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1. INTRODUCTION

Background to the Study

- 1.1 The Sha Tin and Tai Po Drainage Master Plan (DMP) Study, completed in October 1999, indicated that certain stormwater drains and natural rivers/streamcourses in the Sha Tin and Tai Po areas did not have the required hydraulic capacity to meet the flow requirements. To minimise the risks of flooding and to cope with future developments as identified in the DMP Study, construction of river channels, upgrading of existing stormwater drains, construction of flood pumping stations in the low-lying areas and other minor drainage facilities were recommended.
- 1.2 Upon completion of the DMP Study, the Drainage Services Department (DSD) of Hong Kong SAR Government commissioned Maunsell Consultants Asia Ltd. (MCAL) to undertake Agreement No. CE50/2001 (DS) Drainage Improvement in Sha Tin and Tai Po – Design and Construction (hereinafter referred to as “the Assignment”), for implementing the drainage improvement works at various locations as recommended by the DMP study to alleviate the potential flooding problems in Sha Tin and Tai Po districts.
- 1.3 A Preliminary Environmental Review (PER) was conducted in conjunction with the Preliminary Project Feasibility Study (PPFS) for the DMP Study to identify the potential environmental issues, such as air quality, noise, water quality and ecology, arising from drainage improvement works and the likely mitigation measures required. The PER completed in March 2000 identified 13 project items (i.e. DP-1 to DP-13 stated in Table 1.1 below) which should be regarded as designated projects (DPs) under the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499). A Project Profile was submitted by DSD in June 2001 for an Environmental Impact Assessment (EIA) study brief to proceed with an EIA study for these 13 DPs. A study brief was issued in July 2001 (EIA Study Brief No. ESB-077/2001). **Figure 1.1** shows the locations of these DPs under the original scope of the works.

Table 1.1 Designated Projects under the Assignment

Designated Project No.	Description of Designated Project
<i>Drainage channel improvement to existing rivers</i>	
DP-1	Drainage channel improvement to She Shan River
DP-2	Drainage channel improvement to Tai Po River
DP-3	Drainage channel improvement to Kwun Hang River
<i>Drainage improvement in Tai Po</i>	
DP-4	Stormwater drainage improvement at Tai Po Road – Yuen Chau Tsai
DP-5	Stormwater drainage improvement at Tai Po Market
DP-6	Construction of floodwater pumping station at Tai Po Market
DP-7	Construction of parapet wall at Lam Tsuen River
DP-8	Construction of flap valves at outfalls at Lam Tsuen River

Designated Project No.	Description of Designated Project
DP-9	Construction of cross road drain at CARE village
<i>Drainage improvement in Shuen Wan</i>	
DP-10	Construction of floodwall along Tung Tsz Road, Shuen Wan
DP-11	Construction of floodwater pumping station at Shuen Wan
DP-12	Construction of cross road drain at Po Sam Pai
DP-13	Construction of cross road drain at Shuen Wan

- 1.4 Following the review conducted under this Assignment, the scope of works for each DP has been reviewed and revised, with the extent of the proposed works been more clearly defined.
- 1.5 It is understood that a number of these project works items were being treated as DPs in the PER stage because the proposed works had been classified as “drainage channel or river training works” and fallen within the requirements as stated in Schedule 2 of the EIAO.
- 1.6 Based on the revised scope and the more clearly defined extent of the proposed works, which may be different from those recommended under the DMP Study, together with the consideration of the definition of “drainage channel” and “rivers” provided in ETWB TCW No. 5/2005, a review has been carried out to assess whether these works items should still be regarded as DPs under the EIAO, and the assessment are explained below. The latest scope of the different proposed works is shown in **Figures 1.6A – 1.6N**.

