2.2.5) will reduce disturbance to Sheung Yue River and non-tidal Ng Tung River during this period.</p> <p>Erection of 2m high dull green site boundary fence between ponds along Ng Tung River and any works areas (2.2.3).</p> <p>Avoidance of removal and interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung (2.2.7).</p> <p>Mitigation of dust, construction run-off and pollution impacts on watercourses (4.1.1).</p>	
<p><u>Ma Tso Lung Stream and tributaries and riparian corridor</u></p> <p>Diversion of 130m of Ma Tso Lung Stream in its lower reaches (Moderate) and 12m of tributaries in their upper reaches (Low).</p> <p>Disturbance to Ma Tso Lung Stream: Low during construction and not significant during operation.</p> <p>Run-off and hydrological impacts to Ma Tso Lung Stream (Moderate during construction and not significant during operation)</p> <p>Fragmentation impact on Ma Tso Lung Stream riparian corridor (Moderate during construction and operation).</p> <p>Low fragmentation impact for minor upper tributaries.</p> <p>Combined impacts Low to Moderate during construction and operation.</p> <p>Cumulative disturbance impacts with LMC Loop Project Low.</p>	<p>Permanent</p> <p>Detailed design of development along lower reaches of Ma Tso Lung and Ma Tso Lung Streams in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road (2.3.1).</p> <p>Designation and implementation of buffer zone of 15-30m as appropriate on either side of Ma Tso Lung Stream North of the point where it is crossed by the LMC Loop Eastern Connection Road, Green Belt zoning elsewhere, and Ma Tso Lung Stream diversion (2.3.2).</p> <p>Solid faunal barrier (1.2m) barrier along at-grade section of LMC Loop Eastern Connection Road and faunal underpass (2.3.3 & 2.3.5).</p> <p>Construction phase</p> <p>Diversion of Ma Tso Lung</p>	<p>With provision of mitigation measures, construction phase impact will be of Low severity during road construction, but no significant residual impact due to other elements of the Project.</p> <p>During the operational phase the value of the riparian corridor habitat will improve over time such that a positive residual impact is anticipated after approximately two to three years.</p> <p>Mitigation measures proposed will also ensure that there are no significant cumulative residual impacts with the LMC Loop project.</p>

Habitat/ Impact	Mitigation	Residual Impacts
<p>Cumulative run-off and hydrological impacts with LMC Loop Project Moderate during construction and Low to Moderate during operation.</p> <p>Cumulative hydrological disruption impacts with LMC Loop Project Moderate during construction and operation.</p> <p>Cumulative fragmentation impacts with LMC Loop Project High during construction and operation Moderate.</p> <p>Cumulative combined impacts with LMC Loop Project Moderate.</p>	<p>Stream and reinstatement of natural stream bed, channel and enhanced riparian zone (2.3.2).</p> <p>Measures to control hydrological disruption, construction run-off and pollution (4.1.1).</p> <p>Erection of 2m high construction phase barrier between active works areas and stream and tributaries (2.3.4).</p> <p>Pre-works commencement check on watercourses to be physically or hydrologically impacted by construction activities (2.5.1).</p>	
<p><u>Pak Shek Au Watercourse</u></p> <p>Re-channelisation (Low).</p> <p>No significant indirect impacts.</p>	<p>Pre-Construction Phase</p> <p>Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1).</p> <p>Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.</p>	No residual impact.
<p><u>Tung Fong/Shek Tsai Ling Watercourse & Kwu Tung Watercourse</u></p> <p>Re-channelisation (Low).</p> <p>No significant indirect impacts.</p>	<p>Pre-Construction Phase</p> <p>Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1).</p> <p>Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.</p>	No significant residual impact.
<p><u>Fung Kong & Ho Sheung Heung Watercourses</u></p> <p>Re-channelisation (Low).</p> <p>No significant indirect impacts.</p>	<p>Pre-Construction Phase</p> <p>Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1).</p> <p>Formulation and implementation of practicable and effective mitigation measures, if required, in</p>	No significant residual impact.

Habitat/ Impact	Mitigation	Residual Impacts
	consultation with AFCD.	
<p><u>Long Valley Watercourse</u> Re-channelisation (Low). Run-off and hydrological impacts on Long Valley: most likely of Low severity but could be Moderate if hydrological disruption is prolonged and during the dry season.</p>	<p>Pre-Construction Phase Pre-works check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourse to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.</p> <p>Construction Phase Measures to ensure no disruption to Long Valley Watercourse to be designed at detailed design stage for rechannelisation of Long Valley Watercourse and areas through which it flows including KTN area B3-12 and contingency plan to address any disruption to be included in LVNP HCMP (2.5a.1).</p> <p>Measures to control hydrological disruption, construction run-off and pollution (4.1.1).</p>	<p>Measures to maintain continuity of water supply to Long Valley will be designed at the detailed design stage for the rechannelisation of the Long Valley Watercourse and will also be required at the detailed design of any development areas through which it flows. In addition, the LVNP HCMP will include a contingency plan to address any unexpected disruption. With these measures in place, there will be no significant residual impacts; scope to increase ecological value of section adjacent to Yin Kong village should also be addressed during the detailed design of the rechannelisation works.</p>
<p><u>Cheung Po Tau & Fu Tei Au Watercourse</u> Re-channelisation of Fu Tei Au Watercourse (Low). No significant indirect impacts.</p>	<p>Pre-Construction Phase Pre-works check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.</p>	<p>No significant residual impact.</p>
<p><u>Sheung Shui Wa Shan Watercourses</u> Re-channelisation of approx. 80m length of both watercourses (lowest reaches) (Low). No significant indirect impacts.</p>	<p>Pre-Construction Phase Pre-works check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.</p>	<p>No significant residual impact.</p>

Habitat/ Impact	Mitigation	Residual Impacts
<p><u>Siu Hang San Tsuen Watercourse</u> Re-channelisation of approx. 180m length of lowest reaches (Low). Disturbance impacts during construction and operation not significant. Run-off and hydrological impacts (Low during construction). Combined impacts Low to Moderate during construction and Low during operation.</p>	<p>Permanent Detailed design of Siu Hang San Tsuen Stream to have 10m wide vegetated buffer in Open Space zone in FLN area D1-3 (2.4.1). Bypass to cross stream on viaduct (2.4.1). Any channelisation works in upstream section not recommended (2.4.1). Pre-Construction Phase Pre-works check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD. Construction phase Lower reaches (within works area) to have 10m wide vegetated buffer on either side of stream (2..1). Measures to control hydrological disruption, construction run-off and pollution (4.1.1).</p>	<p>With provision of mitigation measures, there will be no significant residual impacts arising from rechannelisation works. No significant residual impacts are predicted during operation.</p>
<p><u>Man Kok Village, Tin Ping Shan Tsuen, Shek Wu San Tsuen & Ma Shi Po Watercourses</u> Re-channelisation (Low). No significant indirect impacts</p>	<p>Pre-Construction Phase Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.</p>	<p>No significant residual impact.</p>
<p><u>Ma Wat River</u> Re-channelisation of approx. 700m of lower stream course (Low). Disturbance of approx. 3000m of channelised stream course (Low during construction and operation). Run-off and hydrological impacts on channelised stream course (Low to Moderate during</p>	<p>Pre-Construction Phase Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable</p>	<p>With scope for minor adjustments to design, timing of works and measures to minimise impacts on species of conservation significance, no significant residual impact.</p>

Habitat/ Impact	Mitigation	Residual Impacts
construction and Low during operation). Combined impacts Low to Moderate during construction and Low during operation.	and effective mitigation measures, if required, in consultation with AFCD.	
<u>San Uk Tsuen, Ma Wat Wai & Tong Hang Watercourses</u> No direct impact. Disturbance of approx. 100m of Tong Hang Watercourse during construction of Fanling Bypass (Low).	Pre-Construction Phase Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.	No significant residual impact.
<u>Kau Lung Hang Watercourses</u> No direct impact. Disturbance of approx. 50m during construction of Fanling Bypass (Low).	Pre-Construction Phase Pre-works commencement check for presence of any protected flora and fauna and flora of conservation significance and bat roosts on watercourses to be physically or hydrologically impacted by construction activities (2.5.1). Formulation and implementation of practicable and effective mitigation measures, if required, in consultation with AFCD.	No significant residual impact.
<u>Upland Grassland</u> Loss of 6.95ha (Low). Disturbance (Low during construction and operation).	Pre-Construction Phase Pre-site clearance check on all construction sites for presence of flora and fauna of conservation significance (5.2.2).	No significant residual impact.
<u>Lowland Grassland</u> Loss of 53.21a (Low). Disturbance during construction and operation (Low).	Pre-Construction Phase Pre-site clearance check on all construction sites for presence of flora or fauna of conservation (5.2.2).	No significant residual impact.
<u>Seasonally Wet Grassland</u> Loss of 2.86ha near lower stream reaches of Ma Tso Lung Stream (Low to Moderate) and elsewhere 1.21ha (Low). Only the former requires mitigation. Disturbance, run-off and hydrological disruption of seasonally wet grassland at Ma Tso Lung (Low to Moderate during construction and Low during operation); Low during	Construction Phase Loss at Ma Tso Lung of seasonally wet grassland of limited ecological value due to lack of floral and structural diversity to be compensated by more floristically and structurally diverse marsh habitat in restored habitat in Ma Tso Lung Stream riparian corridor (2.3.1). Pre-site clearance check on all	Ma Tso Lung: with provision of mitigation measures, impacts during the construction phase severity are not significant and restored/created habitat expected to be of significantly higher ecological value than existing habitat, so beneficial residual impact. Elsewhere: no significant residual impact.