DP-1

- 1.7 The original proposed drainage improvement works at She Shan River is considered as a DP under Schedule 2 of the EIAO since the works would fall partly within a Conservation Area (CA). A design review has been conducted under the Assignment, and changes in the design for the channel improvement works in She Shan River were recommended. A by-pass channel of about 150m long is proposed to be built along an upstream section of the river so as to leave the natural river section in the CA untouched as well as to provide a buffer for the CA. The alignment of the original proposed scheme and the alternative scheme are shown in Figure 1.2 and 1.3 respectively. Impacts on the more natural, upstream areas of She Shan River would also be avoided through the construction of the by-pass channel running alongside the existing stream channel. Given that the revised proposed drainage improvement works are now outside the designated CA, it is considered that the proposed drainage improvement works at She Shan River, with the adoption of the alternative scheme, should not be considered as a DP under the EIAO. Notwithstanding the above, measures are proposed to minimize the impact on She Shan River. It is recommended that the excavation work carried out within water body should be restricted to enclosed dry section of the river with appropriate containment measure to minimize the potential sedimentation of downstream water body. Besides, vegetated gabion channel wall is proposed for the restoration of riparian zone. Details of the proposed measures are presented in Appendix 1.1.

DP-2

- 1.8 This project item was considered as a DP since the works are proposed at sections of the Upper Tai Po River with discharge into an area less than 300m from two sites of cultural heritage, namely the Wun Yiu Pottery Kilns and Fan Sin Temple, both of which are declared monuments under the *Antiquities and Monuments Ordinance*. The extent of the works areas of the Project has been

reviewed, revised and minimised as far as practicable to maximise the distance from the two sites of cultural heritage. The potential indirect impacts on the recorded resources through noise/vibration, dust and/or site runoff from the proposed construction activities are also minimised and considered to be minor given the scale of works involved is small. There is limited scope of vibratory plant for the construction works and adequate buffer zones will be provided between the works area and the recorded resources.

- 1.9 Various measures have been proposed to minimise and mitigate the possible ecological impacts. A more environmentally-friendly' channel design instead of the standard, trapezoidal concrete lined channel used in many previous drainage improvement projects. Furthermore, the existing large boulders will be maintained as much as possible or returned to form a potentially important microhabitat for fauna to the riverbed following excavation works. In addition, a section of about 150m of the existing, natural riverbank on the western side of the river will also be maintained.
- 1.10 With these changes along with the implementation of mitigation measures, it is considered that the proposed works would not incur insurmountable impact to the environment. A project profile has been prepared to apply for permission to direct application of an environmental permit under Section 5(11) of the EIAO as the environmental impacts associated with the proposed works would fall within the guidelines and criteria laid down in the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM) and the effectiveness of the mitigation measures has been demonstrated in practice. The application was approved in July 2005 and an environmental permit No. EP-223/2005 was granted in August 2005.

DP-3

- 1.11 According to the original proposal for DP-3 (i.e. drainage channel improvement to Kwun Hang River) as presented in the PFFS, about 0.5km of Kwun Hang River would be upgraded to a concrete engineered channel. The original proposal has subsequently been reviewed and revised; the revised scope for the proposed drainage channel improvement works at Kwun Hang River has been significantly reduced. In the revised design proposal, only the existing single-cell box culvert and the associated head walls under Sai Sha Road would be re-constructed to remove the bottleneck identified in Kwun Hang River. With this revision to the proposed drainage improvement works, this works item is not considered to be a DP according to the EIAO. Nevertheless, it is proposed that the excavation works within water body to be carried out by land-based plant and be restricted to enclosed dry section to minimize the potential water quality impacts to marine habitats downstream of proposed works. Details of the proposed measures are presented in Appendix 1.1.

DP-4 and DP-5

- 1.12 Works Items (4) and (5) involves installation of underground drainage pipes along Tai Po Road – Yuen Chau Tsai and in Tai Po Market. These project items were considered as DPs since they were considered as “drainage channels” or “rivers” with discharge into an area less than 300m from declared monuments namely “Island House”, “Man Mo Temple” and “Tai Po Market Railway Station”. The revised proposed works only involve laying of underground drainage pipe which would not fall within the category of “drainage channel or river training and diversion works” as stipulated in Schedule 2 of the EIAO and hence they are not considered as DPs according to the EIAO. In view that the works is proximate to the residential areas, the use of quieter PME, temporary noise barrier and acoustic shed is recommended to be adopted to mitigate the adverse noise impact. Details of the proposed measures are presented in Appendix 1.1.

DP-6 and DP-8

- 1.13 DP-6 and DP-8 encompass the construction of a floodwater pumping station at Tai Po Market and installation of flap valves at outfall of Lam Tsuen River. Since these two works were considered as “drainage channels” or “rivers” and with discharge within 300m from a declared monument – Man Mo Temple, they were designated as DPs previously. However, the revised proposed works under these two project works only involve construction of floodwater pumping station and flap valves at the river bank of Lam Tsuen River which do not fall within the description of “drainage channel or

river training and diversion works” under Schedule 2 of the EIAO, and therefore they should not be considered as DPs according to the EIAO. In view that the works is proximate to the public school, the use of quieter PME and temporary noise barrier is proposed to reduce the adverse noise impact. Details of the proposed measures are presented in Appendix 1.1.

DP-7

- 1.14 The proposed drainage improvement works for DP-7 involves construction of parapet wall at the river bank of Lam Tsuen River. The reason for classifying it as a DP was due to the proposed works were considered to be related to “drainage channels” or “rivers” with discharge less than 300m from a declared monument – Man Mo Temple. However, after reviewing the necessity of this project works item, it has been concluded that the existing river bank is able to provide adequate flood protection to the areas and as a result this project works item is considered not necessary and have been deleted from the project.

DP-9

- 1.15 DP-9 involves construction of a crossroad drain at CARE village across KCRC. This works item was considered as to be related to “drainage channels” or “rivers” with discharge within 300m from the Island House at Yuen Chau Tsai, which is a declared monument, and was considered to be a DP. The exact extent of this project item has been reviewed and revised which now only involves the construction of an underground pipe by trenchless method and does not fall in the category of “drainage channel or river training and diversion works” under Schedule 2 of EIAO. As such this works item should not be considered to be a DP according to the EIAO. In view that the works is proximate to the residential areas, the use of quieter PME, temporary noise barrier and noise enclosure is recommended to mitigate the adverse noise impact. Details of the proposed measures are presented in Appendix 1.1.

DP-10, DP-11 and DP-13

- 1.16 DP-10, DP-11 and DP-13 were collectively undertaken for drainage improvement for the Shuen Wan area in Tai Po. The flood protection works proposed under the original design included the construction of a floodwall along Tung Tsz Road, a floodwater pumping station at Shuen Wan and a cross road drain at Shuen Wan. Layout of the original flood protection scheme is shown in **Figure 1.4**. After a comprehensive design review and consultation with the local residents and the District Council have been conducted, the original proposed works have been revised accordingly.
- 1.17 During the course of public consultation, several alternative flood protection schemes, including doing nothing, raising of Tung Tsz Road, provision of invert siphon, construction of box culvert along Tung Tsz Road, were explored in addition to the original scheme. Details of the alternative schemes are discussed in Section 2. Having considered the practicality, reliability, cost effectiveness and environmental and social acceptability of alternatives and the comment given by the Environmental and Works Committee of Tai Po District Council, the scheme involving the construction of box culvert along Tung Tsz Road was adopted as the preferred scheme. The latest scope of works for the drainage improvement in the Shuen Wan area (hereinafter referred to as “the Project”) is shown in **Figure 1.5**, the works comprise:
- I. Construction of a twin-cell box-culvert along Tung Tsz Road (Alternative of DP-10)
 - II. Construction of a floodwater pumping station at Shuen Wan (DP-11)
 - III. Replacement of mechanical gate at Wai Ha River
 - IV. Construction of about 280m of relief drain in Wai Ha Village
 - V. Construction of about 260m drainage pipe along Ting Kok Road

- 1.18 With the implementation of the proposed twin-cell box-culvert and the pumping station, the original proposed cross road drain at Shuen Wan, which was designated as DP-13, for the purpose of providing additional capacity for flood relief at the mouth of Wai Ha River is no longer required.
- 1.19 The original proposed works involve the construction of a floodwall along Tung Tsz Road. This has now been replaced by the construction of a twin cells box-culvert along Tung Tsz Road. In accordance with Category Q.1 of Part 1, Schedule 2 of the EIAO, works partly or wholly in an existing Conservation Area are classified as a DP. Since a section of the proposed box-culvert along Tung Tsz Road would be constructed within the CA, the Project should be considered to be a DP under the EIAO. The cumulative effects of all works items in para 1.17 above to the respective sensitive receivers will be assessed and addressed in this EIA study. Environmental permits are required before the construction and operation of the Project can commence.