Habitat/ Impact	Mitigation	Residual Impacts
construction and operation elsewhere. Cumulative impact with LMC Loop Project Low to Moderate during construction and operation.	construction sites for presence of flora or fauna of conservation (5.2.2).	
<u>Grassland/ Shrubland</u> Loss of 1.63ha (Low). Disturbance during construction and operation (Low).	Construction Phase Pre-site clearance check on all construction sites for presence of flora or fauna of conservation (5.2.2).	No significant residual impact.
<u>Shrubland</u> Loss of 1.11ha (Low). Disturbance of shrubland at Crest Hill (most likely Low but possibly Low to Moderate during construction if a Eurasian Hobby nest site were to be affected and Low during operation); Low during construction and operation elsewhere.	Permanent Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on shrubland (2.6.3). Construction Phase Pre-site clearance check on all construction sites for presence of flora or fauna of conservation (5.2.2). Disturbance impacts at Crest Hill to be mitigated by erection of 2m high solid green site barrier fence between active works areas at KTN areas D1-11, D1-12, G1-4 and G1-5 and adjacent natural habitats to minimise disturbance impacts on shrubland habitats (2.6.1). Measures to control dust, construction run-off and pollution (4.1.1).	With mitigation measures in place severity of residual impact on shrubland at Crest Hill will be not significant; there will be no significant residual impact in other areas.
<u>Ho Sheung Heung Fung Shui Woodland & Secondary Woodland</u> Loss of 0.23ha of secondary woodland (Low to Moderate). Disturbance of <i>fung shui</i> and secondary woodland (Low to Moderate during construction and Low during operation). Dust deposition on vegetation during construction (Low). Fragmentation impact on woodland (Low during construction and). Combined impacts Low to Moderate during construction and Low during operation.	Permanent Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland (2.6.3). Compensatory native woodland planting in KTN areas E1-8 and G1-3. Construction Phase Erection of 2m high solid green site barrier fence between active works areas at KTN areas D1-7 and D1-11 and adjacent natural habitats to minimise disturbance impacts on <i>fung shui</i> woodland and secondary woodland habitats (2.6.1).	With mitigation measures in place severity of residual construction phase impact on secondary <i>fung shui</i> and secondary woodland at Ho Sheung Heung will not be of significance and any residual impact is considered to be acceptable. Since woodland takes a long time to become established, there will continue to be a residual impact of Low severity until the compensatory woodland habitat is sufficiently mature that it has a similar ecological function to areas which will be lost. Subsequently, because of the larger size of the woodland area planted, relative to the areas which will be lost, these areas will have a small beneficial impact.

Habitat/ Impact	Mitigation	Residual Impacts
	Measures to control dust, construction run-off and pollution (4.1.1).	
<p><u>Secondary Woodland west of Siu Hang San Tsuen</u></p> <p>No direct impact.</p> <p>Disturbance (Low during construction and operation).</p> <p>Dust deposition on vegetation (Low during construction and operation).</p> <p>Combined impacts Low during construction and operation.</p>	<p>Construction Phase</p> <p>Erection of 2m high solid green site barrier fence on the northern side of active works areas for the Fanling Bypass to minimise disturbance impacts on secondary woodland (and other) habitats (2.6.1).</p> <p>Measures to control dust, construction run-off and pollution (4.1.1).</p>	With mitigation measures in place, the severity of the residual construction impact will be not significant and there will be no significant impact during the operational phase of the project.
<p><u>Other Secondary Woodland</u></p> <p>No direct impact.</p> <p>Disturbance and dust deposition during construction, and disturbance during operation (Low).</p>	<p>Construction Phase</p> <p>Erection of 2m high solid green site barrier fence Bypass to minimise disturbance impacts on secondary woodland (and other) habitats (2.6.1).</p> <p>Measures to control dust, construction run-off and pollution (4.1.1).</p>	With mitigation measures in place, the severity of residual construction impact on other secondary woodland will not be significant during the construction and operational phases of the Project.
<p><u>Hillside Plantation</u></p> <p>Loss of 8.65ha (Low).</p> <p>Disturbance during construction and operation (Low to Moderate).</p> <p>Fragmentation impacts on hillside plantation during construction and operation (Low).</p> <p>Combined impacts on hillside plantation Low to Moderate during construction and operation.</p>	<p>Permanent</p> <p>Compensatory native woodland planting in KTN areas E1-8 and G1-3.</p> <p>Construction Phase</p> <p>Erection of 2m high solid green site barrier fence between active works and adjacent natural habitats to minimise disturbance impacts on hillside plantation habitats (2.6.1).</p> <p>Measures to control dust, construction run-off and pollution (4.1.1).</p>	Since woodland takes a long time to become established, there will continue to be a residual impact of Low severity until the compensatory woodland habitat is sufficiently mature that it has a similar ecological function to areas which will be lost. After this point there will be a net positive residual impact as a consequence of the increased ecological function of the compensatory woodland.
<p><u>Roadside and Urban Plantation</u></p> <p>Loss of 73.43ha Low.</p> <p>(Loss of 0.27ha of plantation supporting Man Kam To Egrettry addressed under 'Egrettries and Egrettry flight-lines' below).</p> <p>Disturbance during construction and operation (Low).</p>	<p>Permanent</p> <p>Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development along river corridors (3.1.1).</p> <p>Planning for compensation for loss of trees, woodland and shrubland by compensatory planting in open spaces, amenity areas, open areas in streetscape and open areas in development lots; screen planting and road greening (3.1.2).</p>	Because of the long duration of the Project planting undertaken in earlier phases of the Project will have matured by the time impacts from later phases occur. Regardless of this point, despite the large scale of habitat loss, both construction and operational phase impacts are not considered to be of significance ecologically as the habitat does not have any significant ecological function. Once habitats in the final phases of the Project have matured, there is expected to be a positive residual impact.
<u>Mitigation Plantation</u>	Permanent	Mitigation plantation along the major watercourses is primarily of ecological

Habitat/ Impact	Mitigation	Residual Impacts
<p>Loss of 10.75ha (Low).</p> <p>Disturbance to species using mitigation plantation (Low).</p> <p>Fragmentation impacts on species using mitigation plantation (Low).</p> <p>Combined impacts on species using Low to Moderate during construction and operation.</p>	<p>Stringent planning control in area north and east of the Sheung Yue River (2.2.1).</p> <p>Screen planting along Ng Tung, Sheung Yue and Shek Sheung Rivers (2.2.2).</p> <p>Retention of existing mitigation plantation trees in Open Space zones along the Sheung Yue, Ng Tung and Shek Sheung Rivers and incorporation of these in screen planting along the rivers in the detailed design of these Open Space zones (2.6.2).</p> <p>Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development along river corridors (3.1.1). Planning for compensation for loss of trees, woodland and shrubland by compensatory planting in open spaces, amenity areas, open areas in streetscape and open areas in development lots; screen planting and road greening (3.1.2).</p> <p>Construction Phase</p> <p>Erection of 2m high solid green site barrier fence to minimise disturbance impacts on mitigation plantation (2.6.1).</p> <p>Measures to control dust, construction run-off and pollution (4.1.1).</p>	<p>importance as a consequence of the screening function which it provides to adjoining habitats, including Long Valley, mitigation wetland and the rivers. In addition, it provides linkages between otherwise more isolated areas of wooded habitats for some fauna, although most of the species involved are relatively vagile and not restricted to wooded habitats. During the construction phase, the screening function of the woodland will be fulfilled by solid barriers which will provide greater noise attenuation and will form a more effective visual barrier. Accordingly, impacts of loss of screening function caused by loss of plantation area will not be significant during the construction phase.</p> <p>Retention of as much of the mitigation plantation as is feasible, together with the incorporation of ecological considerations during the planning of open space zones will mitigate for most potential fragmentation impacts on fauna species using the plantation. Accordingly, fragmentation impacts as a result of the loss of mitigation plantation are not considered to be of significance with mitigation measures in place during the construction and operational phase of the project.</p>
<p><u>Orchard</u></p> <p>Loss of 8.70ha (Low).</p> <p>Disturbance to orchard (Low).</p>	<p>No mitigation measures required under the Project.</p>	<p>Floral diversity in orchard areas is low and habitat is utilised by habitat-generalist fauna in small numbers. No residual impacts of significance.</p>
<p><u>Village, Urban/Residential Areas & Waste Ground</u></p> <p>Habitat is of low ecological value hence severity of impact is.</p> <p>Disturbance to developed areas will not increase significantly.</p>	<p><u>Permanent</u></p> <p>Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development along river corridors (3.1.1).</p> <p>Planning for compensation for loss of trees, woodland and shrubland by compensatory planting in open spaces, amenity areas, open areas in streetscape and open areas in development lots; screen planting and road greening (3.1.2).</p>	<p>No impacts of significance are predicted.</p>
<p><u>Deep Bay Wetland Ecosystem</u></p> <p>Cumulative impact of loss of</p>	<p><u>Permanent:</u></p> <p>Designation of area south and</p>	<p>With the implementation of mitigation measures, all cumulative impacts of the</p>

Habitat/ Impact	Mitigation	Residual Impacts
<p>wetland habitat in the Project Area and LMC Loop Project Area and possible development at Hoo Hok Wai (Low Severity).</p> <p>Cumulative disturbance to wetland habitat (Low).</p> <p>Cumulative fragmentation impact on linkages in the Deep Bay ecosystem of the Project and the LMC Loop Project and possible development at Hoo Hok Wai (Low).</p> <p>Run-off impact on Deep Bay ecosystem likely to be Low to Moderate severity during construction and Low in operation phase.</p> <p>Impact of pollution events on Deep Bay ecosystem have potential for High severity, but dependent on nature and scale but most events likely to be of Low to Moderate severity during construction and Low severity during operation.</p> <p>With proper mitigation in place, cumulative impact of run-off and pollution on the Deep Bay ecosystem is of Low Severity during construction and of Low Severity during operation due to large area and scale of more likely events.</p>	<p>east of the Sheung Yue River as LVNP (37ha); preparation and implementation of HCMP to enhance wetland and non-wetland habitats (1.1.1 & 1.1.2).</p> <p>Screen planting to be enhanced along river channels, subject to constraint of need to avoid loss of wetland area or function (2.2.2).</p> <p>Prevention of dust, run-off and pollutants entering Deep Bay (4.1.1).</p>	<p>project on the area and connectivity of wetland habitat in the Deep Bay area will be insignificant.</p> <p>With the implementation of mitigation measures, there will be no significant cumulative impact of the project on water quality in the Deep Bay wetland ecosystem w during the construction phase during the operational phase of the project.</p> <p>No residual impacts are predicted.</p>

Table 13.152 - Potential Total Residual Direct, Indirect, Fragmentation and Cumulative Ecological Impacts of the Project on Species Groups and Species

Note: in the table below the severity of impacts are presented hierarchically and inclusively, but repetition has been avoided for the purposes of clarity. For example, the severity of combined impacts on Three-banded Box Terrapin is predicted to be Moderate: the severity of this combined impact has been predicted by combining the severities of relevant impacts on all fauna, herpetofauna, reptiles and this species.