DP-12

- 1.20 The proposed drainage improvement works under DP-12 only involves the upgrading of the existing crossroad box culvert at Po Sam Pai. It was considered as a DP since the proposed drainage works was considered as “drainage channels” or “rivers” with discharge within 300m from the coastal protection area and Site of Special Scientific Interest. The exact extent of the project has critically be reviewed and the revised works on upgrading for the box-culvert now does not fall within the description of “drainage channel or river training and diversion works” under Schedule 2 of EIAO, this works item is not considered to be a DP according to EIAO. Nevertheless, it is proposed that the excavation works within water body to be carried out by land-based plant and be restricted to enclosed dry section to minimize the potential water quality impacts to marine habitats downstream of proposed works. Further, the works is proximate to the residential areas, the use of quieter PME, temporary noise barrier and noise enclosure is proposed to be adopted to mitigate the adverse noise impact. Details of the proposed measures are presented in Appendix 1.1.

Purpose and Scope of EIA

- 1.21 According to section 3.2 of the EIA Study Brief No. ESB-077/2001, the scope of the EIA study should cover the designated projects (DP-1 to DP-13) listed in section 1.2 (i) to (xiii). However, as explained above, only the construction of the box culvert is regarded as a DP under the EIAO and therefore, the scope of this EIA study covers this works item and its associated works for drainage improvement in the Shuen Wan area that are described in section 1.17 above.
- 1.22 The purpose of the Environmental Impact Assessment Report is to provide information on the nature and extent of environmental impacts arising from the construction and operation of the proposed Project and related activities taking place concurrently. The information will contribute to decisions on:-
- overall environmental acceptability of any adverse environmental consequences of the proposed Project.
 - the conditions and requirements for the detailed design and construction of the Project to mitigate against adverse environmental consequences wherever practicable.
 - the acceptability of residual impacts after the proposed mitigation measures.

EIA Study Area

- 1.23 The Assessment Area for the purpose of this EIA Report, as specified in the Study Brief, is presented below:
- Noise impact assessment – include areas within 300m from the Project boundary. (If the first layer of noise sensitive receivers provides acoustic shielding to those receivers further from the site, the assessment area could be reduced accordingly).

- Air quality impact assessment - the assessment area should be a distance of 500m from the Project boundary.
- Water quality impact assessment – include areas within 5km from the Project boundary.
- Ecological impact assessment – the assessment area for terrestrial ecological assessment should include areas within 500 m from the site boundary of the works areas, or the area likely to be impacted by the Project. For aquatic ecology, the assessment area should be the same as for water quality assessment.
- Landscape and visual impact assessment – the assessment area for landscape impact assessment should include areas within 300 m from the work limit of the proposed designated project, while the assessment area for the visual impact assessment should be defined by the visual envelope of the designated project.
- Fisheries impact assessment – the assessment area should include the Fish Culture Zones at Yim Tin Tsai and Yim Tin Tsai (East).

Structure of the Report

1.24 The remainder of the report is organised as follows:

- Section 2 describes the Project and its need, implementation programme, and addresses alternative considerations, designs and construction methods.
- Section 3 identifies and assesses the potential noise impacts associated with the construction of the Project, and recommends mitigation measures to comply with the established noise standards, wherever necessary.
- Section 4 identifies and assesses the potential air quality impacts associated with the construction of the Project, and recommends necessary mitigation measures.
- Section 5 identifies and assesses the potential water quality impacts associated with the construction and operation of the Project, and recommends mitigation measures to minimize the impact.
- Section 6 identifies and assesses the potential waste management implications associated with the construction of the Project and recommends appropriate waste handling, transportation and disposal practices.
- Section 7 identifies and assesses the potential ecological impact associated with the construction and operation of the Project, and recommends mitigation measures to minimize the impact.
- Section 8 identifies and assesses the potential landscape and visual impacts associated with the construction and operation of the Project.
- Section 9 identifies and assesses the potential fisheries impact associated with the construction and operation of the Project.
- Section 10 highlights the Environmental Monitoring and Audit (EM&A) requirements for the Project. The scope and approach are presented in detail in a stand-alone EM&A Manual.
- Section 11 concludes the findings of the EIA Study.
- Section 12 presents the Implementation Schedules of the various environmental issues addressed in the EIA Study.