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
All flora and fauna	Direct and indirect loss of habitats in the Project Area as a whole of Low Severity .	Measures to mitigate for impacts on habitats described in Table 13.128 above.	It is inevitable that a project of the scale of the NDAs will result in redistribution of flora and fauna, especially during the construction phase; however no unacceptable residual impacts on fauna and flora in general or on any species or species group are predicted during either the construction or operational phases of the project.
Flora of conservation significance	Construction phase impacts at Ho Sheung Heung <i>fung shui</i> and secondary woodland: dust deposition of Low Severity , damage or	Permanent Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland (2.6.3).	With implementation of mitigation measures, adverse residual impacts not significant.

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
	death of Low to Moderate Severity .	Additional mitigation measures (in the order of. preserve on site, transplantation and provision of compensatory planting) would be formulated and implemented should Individual of species of conservation concern be identified before and during the construction stage. Construction Phase Erection of 2m high solid green site barrier fence between active works areas at KTN areas D1-7 and D1-11 and adjacent natural habitats to minimise disturbance impacts on <i>fung shui</i> woodland and secondary woodland habitats (5.1.1). Measures to control dust, construction run-off and pollution (4.1.1).	
Mammals and Herpeto-fauna	Mortality impacts: Low in the Project Area as a whole but Low to Moderate in the Ma Tso Lung area for riparian fauna of conservation significance and Moderate to High for any mortality of Three-banded Box Terrapin.	Construction Phase Erection of 2m high solid green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including any roads adjacent to or penetrating into areas/habitats of ecological importance (5.2.1). Pre-site clearance check on all construction sites and pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for the presence of mammals and herpetofauna of conservation significance (5.2.2). Permanent Construction and maintenance of permanent 1.2m high solid faunal barrier at all at-grade sections of LMC Loop Road north of junction with road D4 within 15-30m as appropriate of Ma Tso Lung Stream buffer to prevent terrestrial fauna mortality and a faunal underpass to mitigate for fragmentation impacts (5.11.3).	With implementation of mitigation measures, adverse residual impacts not significant.
Bat Roosts	Roost destruction during site clearance works: Low .	Pre-site clearance check on all construction sites for presence of bat roosts (5.3.1).	With implementation of mitigation measures, adverse residual impacts not significant.
Birds	Mortality impacts on breeding birds during site clearance works: generally Low ; Moderate if an egretry site were to	Preparation and implementation of Guidelines for building design measures to minimise mortality and light and glare impacts to fauna (5.4.1). Use opaque, non-transparent, non-	With implementation of mitigation measures, adverse residual impacts not significant during construction phase. With implementation of mitigation measures, there will be no

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
	<p>be cleared during the breeding season.</p> <p>Mortality impacts arising from collision: Low, largely smaller birds.</p> <p>Increase in lighting and glare: probably Low for most species but may be Low to Moderate for migrating birds.</p> <p>Combined impacts: Low (except as noted above).</p>	<p>reflective noise barriers for all roads. Unnecessary lighting should be avoided.</p> <p>Potential impacts of nocturnal avian collision with buildings should be minimised (5.4.2).</p> <p>Pre-site clearance check on all construction sites and pre-works commencement check on egrettries and watercourses to be physically and/or hydrologically impacted by construction activities for the presence of birds of conservation significance (5.2.2).</p> <p>Unavoidable clearance of Man Kam To Road Egrettry to be scheduled outside breeding season.</p> <p>Experience elsewhere in the world (and, anecdotally, in Hong Kong) is that 'black spots', where a combination of environmental factors results in high collision mortality, are likely. Post-construction monitoring should, therefore, be undertaken to identify any such 'black spots' and additional/remedial mitigation measures should be applied. With such additional measures in place, adverse residual mortality impacts on birds will not be significant in any location in the Project Area.</p>	<p>significant adverse residual impacts on birds during the construction and operational phases of the project in the Project Area as a whole.</p>
Wetland-dependent bird species	<p>Direct loss of wetland habitats: Low.</p> <p>Indirect loss of wetland habitats: Low to Moderate on birds using the Sheung Yue River and non-tidal Ng Tung River, but Low elsewhere, during the construction phase.</p> <p>Low on birds using the Sheung Yue River; Low to Moderate on non-tidal Ng Tung Rivers, but not significant elsewhere, during operational phase.</p> <p>Fragmentation impact: Low to Moderate Severity during construction and operation on the linkage between Long Valley and the long non-tidal Ng</p>	<p>Long Valley Nature Park (LVNP) designation, design, implementation and design including redistribution of wetland habitats in LVNP to concentrate closed wetland habitats (marsh and reed marsh) in more disturbed areas and to undertake supplementary stocking of fish to mitigate for any loss of foraging habitat for large waterbirds in disturbed areas including the Sheung Yue River, especially during the construction phase (5.5.1).</p> <p>Stringent planning control in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung Egrettry (5.5.2).</p> <p>Planning for creation of Green Corridors along larger watercourses, detailed design of Open Space areas and development areas along river corridors to provide screening of rivers (5.5.5).</p> <p>Enhancement of wetland habitats in LVNP (5.5.4).</p> <p>Building setback from Long Valley</p>	<p>With provision of mitigation measures, in particular the designation, management and maintenance of the LVNP, there will be a positive residual impact on most wetland-dependent bird species from the project; in particular those freshwater wetland species, including Greater Painted-snipe, for which Long Valley is of particular significance in a Hong Kong context.</p> <p>There will be residual impacts, especially during the construction phase, on those large waterbird species which forage in the main river channels, especially the Sheung Yue River in significant numbers. All of these species also forage in Long Valley, none are freshwater wetland specialists, and all occur in much larger numbers in the Deep Bay area. Accordingly, the residual disturbance impacts on non-breeding waterbirds are considered not to be of significance in a Hong Kong</p>

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
	<p>Tung River; Low Severity on the linkage between Long Valley and the Deep Bay wetland ecosystem along the tidal Ng Tung River during construction but not significant during operation; no other significant fragmentation impacts.</p> <p>Combined impacts of habitat loss, disturbance and fragmentation: Low overall but Low to Moderate for freshwater wetland/wet agricultural land habitat-specialist species and species using the Sheung Yue River and non-tidal section of Ng Tung River in significant numbers (especially breeding Little Egrets and Chinese Pond Herons).</p>	<p>(5.5.3). Erection of 2m high solid dull green site barrier fence between river channel and any active works area along or adjacent to Ng Tung, Sheung Yue and Shek Sheung Rivers (5.5.6).</p> <p>Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance (5.5.7).</p> <p>Pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of wetland bird species of conservation significance (5.5.8).</p> <p>Review of bridge design and construction methods during detailed design phase to ensure that disturbance impacts from these sources are minimised (5.5.9).</p> <p>Avoidance of removal and interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung (5.5.10).</p> <p>Some phasing of construction such that bridges over watercourses are not constructed simultaneously (5.5.11).</p>	<p>context, hence the residual impacts on these birds are acceptable.</p> <p>Numbers of Little Egrets and Chinese Pond Herons breeding at Ho Sheung Egretty are considered to be significant; hence loss of foraging habitat may be of significance for these birds. Accordingly, these species have been identified as Key Target Species for habitat enhancement and management measures in the LVNP. Management measures will include the provision of undisturbed foraging habitat and supplementary provision of fish to compensate for any loss of foraging habitat in the rivers. With such provision, residual impacts on breeding Little Egrets and Chinese Pond Herons from loss of foraging habitat will be fully mitigated.</p>
Non wetland-dependent bird species (except Grey Nightjar and Eurasian Hobby)	<p>Direct loss of habitats: Low.</p> <p>Indirect loss of habitats: Low.</p> <p>Fragmentation impact: Low.</p> <p>Combined impacts: Low.</p>	<p>Long Valley Nature Park (LVNP) designation, design, implementation and design (5.6.1).</p> <p>Stringent planning control requirements in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung egretty (5.6.2).</p> <p>Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development areas along river corridors to provide screening of rivers (5.6.3).</p> <p>Enhancement of non-wetland habitats in LVNP (5.6.4)</p> <p>Compensatory native woodland planting, management and maintenance (5.6.5).Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development</p>	<p>Impacts on non-wetland bird species are all low in the absence of mitigation. With provision of mitigation measures, there will be no significant residual impacts on non wetland-dependent bird species from the project.</p>

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
		<p>areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance (5.6.6).</p> <p>Avoidance of removal and interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung (5.6.7).</p> <p>Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland at Ho Sheung Heung and Crest Hill (5.6.8).</p>	
Bird species utilising dry agricultural land and woodland	<p>Direct loss of habitats: Low.</p> <p>Indirect loss of habitats: Low.</p> <p>Fragmentation impact: Low.</p> <p>Combined impacts: Low.</p>	<p><u>Species utilising dry agricultural land and woodland</u></p> <p>Long Valley Nature Park (LVNP) designation, design, implementation and design will include enhancement of non-wetland habitats (5.6.1).</p> <p>Enhancement of non-wetland habitats in LVNP (5.6.4).</p> <p>Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance (5.6.6).</p> <p>Avoidance of removal and interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung (5.6.7).</p> <p><u>Species utilising woodland</u></p> <p>Planning for compensation for loss of trees, woodland and shrubland by compensatory planting in open spaces, amenity areas, open areas in streetscape and open areas in development lots; screen planting and road greening (3.1.2).</p> <p>Compensatory native woodland planting, management and maintenance (5.6.5).</p>	<p>With provision of mitigation measures, in particular the designation, management and maintenance of non-wetland habitats in LVNP for species using dry agricultural land, and woodland and tree planting for species using wooded habitats, there will be a no significant residual impact on non wetland-dependent bird species from the project during either the construction or operational phase.</p>
Eurasian Hobby	<p>Combined impacts: Low to Moderate depending on proximity of any nest site in Crest Hill area to works areas.</p>	<p>Pre-site clearance of construction sites in Crest Hill area (KTN areas D1-7, D1-11 and G1-5) for presence of any breeding birds/breeding site (5.7.1).</p> <p>Erection of 2m high solid dull green</p>	<p>With pre-site checking to confirm if a Eurasian Hobby nest site is present in or near a planned active works area, adjustment to works programme or area, and/or other mitigation measures identified</p>

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
		site barrier fence between active works areas sites in KTN areas D1-7, D1-11 and G1-5 and all areas/habitats of natural habitat (5.7.2).	depending upon proximity of nest site to works area; impacts on this species will not be significant.
Grey Nightjar	Combined impacts: Low to Moderate depending on proximity of any nest site area to works areas.	Pre-site clearance of construction site on Cheung Po Tau (FLN area A3-1) for presence of any breeding birds/breeding site (5.8.1). Erection of 2m high solid dull green site barrier fence between active works areas sites in FLN area A3-1 and all areas/habitats of natural habitat (5.8.2).	With pre-site checking to confirm if a Grey Nightjar nest site is present in or near a planned active works area, adjustment to works programme or area, and/or other mitigation measures identified depending upon proximity of nest site to works area; impacts on this species will not be significant.
Egrettries and egrettry flight-lines	Direct loss of Man Kam To Road Egrettry: Low to Moderate . Disturbance to Ho Sheung Heung Egrettry: Low . Fragmentation impact on flight-lines between Ho Sheung Heung Egrettry and foraging areas: Low to Moderate during construction and Low during operation. Fragmentation impact on flight-lines between Man Kam To egrettry and foraging areas: Low to Moderate during construction prior to clearance of egrettry site. Combined impact: Moderate during construction and Low during operation.	Egrettry Habitat Creation & Management Plan (EHCMP) and compensatory egrettry habitat provision (5.9.1). Stringent planning control requirements in Long Valley north and west of Sheung Yue River, including Ho Sheung Heung Egrettry (5.9.2). Planning for creation of Green Corridors along larger watercourses and detailed design of Open Space areas and development areas along river corridors (5.9.3). No construction during ardeid breeding season (1 st March to 31 st July) along Sheung Yue River north or east of KTN D1-5 and east of D1-9 and C2-3 and restriction of working hours on new pedestrian bridges over the Sheung Yue River and tidal Ng Tung River to 09.00 to 17.30 during the ardeid breeding season (5.9.4). Unavoidable clearance of Man Kam To Road Egrettry scheduled outside breeding season. Review of bridge design and construction methods during detailed design phase to ensure that disturbance impacts from these sources are minimised (5.9.5). Creation and operation of Long Valley Nature Park and creation and enhancement of wetland within LVNP including redistribution of wetland habitats in LVNP to concentrate closed wetland habitats (marsh and reed marsh) in more disturbed areas and to undertake supplementary stocking of fish to mitigate for any loss of foraging habitat for large waterbirds in disturbed areas including the Sheung Yue River, especially during	With implementation of mitigation measures, there will be no significant construction phase impacts to Ho Sheung Heung Egrettry and to flight-lines. Together with measures to mitigate for impacts on foraging habitat for ardeids breeding at the egrettry, no significant impacts on the egrettry and on egrets breeding there are predicted. The effectiveness of mitigation measures to compensate for loss of Man Kam To Egrettry site by re-provision is uncertain as, even if suitable habitat is provided at the compensation site, the birds may nest elsewhere. However, other measures to address adverse impacts on ardeids will ensure that the environment in the Study Area will continue to provide suitable breeding sites and foraging areas. Accordingly, the residual impact of the loss of the current breeding site will be, at most, of Low severity for one breeding season, if some individuals do not breed in the first season after the site is cleared. In the longer term, loss of this site is not significant in a Hong Kong context, hence this impact is considered acceptable. Mitigation measures are proposed to minimise impacts on flight-lines from this egrettry prior to the egrettry site being cleared; however there will still be residual impacts on these flight-lines with mitigation measures in place. However, in view of the small size of the egrettry (nine nests in 2013), this impact is considered not to be of significance. No significant residual impacts anticipated with the mitigation

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
		<p>the construction phase (5.9.6). Erection of 2m high solid dull green site barrier fence between river channel and any active works area along or adjacent to Ng Tung, Sheung Yue and Shek Sheung Rivers (5.9.7). Avoidance of removal and interference with screen planting undertaken under the Construction of Cycle Tracks and Associated Supporting Facilities from Sha Po Tsuen to Shek Sheung (5.9.8). The condition of egretries before commencement and during works would be monitored. Additional mitigation measures would be formulated and implemented if necessary.</p>	measures in place.
Reptile species	<p>Direct loss of habitats: Low. Indirect loss of habitats: Low. Fragmentation impact: Low. Combined impacts: Low.</p>	<p>Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance (5.10.1). Pre-site clearance check on all construction sites for presence of species of conservation significance (5.10.2).</p>	With implementation of mitigation measures, adverse residual impacts not significant.
Three-banded Box Terrapin	<p>Combined impacts: Moderate.</p>	<p>Detailed design of development along lower reaches of Ma Tso Lung Stream in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road (5.11.1). Buffer zone of 15 to 30m as appropriate on both sides of Ma Tso Lung Stream and tributaries north of the point where it is crossed by the LMC Loop Eastern Connection Road. Ma Tso Lung Stream diversion during construction of the LMC Loop Eastern Connection Road; development along lower reaches of Ma Tso Lung and Ma Tso Lung San Tsuen Streams in OU zones in KTN areas F1-2 and F1-3 to be set back beyond buffer (5.11.2). Construction and maintenance of permanent 1.2m high solid faunal barrier at all at-grade sections of LMC Loop Road north of junction with road D4 within 15-30m as appropriate of Ma Tso Lung Stream buffer to prevent terrestrial fauna mortality and a fauna underpass to</p>	With implementation of mitigation measures, adverse residual impacts not significant during construction phase and a positive residual impact once re-provided riparian habitat matures.

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
		<p>mitigate for fragmentation impacts (5.11.3).</p> <p>Erection of a 2m high dull green site barrier fence at interface between active works and riparian corridor of Ma Tso Lung Stream and tributaries (5.11.4).</p> <p>Pre-site clearance check on all construction sites for presence of Three-banded Box Terrapin (5.10.2).</p>	
Amphibian species	Combined impacts: Low .	<p>Erection of 2m high solid dull green site barrier fence between active works areas and all areas/habitats of ecological importance on edge of development areas, including along any roads adjacent to or penetrating into areas/habitats of ecological importance (5.10.1).</p> <p>Pre-site clearance check on all construction sites for presence of species of conservation significance (5.10.2).</p>	With implementation of mitigation measures, adverse residual impacts not significant.
Chinese Bullfrog	Combined impacts: Low to Moderate .	<p>Creation and operation of Long Valley Nature Park and creation and enhancement of wetland within LVNP (5.12.1).</p> <p>Pre-site clearance check on all construction sites for presence of species of conservation significance (5.12.2).</p> <p>Construction and maintenance of permanent 1.2m high solid faunal barrier at all at-grade sections of LMC Loop Road north of junction with road D4 within 15-30m as appropriate of Ma Tso Lung Stream buffer to prevent terrestrial fauna mortality and a faunal underpass to mitigate for fragmentation impacts (5.11.3).</p>	With implementation of mitigation measures, adverse residual impacts not significant during construction phase, positive residual impact during operational phase.
Butterflies	Combined impacts: Low in construction phase, Low during operational phase.	<p>Prevention of dust impact from active works areas from sites adjacent to Ho Sheung Heung and Crest Hill woodland and shrubland in KTN areas D1-7, D1-11 and G1- (5.13.1).</p> <p>Review development footprint and layout of proposed developments in KTN areas D1-11a and G1-5 to avoid/minimise direct and indirect impacts on secondary woodland at Ho Sheung Heung and Crest Hill. (5.13.2).</p>	With implementation of mitigation measures, adverse residual impacts not significant.
Dragonflies	Combined impacts:	Measures to control hydrological disruption, construction run-off and	With implementation of mitigation measures, adverse residual

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
	Low.	pollution (4.1.1).	impacts not significant.
Fish	Combined impacts: Low.	Measures to control hydrological disruption, construction run-off and pollution (4.1.1).	With implementation of mitigation measures, adverse residual impacts not significant.
Small Snakehead	Combined impacts: Low to Moderate during construction phase of Ma Tso Lung Stream diversion works; otherwise Low during construction and operation.	Detailed design of development along lower reaches of Ma Tso Lung Stream in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road (5.15.1). Buffer zone of 15 to 30m as appropriate on both sides of Ma Tso Lung Stream and tributaries north of the point where it is crossed by the LMC Loop Eastern Connection Road. Ma Tso Lung Stream diversion during construction of the LMC Loop Eastern Connection Road; development along lower reaches of Ma Tso Lung and Ma Tso Lung San Tsuen Streams in OU zones in KTN areas F1-2 and F1-3 to be set back beyond buffer (5.15.2). Pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of Small Snakehead (5.15.3).	With implementation of mitigation measures, adverse residual impacts not significant during construction phase, positive residual impact during operational phase.
<i>Somannia-thelphusa zanklon</i>	Combined impacts: Low.	Measures to control hydrological disruption, construction run-off and pollution (4.1.1). Detailed design of development along lower reaches of Ma Tso Lung Stream in OU zones (KTN areas F1-2 and F1-3 and detailed design of LMC Loop Eastern Connection Road (5.15.1). Buffer zone of 15 to 30m as appropriate on both sides of Ma Tso Lung Stream and tributaries north of the point where it is crossed by the LMC Loop Eastern Connection Road (5.15.1). Ma Tso Lung Stream diversion during construction of the LMC Loop Eastern Connection Road; development along lower reaches of Ma Tso Lung Stream in OU zones in KTN areas F1-2 and F1-3 to be set back beyond buffer (5.15.2). Pre-works commencement check on watercourses to be physically and/or hydrologically impacted by construction activities for presence of <i>Somannia-thelphusa zanklon</i> and translocation to Ma Tso Lung	With implementation of mitigation measures, adverse residual impacts not significant.

Sensitive Receiver	Severity of Impact	Mitigation	Residual Impacts
		Stream (5.15.3).	

With mitigation measures most ecological impacts of the implementation of the Project will be fully mitigated. In particular, there will be a positive residual impact on wetland-dependent bird species of conservation significance, including all those species associated with freshwater wetland habitats. However, while mitigation measures to reduce disturbance impacts on waterbirds using the main river channels are proposed, disturbance impacts to the more sensitive species on the Sheung Yue and Ng Tung River channels can be mitigated in full by provision of compensatory wetland habitat within LVNP.

The requirement to compensate for impacts on large waterbirds using the main river channels will be greatest during the construction phase of the Project. However, following completion of the Project, the southern section of the Sheung Yue River and the Ng Tung River east of western terminus of the Fanling Bypass will still be subject to some disturbance from developed areas and the activities of people using them. Measures have been proposed to mitigate for these impacts by increased carrying capacity for these species in the LVNP.

Construction phase impacts of Low severity are predicted on some wooded habitats and areas. This is largely a consequence of wooded habitats taking some time to mature.

13.11 Ecological Monitoring & Audit

13.11.1 Ecological Monitoring Programme

The ecological impact assessment has evaluated the predicted ecological impacts of the NDAs project and has concluded that ecological impacts can be avoided or reduced to a low and acceptable level with the implementation of appropriate mitigation measures.

Major mitigation measures proposed include the creation of Long Valley Nature Park (LVNP) where compensatory wetland habitat will be created or enhanced; compensatory egret habitat provision at FLN A1-7; and compensatory woodland habitat creation.

In addition, mitigation measures to minimise adverse impacts of the projects on the Ng Tung, Sheung Yue and Shek Sheung Rivers and large waterbirds using them (including compensatory habitat provision for impacts on large waterbirds in LVNP are proposed. At Ma Tso Lung Stream a series of measures are proposed to minimise and mitigate for impacts on the stream and riparian fauna

In addition, *in situ* mitigation measures are proposed to address potential impacts on habitats and fauna of conservation significance in a number of locations, including woodland at Ho Sheung Hill, shrubland at Crest Hill and elsewhere as noted in Section 13.8 and 13.9 and Chapter 15 of this report.

The proposed ecological mitigation measures should be checked as an element of the environmental monitoring and audit programme prior to and during the project construction stage.

13.11.2 Mitigation Measures

Mitigation measures have been identified and designed in accordance with Annex 16 of the EIAO-TM. The Implementation Schedule for these measures is detailed in **Appendix 2-2**. Required measures are described in more detail below.

13.11.2.1 Wetland Habitat Loss

Unavoidable loss of 6.12ha of wetland across the two NDAs will be compensated by creation and enhancement of 37ha of wetland habitat in the LVNP. Detailed design and proposed management and maintenance of this wetland habitat will be included in the Detailed Habitat Creation & Management Plan for LVNP (see also **Appendix 13.10**).

13.11.2.2 Wetland Habitat Disturbance

Impacts on the Ng Tung, Sheung Yue and Shek Sheung Rivers will occur during the construction and operational stages of the project. Focus shall be made on more disturbance-sensitive species of large waterbirds foraging in the rivers. Impacts are also predicted on Long Valley, in particular disturbance impacts on large waterbirds, especially in the southwest of the proposed LVNP. Mitigation measures to address these impacts are proposed to mitigate for impacts on the river habitats and on the waterbirds using them. The latter will be mitigated, in part by the provision of compensatory habitat in LVNP. Mitigation will be provided in part by the enhancement of wetland in Long Valley described in **Section 13.2.1** above and in part by appropriate screen planting in the Open Space zone along the river banks. During the construction phase disturbance to large waterbirds in these channels should be minimised by erection of a 2m high, solid dull green site boundary fence between the channel and any active works area.

Surveys of waterbirds and other species of conservation significance using Long Valley and the main river channels are required throughout the year to monitor the effectiveness of the mitigation measures and to inform the adaptive management of LVNP to meet the needs of target species and species groups. Should unacceptable disturbance impacts be noted, appropriate measures to further reduce disturbance impacts

should be devised and implemented as is discussed below and in **Chapter 15**.

13.11.2.3 Woodland Habitat Loss

Unavoidable loss of 8.88ha of secondary woodland and plantation of ecological significance will be compensated by planting native tree and shrub species at an area ratio of at least 1:1. Areas of grassland of low ecological value comprising 16.03ha have been identified for compensatory planting (**Figures 13.14a-c**). The area identified for planting is approximately twice the area of loss, which allows for both the lower initial ecological value of the areas to be planted relative to the areas lost, and also makes an allowance for parts of the areas identified being unsuitable for planting (for example due to topography, soil conditions, existing vegetation or footpaths).

13.11.2.4 Man Kam To Egret Habitat Loss

A site of 0.14ha in A1-7, FLN has been identified for the planting of bamboos and trees to compensate for the loss of the site of Man Kam To Road Egret. The site is on land comprising a former meander of the Ng Tung River which is currently managed as compensatory wetland habitat. No loss of wetland will be involved in this compensatory provision which will be undertaken on dry land within the ox-bow of the meander. Compensatory planting and measures to attract egrets (decoy models and broadcast of calls) should be undertaken as advance works for the NDAs project and well in advance of the existing egret site being impacted.

It should be noted that compensatory provision of this nature has been successful overseas but success cannot be assured as it is dependent on the birds relocating under their own volition.

13.11.2.5 Measures to minimise impacts to the Ma Tso Lung Stream and the Siu Hang San Tsuen Stream

Impacts to the Ma Tso Lung Stream and its tributaries will be avoided by Green Belt zoning except for a section of the lower Ma Tso Lung Stream that will be impacted by the construction of the LMC Loop Eastern Connection Road. Mitigation measures to minimise ecological impacts will include the avoidance of direct impacts at the point where the road crosses the stream by the road being placed on viaduct. A short section of stream (130m in total) will be diverted and a buffer corridor with a minimum width of 15m from the road (and 45mm in total) will be reinstated with natural riparian vegetation and maintained during the operational period of the Project. Detailed mitigation measures will be designed at the detailed design phase of the road.

The lower reaches of the Siu Hang San Tsuen Stream will be crossed by the Fanling Bypass and will lie within Open Space Zone D1-3. The

bypass will be on viaduct at this point, which should serve to minimise impacts to the stream and stream fauna. However, measures to reduce any impacts to an acceptable level will be designed at the detailed design stage of the road and the D1-3 zone.

13.11.2.6 Measures to minimise impacts on ecologically sensitive habitats from disturbance and pollution

Mitigation measures to minimise disturbance and pollution of adjacent areas of ecologically sensitive habitats are also pertinent in ensuring that ecological impacts of the project are kept to acceptable levels. These measures include the provision of site hoarding around all construction areas to minimise disturbance to adjacent habitats. Measures required are as detailed in **Section 13.9** and in **Appendix 2-2**.

13.11.3 Monitoring and Audit Requirements

13.11.3.1 Ecological Audit

The implementation of mitigation measures described above shall be audited periodically during the implementation of the project. This will cover implementation of the mitigation measures described in **Section 13.9** and in the Environmental Monitoring & Audit (EM&A) Manual (**Chapter 15** of this report) and the Project Implementation Schedule detailed in **Appendix 2-2**.

Monitoring activities described below should be conducted by the Environmental Team (ET) and supervised by a qualified ecologist who will be a member of the ET.

13.11.3.2 Ecological Monitoring

Monitoring of Construction and Operation of LVNP (including creation of compensatory wetland habitat)

Monitoring measures for the construction of the LVNP, including creation and enhancement of wetland to compensate for wetland loss will be detailed in the LVNP Habitat Creation and Management Plan. After the construction and establishment stages, management and monitoring will be the responsibility of AFCD.

As noted below, monitoring should also be undertaken in all areas where impacts on habitats and fauna may arise as a consequence of the project. This includes LVNP where impacts on disturbance-sensitive fauna are predicted in the absence of mitigation measures (including adaptive management measures in Long Valley). The ecological monitoring protocol to be followed in LVNP should, therefore satisfy three objectives, as follows:

- Monitoring of numbers and distribution of fauna (especially species of conservation significance) relative to adaptive management targets;
- Monitoring of numbers and distribution of fauna (especially species of conservation significance) for which habitat enhancement and other measures in LVNP are required to mitigate for impacts of the project on their use of Long Valley habitats;
- Monitoring of numbers and distribution of fauna (especially species of conservation significance) for which habitat enhancement and other measures in LVNP are required to mitigate for impacts of the project on their use of habitats in the main river channels.

It follows that the monitoring protocol in order to address the second and third of these requirements should be consistent with that described below in respect of monitoring of measures to mitigate for impacts on wetland-dependent fauna using the Ng Tung, Sheung Yue and Shek Sheung Rivers.

Details of monitoring protocol will be included in the HCMP for LVNP. Subject to confirmation following the completion of pre-construction baseline surveys and the adoption and implementation of the HCMP, the following survey methodologies and frequencies are recommended in respect of fauna species and groups of species which are the targets for mitigation measures:

- Mammals: infra-red camera ‘traps’ to be deployed;
- Birds: weekly surveys following similar methodologies to those utilised by HKWBS since 2005 (in order to allow comparability of data), together with any additional surveys required in order to address the need for survey data to be comparable with that collected in respect of bird use of the main river channels, as described below);
- Herpetofauna: monthly transect surveys, including night-time surveys during March to July;
- Butterflies and dragonflies: monthly transect surveys; exuviae monitoring in any areas managed with creation or enhancement of conditions as a breeding site.

Monitoring of Measures to Mitigate for Impacts of the Project on Wetland-dependent Fauna using the Ng Tung, Sheung Yue and Shek Sheung Rivers

Where development under the NDAs project is undertaken within 200m (the maximum distance at which it is predicted there may be some

disturbance, and hence a reduction in numbers, of large waterbirds) of the Ng Tung, Sheung Yue and Shek Sheung Rivers and Long Valley (including wetland enhancement measures in LVNP), the monitoring protocol detailed in **Table 13.153** should be followed. A transect should be undertaken throughout the sections of the rivers where NDA construction activities are proposed; as the sensitive receivers (large waterbirds) are easily visible, the transect route needs only follow one bank of the rivers. The transect route should remain the same during the different phases in order to ensure that data are comparable. As stated in this report, it is predicted that there will be some construction and operational phase disturbance impacts on large waterbirds using these rivers, and mitigation will in part be provided by enhancement measures for large waterbirds in LVNP. Monitoring of large waterbirds should, therefore, also be undertaken with the same frequency in LVNP (see above). A detailed monitoring plan would be formulated at least one year before the commencement of construction phase.

Table 13.153 - Monitoring of Measures to Minimise Disturbance to Waterbirds on Ng Tung, Sheung Yue and Shek Sheung Rivers

Phase	Methodology
Pre-construction (Baseline)	Weekly transect at both high and low tides to identify and enumerate all bird species utilising the river channels and LVNP area for 12 months prior to the commencement of construction.
Construction	Weekly transect at both high and low tides to identify and enumerate all bird species utilising the river channels and LVNP and identify any sources of actual or potential disturbance to birds due to construction activities throughout the construction period.
Post-construction	Weekly transects at both high and low tides to identify and enumerate all bird species utilising the river channels and LVNP and identify any sources of actual or potential disturbance to birds due to operational activities for 12 months following the completion of the construction period.

Measures to respond to decreases in numbers of large waterbirds using the river channels are detailed in **Table 13.154**. Action and limit levels will be determined following evaluation of the pre-construction (baseline) data. Note that waterbird numbers refer to combined numbers using the channels and LVNP.

Table 13.154 - Action and Limit Levels and Responses to Evidence of Disturbance to Waterbirds using in Ng Tung, Sheung Yue and Shek Sheung Rivers

Action Level	Response	Limit Level	Response
Construction Phase			
Decline in numbers of all waterbird species relative to numbers	Investigate cause and if cause identified as related to NDAs project instigate	Decline in numbers of all waterbird species relative to numbers	Investigate cause and if caused identified as related to NDAs

Action Level	Response	Limit Level	Response
during Baseline Monitoring such that the Action Level response is triggered.	remedial action to remove or reduce source of disturbance.	during Baseline Monitoring such that the Limit Level response is triggered.	project instigate remedial action. Review and adjust LVNP management measures to improve conditions for affected species.
Decline in numbers of any one waterbird species occurring in significant numbers* during Baseline Monitoring such that the Action Level response is triggered.	Investigate cause and if cause identified as related to NDAs project instigate remedial action to remove or reduce source of disturbance.	Decline in numbers of any one waterbird species occurring in significant numbers* during Baseline Monitoring such that the Limit Level response is triggered.	Investigate cause and if caused identified as related to NDAs project instigate remedial action. Review and adjust LVNP management measures to improve conditions for affected species.
Operational Phase			
Decline in numbers of all waterbird species relative to numbers during Baseline Monitoring such that the Action Level response is triggered.	Investigate cause and if cause identified as related to NDAs review and adjust LVNP management measures to improve conditions for affected species in LVNP.	Decline in numbers of all waterbird species relative to numbers during Baseline Monitoring such that the Limit Level response is triggered.	Investigate cause and if cause identified as related to NDAs consider and implement additional mitigation measures (e.g. additional screening and screen planting, adjustments to infrastructure design).
Decline in numbers of any one waterbird species occurring in significant numbers* during Baseline Monitoring such that the Action Level response is triggered.	Investigate cause and if cause identified as related to NDAs review and adjust LVNP management measures to improve conditions for affected species.	Decline in numbers of any one waterbird species occurring in significant numbers* during Baseline Monitoring such that the Limit Level response is triggered.	Investigate cause and if cause identified as related to NDAs consider and implement additional mitigation measures (e.g. additional screen planting, adjustments to infrastructure design).

* Whether numbers are significant will depend on species and season and should be determined following the collection and evaluation of Baseline survey data.

Monitoring of Compensatory Egretty Habitat Provision

Site clearance works at the current egretty location at Man Kam To Road should be undertaken outside the ardeid breeding season (typically 1st March to 31st July). Irrespective of the foregoing, egretty location should be checked for any evidence of occupation by a qualified ecologist of the ET prior to the commencement of any works activity within 100m of the egretty.

An Egretty Habitat Creation and Management Plan that includes the monitoring and reporting requirements will be prepared and the measures proposed in this plan shall be implemented as an advance works element of the project.

The plan should detail any site preparation works, including changes to ground levels in the proposed compensatory planting site in FLN area A1-7. Consideration should be given as to whether the area and type of wetland and non-wetland habitats should be adjusted, subject to ensuring that the principle of 'no net loss' of wetland function is adhered to.

The plan should also include a detailed planting plan, including, but not limited to, planting a clump of *Bambusa eutuldoides* as a compensatory breeding site. Measures to protect the site from disturbance including fencing, use of water as a barrier to inhibit disturbance, and screen planting and bunding should be included.

The plan should also detail post-construction methods to attract breeding ardeids including, but not limited to use of decoy models and recordings of breeding vocalisations to attract birds, following current best international practice.

In addition, a construction phase; post-construction 'attraction-phase'; and operational phase (i.e. if, and when, attraction is successful) programme for monitoring site conditions and use of the site by ardeids and any other species of conservation significance should be specified.

Monitoring of Measures to Minimise Impacts to the Ma Tso Lung Stream and the Siu Hang San Tsuen Stream

Aquatic faunal monitoring should be carried out during a 12-month pre-construction phase, the construction phase and the first 12 months of the operational phase.

Table 13.156 - Monitoring of Measures to Minimise Impacts to Ma Tso Lung Stream and Siu Hang San Tsuen Streams

Phase	Methodology
Pre-construction (Baseline)	Monthly quantitative replicate surveys of stream fauna using standardised methodology at fixed points, the number of which should be determined prior to the first monitoring event.

Phase	Methodology
Construction	Monthly quantitative replicate surveys of stream fauna using standardised methodology at the fixed points determined in the pre-construction phase.
Post-construction	Monthly quantitative replicate surveys of stream fauna using standardised methodology at the fixed points determined in the pre-construction phase.

Measures to respond to decreases in numbers of aquatic fauna using the watercourses and action and limit levels to trigger these measures are detailed in **Table 13.157**. Monitoring in the post-construction phase should continue for 12 months or until a time when neither the action nor limit levels are exceeded, whichever is the later.

Table 13.157 - Action and Limit Levels and Responses to Evidence of Declines in Aquatic Fauna

Action Level	Response	Limit Level	Response
Construction Phase			
Reduction in taxa diversity such that Action Level response is triggered.	Investigate cause and if cause identified as related to Project instigate remedial action to remove or reduce source of disturbance.	Reduction in taxa diversity such that Limit Level response is triggered.	Investigate cause and if caused identified as related to Project instigate remedial action.
Operational Phase			
Reduction in taxa diversity such that Action Level response is triggered.	Investigate cause and if cause identified as related to Project review and adjust LVNP management measures to improve conditions for affected species.	Reduction in taxa diversity such that Limit Level response is triggered.	Investigate cause and if cause identified as related to Project consider and implement additional mitigation measures.

* Whether numbers are significant will depend on species and season. Action and Limit Levels and Significance threshold for each species should be determined following collection of Baseline survey data.

Monitoring of measures to minimise impacts on ecologically sensitive habitats from disturbance and pollution

In order to monitor the effectiveness of measures to minimise impacts on ecologically sensitive habitats from disturbance and pollution standard faunal transect surveys should be carried out in the following areas:

- Ma Tso Lung riparian zone and associated wetland habitats
- Siu Hang San Tsuen Stream
- Areas in the western part of KTN

- Green belt areas E1-8, D1-8 and G1-3
- AGR zone C2-4 and C2-2 in KTN NDA
- Fanling North Freshwater Service Reservoir
- Areas north of Ng Tung River
- South side of Fanling Highway in the vicinity of Pak Shek Au
- Areas west and east of the southern limit of the Fanling Bypass works area

Monitoring of measures to minimise impacts should be carried out during a 12-month pre-construction phase, the construction phase and the first 12 months of the operational phase.

Table 13.158 - Monitoring of Measures to Minimise Impacts on ecologically sensitive habitats from disturbance and pollution

Phase	Methodology
Pre-construction (Baseline)	Monthly quantitative surveys of non-aquatic fauna using standard route transect counts.
Construction	Monthly quantitative surveys of non-aquatic fauna using standard route transect counts.
Post-construction	Monthly quantitative surveys of non-aquatic fauna using standard route transect counts.

Measures to respond to decreases in numbers of fauna and action and limit levels to trigger these measures are presented in **Table 13.159**. Monitoring in the post-construction phase should continue for 12 months or until a time when neither the action nor limit levels are exceeded, whichever is the later.

Table 13.159 - Action and Limit Levels and Responses to Evidence of Declines in Aquatic Fauna

Action Level	Response	Limit Level	Response
Construction Phase			
Reduction in species diversity such that Action Level response is triggered.	Investigate cause and if cause identified as related to Project instigate remedial action to remove or reduce source of disturbance.	Reduction in taxa diversity such that Limit Level response is triggered.	Investigate cause and if caused identified as related to Project instigate remedial action.
Operational Phase			
Reduction in species such that Action Level response is triggered.	Investigate cause and if cause identified as related to Project review and adjust LVNP management measures to improve conditions for affected species.	Reduction in taxa diversity response is triggered.	Investigate cause and if cause identified as related to Project consider and implement additional mitigation measures.

* Whether numbers are significant will depend on species and season. Action and Limit levels
Significance threshold for each species should be determined following collection of Baseline
survey data.

13.12 Conclusion

An ecological impact assessment has been conducted to address the potential ecological impacts arising from the development of the NDAs.

The area of highest ecological value in the Study Area is Long Valley which is a site of ecological significance in a Hong Kong context due to its being the largest remaining contiguous area managed for the production of wet agricultural crops. These, in combination with the other habitats in the Long Valley area, support a diverse fauna, of which the bird community, especially the freshwater-associated wetland bird community, is of high significance.

The Ma Tso Lung Stream, its tributaries and the riparian zone of these streams is also of ecological importance. While it is disturbed in several places by developed areas, and includes some partially channelised sections in the north of the Study Area, much of the stream is largely natural. A number of species of conservation importance have been found in or near the stream, of these Three-banded Box Terrapin, which is listed as being Critically Endangered globally is of greatest significance.

Other habitats and sites of particular ecological interest include the channel of the Ng Tung, Sheung Yue and Shek Sheung Rivers, *fung shui* woodland at Ho Sheung Heung, young secondary woodland and older plantations and some other streams.

Alternatives to safeguard the conservation value of Long Valley were considered and it is proposed to designate the area of highest ecological value (37.17ha), the largely wetland area south and east of the Sheung Yue River and south and west of the Shek Sheung River, as LVNP, zoned as Other Uses (OU) Nature Park (area C1-9 in KTN).

The proposed Long Valley Nature Park will safeguard the ecological value of this freshwater wetland area, which is unique in a Hong Kong context. Active conservation management of the LVNP will also provide the opportunity to enhance its ecological value, both to mitigate for loss of wetland habitats and other impacts on wetland fauna, and to increase its value for wildlife.

It is proposed to retain the agricultural (AGR) zonings of the area west and north of the Ng Tung and Sheung Yue Rivers and east of Ho Sheung Heung (C2-2), and the area south and east of area C1-9 and east of Yin Kong (C1-6). To strengthen the planning control over the AGR zone to reflect the importance of this area being on the flight path of the birds and a buffer zone for the LVNP, stringent planning control will be exercised

and such intention will be stated in an Explanatory Statement of the relevant Layout Plan.

Alternatives to avoid potential impacts to Man Kam To Road Egretry were considered, but were found to be impractical due to engineering constraints and requirements; mitigation measures to compensate for this loss are therefore proposed;

Alternatives to avoid potential impacts to the Ma Tso Lung Stream and marsh and its riparian corridor and fauna of conservation significance were considered, and the stream and its tributaries and their riparian corridors south of the point where it will be crossed by the LMC Loop Eastern Connection Road will be included in a Green Belt zone (KTN area H1-1) where there is a presumption against development. Where the construction of the LMC Loop Eastern Connection Road will result in unavoidable impact to a downstream section of the stream in the north of the Project Area, alternatives to minimise impacts were considered. Avoidance of direct impacts by placing the road on viaduct were evaluated as being greater than impacts of diverting a section of the stream and minimising and compensating for such impacts.

Options to find an appropriate balance between the width of buffer which could be provided post-diversion, and the length of stream to be diverted were then considered; and it was resolved that the optimum solution, given the site constraints, is for a section of 130m of Ma Tso Lung Stream to be diverted and reinstated, with a minimum buffer width of 15m from the road to be maintained, following diversion, on the west side of the stream. On the east side a buffer width of up to 30m would be maintained from any development under the Project (such that at no point will the combined width of the buffer on both sides of the stream be less than 45m). The stream section to be diverted will be reinstated with natural materials and marsh vegetation will be established alongside the stream, Tree and shrub planting will be undertaken on each side of this up to the edges of the buffer zone. Once this vegetation has become established it is considered that the ecological value of the riparian corridor as a movement corridor for target fauna species of conservation significance will be fully mitigated, if not increased. In addition, in order to maintain connectivity for fauna moving in a direction perpendicular to the riparian corridor (and the LMC Loop Eastern Connection Road) a faunal underpass will be formed beneath the road. This, together with similar underpasses to be provided to the north of the project boundary under the LMC Loop project, will mitigate for cumulative fragmentation impacts of the two projects.

Finally, in order to minimise mortality impacts on fauna, construction stage barriers are proposed to prevent fauna from entering any project works area and a permanent barrier is proposed to minimise mortality impacts on fauna, in particularly the critically endangered Three-banded Box Terrapin,

Impacts of the Project

Construction and operation of the Project will result in a range of ecological impacts some of which, if unmitigated, are predicted to cause ecological impact of significance. The key habitat losses and indirect impacts are as follows:

Direct Impacts

Direct impacts of the Project will not result in the direct loss of areas of habitat that are of high importance, either in terms of function or area, in the context of the Study Area and the northern New Territories. However, the combined loss of wetland habitats of ecological value, including wet agricultural land, pond, mitigation wetland and seasonally wet grassland is 8.70ha. Most of the areas which will be lost are fragmented and somewhat disturbed, and of limited ecological function, but the loss of wetland area, in aggregate, is of significance.

Indirect Impacts

- Disturbance impact on Long Valley;
- Indirect impact including disturbance, hydrological impact, potential pollution impact and fragmentation impact on Ma Tso Lung Stream and riparian corridor;
- Disturbance impact on Sheung Yue, Ng Tung and Shek Sheung Rivers and on wetland-dependent fauna using the rivers, in particular impacts on large waterbirds foraging in the Sheung Yue River and using the flight-line linking Long Valley along the Ng Tung River to Hoo Hok Wai;
- Disturbance impact on Ho Sheung Heung *fung shui* and secondary woods.

Key Mitigation Measures

Mitigation measures comprise the following:

- Designation of 37.17ha of Long Valley (LVNP) as Other Uses (Nature Park) in the revised RODP;
- Habitat enhancement measures to be implemented in LVNP to compensate for loss of wetland habitats and ecological function of loss of dry agricultural land;
- A series of measures to mitigate for disturbance impacts on Long Valley, including planning control, installation of 2m high fences around works areas; restrictions on work during the ardeid breeding season on flight-lines;
- Preservation and provision of screen planting and optimize building setback along main river channels;
- Phasing of works along main river channels and near Egrettries;
- Provision of alternative egrettry roosting site;
- A series of measures to protect the Ma Tso Lung Stream riparian corridor including designation of a no-building buffer zone,

minimisation of stream diversion, restoration of the stream to natural conditions following diversion, restoration and enhancement of vegetation in the riparian corridor, LMC Loop Eastern Connection Road to cross the stream on viaduct, a permanent barrier on the at-grade section of the LMC Loop Eastern Connection Road to prevent terrestrial fauna mortality and a faunal underpass to mitigate for fragmentation impacts;

- Compensation for loss of secondary woodland and higher value plantation by provision of compensatory woodland habitats, and native tree and shrub planting;
- Pollution control in works areas of ecological significance, and in or adjacent to watercourses;
- Installation of 2m high fences around works areas adjacent to habitats/areas of ecological importance.

After implementation of mitigation measures, no significant adverse residual ecological impacts are predicted. While mitigation measures to reduce disturbance impacts on waterbirds using the main river channels are proposed, disturbance impacts to the more sensitive species on the Sheung Yue and Ng Tung River channels will be mitigated in full by provision and management of compensatory wetland habitat within Long Valley.

Construction phase impacts of Low severity are predicted on some wooded habitats and areas on some species using these habitats and operation phase disturbance impacts of Low severity on Ho Sheung Heung *fung shui* woodland and secondary woodland. However, the compensatory woodland habitat to be provided will generate a net ecological benefit to the Study Area once established.

13.13 References

Ades, G. 1999. Important discovery of Lesser Bamboo Bat roosting site in Hong Kong. Porcupine! 19: 22.

AFCD. 2012. AFCD Biodiversity Database. <http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/resultlist.asp?lang=en>

Allied Environmental Consultants Ltd. 2012. Provision of Cremators at Wo Hop Shek Crematorium, Quarterly Environmental Monitoring and Audit Report (Aug 2012 – Oct 2012). <http://www.epd.gov.hk/eia/register/english/permit/ep3292009/documents/qemar201208to201210/pdf/qemar201208to201210.pdf>

Anon. 2007. Summer 2007 Report: Egret Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site. Report by Hong Kong Bird Watching Society to the Agriculture, Fisheries and

Conservation Department, Hong Kong Special Administrative Region Government.

Anon. 2008a. Summer 2008 Report: Egret Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site. Report by Hong Kong Bird Watching Society to the Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region Government.

Anon. 2008b. Birds and Humans in Harmony – A Sustainable Management Scheme in Long Valley. Bird Monitoring Programme. Summary Report. Report to Environment and Conservation Fund, Hong Kong SAR Government.

Anon. 2009. Summer 2009 Report: Egret Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site. Report by Hong Kong Bird Watching Society to the Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region Government.

Anon. 2010. Birds and Humans in Harmony – A Sustainable Management Scheme in Long Valley. Bird Monitoring Programme. Summary Report. Report to Environment and Conservation Fund of Agricultural, Fisheries and Conservation Department of Hong Kong SAR Government.

Anon. 2011. Summer 2010 Report: Egret Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site. Report by Hong Kong Bird Watching Society to the Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region Government.

Anon. 2012a. Summer 2011 Report: Egret Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site. Report by Hong Kong Bird Watching Society to the Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region Government.

Anon. 2012b. Summer 2012 Report: Egret Counts in Hong Kong with particular reference to the Mai Po Inner Deep Bay Ramsar Site. Report by Hong Kong Bird Watching Society to the Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region Government.

Arup. 2010. Agreement No. CE60/2005 (TP) Land Use Planning for the Closed Area – Feasibility Study. Final Report.

Atkins China. 2008. Construction of Cycle Tracks and the Associated Supporting Facilities Sha Po Tsuen to Shek Sheung River. Environmental Impact Assessment Report.

Barretto, G. Cribb, P. and Gale, S. 2011. The Wild Orchids of Hong Kong. Natural History Publications, Kota Kinabalu. (Borneo) Shn. Bhd. Kadoorie Farm and Botanic Garden. 697pp.

Bascombe. 1993. The Butterflies of Hong Kong.

Binnie, Black & Veatch. 2002. Sheung Shui to Lok Ma Chau Spur Line Environmental Impact Assessment. Environmental Impact Assessment Report. Report to Environmental Protection Department, Hong Kong SAR Government.

BirdLife International. 2011. Important Bird Areas factsheet: Inner Deep Bay and Shenzhen River catchment area. <http://www.birdlife.org> on 29/04/2011.

BirdLife International 2012. IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 24 April 2013

Bodie, J.R. 2001. Stream and riparian management for freshwater turtles. *Journal of Environmental Management* 62: 443-455.

Brurke, V. J. and Gibbons, J.W. 1995. Terrestrial buffer zones and wetland conservation.: A case study of fresh-water turtles in a Carolina Bay. *Conservation Biology*. 9: 1,365-1,369.

Carey, G.J., Chalmers, M.L., Diskin, D.A., Kennerley, P.R., Leven, M.R., Lewthwaite, R.W., Melville, D.S., Turnbull, M. and Young, L. 2001. The Avifauna of Hong Kong. Hong Kong Bird Watching Society, Hong Kong.

Chan, A., J. Cheung, P. Sze, A. Wong, E. Wong and E. Yau. 2011. A Review of the Local Restrictedness of Hong Kong Butterflies. Hong Kong Biodiversity, Agriculture, Fisheries and Conservation Department Newsletter 21: 1-12.

Chan, S.K-f., Cheung, K-s., Ho, C-y., Lam, F-n. & Tang, W-s. 2005. A Field Guide to the Amphibians of Hong Kong. Hong Kong, Cosmos Books Ltd.

Chik, H.L. and Lam, A.C.Y. 2007. Long Valley Habitat Types Distribution Monitoring Report. Report to Environment and Conservation Fund of Agricultural, Fisheries and Conservation Department of Hong Kong SAR Government.

Clements, M.S. 2003. Effects of shading by bridges on estuarine wetlands. Unpubl. M.Sc. Thesis, North Carolina State University.

Clevenger, A.P., Chruszez, B. and Gunson, K.E. 2001. Drainage culverts as habitat linkages and factors affecting passage by mammals. *Journal of Applied Ecology* 38(6):1340-1349.

CSIS. 2013. China Species Information System. (accessed February 2013) <http://monkey.ioz.ac.cn/bwg-cciced/english/cesis/csispage.htm>

Dodd, C.K., Barichivich, W.J. & Smith, L.L. 2004. Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily traveled highway in Florida. *Biological Conservation*, 118, 619-631.

Dudgeon, D. & Corlett, R. 2001. Biodiversity Survey (version 1.0). Department of Ecology and Biodiversity, The University of Hong Kong.

Fellowes, J.R., Lau, M.W.N., Dudgeon, D., Reels, G.T., Ades, G.W.J. Carey, G.J., Chan, B.P.L., Kendrick, R.C., Lee, K.S., Leven, M.R., Wilson, K.D.P and Yu, Y.T. 2002. Wild animals to watch: terrestrial and freshwater fauna of conservation concern in Hong Kong. *Memoirs of the Hong Kong Natural History Society* (25): 123-160.

Gilliam, J.W., Parsons, J.E. and Mikkelsen, R.L. 2001. Nitrogen dynamics and buffer zones pp 54 – 69 in Haycock, N., Burt, T., Goulding, K., Pinau, G. Eds. *Buffer Zones: Their Processes and Potential in Water Protection*. Harpenden: Haycock Associated Limited.

Gelb, Y. and Delacretaz, N. 2009. Windows and Vegetation: Primary Factors in Manhattan Bird Collisions. *Northeastern Naturalist* 16(3): 455-470.

Hafner, H. 2000. Heron Nest Site Conservation. pp. 201-217 in Kushlan, J.A. and Hafner, H. (Eds.). *Heron Conservation*. Academic Press

Harris, G.L. and Forster, A. 2001. Pesticide contamination of surface waters – the potential role of buffer zones pp 62 - 69 in Haycock, N., Burt, T., Goulding, K., Pinau, G. (Eds.) *Buffer Zones: Their Processes and Potential in Water Protection*. Harpenden: Haycock Associated Limited.

Haycock, N.E. and Muscutt, A.D. 1995. Landscape management strategies for the control of diffuse pollution. *Landscape and Urban Planning* 31: 313-321.

HKBWS. 2012. Birds and Humans in Harmony. <http://www.hkbws.org.hk/website/lv/birdlist.html>.

HKBWS. 2012. Monitoring reports at

<http://www.hkbws.org.hk/BBS/viewthread.php?tid=12044&extra=page%3D1>

Hong Kong Bird Reports. 1958 – 2010. Hong Kong Bird Watching Society, Hong Kong.

Hung, T.H. & Pang, C.C. 2008. Biodiversity Assessment for Long Valley by farmers' survey. Report by the Conservancy Association for Environment and Conservation Fund, Hong Kong SAR government.

Hyder. 2008. Provision of Cremators at Wo Hop Shek Crematorium Environmental Impact Assessment: Environmental Impact Assessment Report. Hyder Consulting Ltd. Hong Kong.

IUCN 2013. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 24 April 2013.

Karsen, S., Lau, M.W.N. and Bogadek, A. 1998. Hong Kong Amphibians and Reptiles. Provisional Urban Council, Hong Kong.

KFBG. 2009. Does the Golden Coin Turtle Survive in Hong Kong? http://www.kfbglivingforests.org/content/issue16/kfbg_c_news.php

Klem, D. 1990. Collisions between birds and windows: mortality and prevention. *Journal Field Orn.* 61(1): 120-128.

Klapproth, J.C. and Johnson, J.E. 2001. Understanding the science behind riparian forest buffers: factors influencing adoption. *Forestry and Wildlife (Virginia Cooperative Extension)* 420-154.

Kruuk, H. 1995. Wild Otters – Predation and Populations. Oxford University Press.

Lee, V.L.F., Lam, S.K.S., Ng, F.K.Y. Chan, T.K.T. and Young, M.L.C. 2004. Field Guide to the Freshwater Fish of Hong Kong. Cosmos Books Ltd., Hong Kong

Lo, P.Y.F. & Hui, W-I. 2010. Hong Kong Butterflies. Third Ed. Cosmos Books Ltd., Hong Kong.

Martin, G.R. 2011. Understanding bird collisions with man-made objects: a sensory ecology approach. *Ibis* 153: 239-254.

Maunsell. 2003. Planning and Development Study on North East New Territories, Technical Paper 13, Environmental Impact Assessment, Final Assessment Report. Maunsell Consultants Asia Ltd., Hong Kong.

Maunsell. 1997. Main Drainage Channels for Fanling, Sheung Shui and Hinterland, Environmental Impact Assessment, Final Assessment Report. Maunsell Consultants Asia Ltd., Hong Kong.

Mott MacDonald. 2010. Liantang/ Heung Yuen Wai Boundary Control Point and Associated Works. Environmental Impact Assessment Report (CE 45/ 2008 (CE)). Mott MacDonald Hong Kong Ltd., Hong Kong

Mott MacDonald. 2012. Review, Design and Tender Documentation for Drainage Improvement Works at Tsung Yuen, Kwu Tung North. Environmental Review for KTN01 (Final) Document No. 296472/005/C. Mott MacDonald Hong Kong Ltd., Hong Kong

O'Connell, T. 2001. Avian window strike mortality at a suburban office park. *The Raven* 72: 141-149.

Ogden, L. J. E. 1996. Collision course: The hazards of lighted structures and windows to migrating birds. Toronto, Ontario: World Wildlife Fund Canada and the Fatal Light Awareness Program.

Ove Arup. 2008. Agreement No. CE 42/2008 (TP). Planning Study on Liantang/ Heung Yuen Wai Cross-boundary Control Point and its Associated Connecting Road in Hong Kong - Feasibility Study. Final Report.

Robins, L. 2002. Managing Riparian Land for Multiple Uses. RIRDC Publications.

San Francisco Planning Dept. 2011. Standards for Bird-Safe Buildings. San Francisco Planning Dept., San Francisco.

Semlitsch, R.D. and Bodie, J.R. 2003. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. *Conservation Biology* 17: 1219-1228.

Shek, C.T. 2006. A Field Guide to the Terrestrial Mammals of Hong Kong, Agriculture, Fisheries and Conservation Department, Hong Kong.

Shek, C-t., Chan, C.S.M. and Wan, Y-t. 2007. Camera trap survey of Hong Kong terrestrial mammals in 2002-06. *Hong Kong Biodiversity* 15: 1-11.

Smith, D.J. 2003. Monitoring wildlife use and determining standards for culvert design: Final report presented to the Florida Department of Transportation for contract BC354-34. Department of Wildlife Ecology and Conservation, University of Florida, Gransville, Florida.

Sung, Y-k, Or, C.K.M. undated. Nature Conservation Management for Long Valley 2010 – 2012. Bird Monitoring Programme. Summary Report – March 2011 to February 2012.

Tam, T-w, Leung, K-k, Kwan, B.S.P., Wu, K.K.Y., Tang, S.S.H., So, I.W.Y., Cheng, J.C.Y., Yuen, E.F.M., Tsang, Y-m and Hui, W-l. 2011. The Dragonflies of Hong Kong. Friends of the Country Parks, Hong Kong.

UNEP-WCMC. 2013. CITES Species Database. <http://www.cites.org/eng/resources/species.html> (accessed Mar 2013)

Uusi-Kamppa, J., Turtola, E., Hartikainen, H. and Ylaranta, T. 2001. The interactions of buffer zones and phosphorous runoff pp43 – 53 in Haycock, N., Burt, T., Goulding, K., Pinau, G. Eds. *Buffer Zones: Their Processes and Potential in Water Protection*. Harpenden: Haycock Associated Limited.

Van der Grift, E.A. and Kuijster, R.M.J. 1998. Mitigation measures to reduce habitat fragmentation by railway lines in the Netherlands. *ICOWET* February 9-12: 166-170.

Wan, P.H. 2010. Nature Conservation Management for Long Valley. Biodiversity Survey of Amphibians, Reptiles and Mammals in 2009/10. Report to Environment and Conservation Fund, Hong Kong SAR Government.

Wang S. (Chief Ed.) 1998. China Red Data Book of Endangered Animals: Aves, Amphibia &, Reptilia, Mammalia and Pisces. Science Press. Beijing. China

White, C.L., Frederick, P.C., Main, M.B. & Rodgers, J.A.Jr. 2008. Nesting Island Creation for Wading Birds. Circular 1473, Wildlife Ecology and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Wilson, K.D.P. 2004. Field Guide to the Dragonflies of Hong Kong. Second edition. Hong Kong, Agriculture, Fisheries and Conservation Department.

Wu, S.H., Lee, W.T.C., 2000. Pteridophytes of Hong Kong. Memoirs of the Hong Kong Natural History Society 23: 5-20.

Xing, F., Ng, S.c and Chau, L.K.C. 2000. Gymnosperms and angiosperms of Hong Kong. Memoirs of the Hong Kong Natural History Society 23: 21-136.

Young, J.J. & Yiu, V. 2002. Butterfly Watching in Hong Kong. Hong Kong, Hong Kong Lepidopterists' Society.

Young, J.J, and Yiu, V. 2011. A Photographic Monograph on Hong Kong Butterflies. Hong Kong Lepidopterists Society, Hong Kong.

Young, L. and Cha, M.W. 1995. The History and Status of Egrettries in Hong Kong with notes on those in the Pearl River Delta, Guangdong, China. Hong Kong Bird Report 1994: 196-215.

Yue, P. and Chen, Y. 1998. China Red Data Book of Endangered Animals: Pisces. Science Press, Beijing, China.

Zhao, E. 1998. China Red Data Book of Endangered Animals: Amphibia and Reptilia. Science Press. Beijing. China.