2. DESCRIPTION OF THE PROJECT

Location of the Project

- 2.1 The Shuen Wan area is a low-lying land situated to the south of Pat Sin Leng Country Park. It is a relatively undeveloped area, mainly served by Ting Kok Road along the coastline of Plover Cove, Tung Tsz Road and some informal village tracks. Marshlands and ponds of ecological significance are found within this area. An area of about 17.5ha to the south of Tung Tsz Road is designated as Conservation Area (CA). Other than the ecological resources, this area also accommodates a number of village settlements including San Tau Kok Village, Wai Ha Village and Po Sam Pai Village located to the north of Tung Tsz Road, Shuen Wan Chim Uk Village and Shuen Wan Chan Uk Village to the south of Tung Tsz Road.

Need of the Project

- 2.2 The proposed works in Shuen Wan form part of the drainage improvement works under the recommendation made in the DMP Study. At present, stormwater runoff within the catchment in Shuen Wan, which is of area about 313 ha, will go into the existing Wai Ha River, which runs through the centre of the CA, then via a box culvert underneath Ting Kok Road and finally discharge to Tolo Harbour.
- 2.3 The water level at Wai Ha River is subject to tidal effects due to ingress of seawater from Tolo Harbour which may reach up to 4.25mPD. According to the results of investigation, the low-lying land in the vicinity of Wai Ha River, particularly north of Tung Tsz Road such as Wai Ha village and San Tau Kok village, will be subject to high risk of flooding during severe storm event. The results of the hydraulic analysis also indicate that the capacity of Wai Ha River is inadequate even under a 1-in-2 year high tide event.
- 2.4 As mentioned above, the cause of flooding in the low-lying land in Shuen Wan area is a combined effect of extensive rainwater conveyed into Wai Ha River during severe storm event and ingress of seawater through the existing box culvert during high tide event. Flooding is considered beneficial to the natural habitat in the CA; however, if the flood level kept increasing and the affected area extended beyond Tung Tsz Road, it would impose high risks to lives and properties of the neighbouring villages with a population over 2,000; thus, flooding in Wai Ha River would need to be controlled.
- 2.5 Based on the past record, during the period from July 1999 to June 2003, 22 Nos. complaints about flooding at Shuen Wan area were received by the Drainage Complaints Information System. The flooding in Shuen Wan area would disrupt the traffic along Tung Tsz Road, which is the only access to the villages located in the Tung Tsz and Wai Ha areas. As a result, the villages would be isolated by the inundation and this incurs an unacceptable risk to life and may cause extensive damage to the properties.
- 2.6 The potential consequences of such flooding include:-
- Risk to life;
 - Damage to property ;
 - Nuisance to public;
 - Disruption to traffic; and
 - Psychological stress.

- 2.7 If the improvement works under this Project do not proceed, the high flooding risks to the villages would persist in this area. Therefore, engineering works proposed in this Project are necessary to provide adequate flood relief.

Scope of the Project

- 2.8 The objective of this project in Shuen Wan area is to develop an optimum solution to relieve the flooding problems there. To provide a long-term solution, it has been proposed to divert a large portion of the stormwater from upstream away to avoid this excessive runoff getting into the low-lying area to further amplify the extent of flooding during extreme storm and tide events. The scope of the proposed drainage improvement works in Shuen Wan includes:-

- Construction of a 1000m long 3m x 2.5m twin-cell box culvert along Tung Tsz Road
- Replacement of existing gates by automatic mechanical gates at the mouth of Wai Ha River
- Construction of a drainage pipe of 280m long and 1200mm in diameter near Wai Ha Village
- Construction of a flood relief drain of 260m long and 2100mm in diameter along Ting Kok Road
- Construction of a floodwater pumping station of about 10m high at Shuen Wan

- 2.9 The design principle of the drainage improvement works in Shuen Wan is described in the following.

- Under normal situation and when the rainfall is not so severe, the existing river within the CA (Wai Ha River) will convey the entire runoff.
- During severe storm and high tide events, the flow as well as the water depth in Wai Ha River will increase. When the tide level has reached the specified level, the proposed automatic mechanical gates installed at the mouth of Wai Ha River will be closed to prevent the ingress of further seawater into the low-lying land in the vicinity of Wai Ha River. The triggering level of the gate closure will be determined from the results of the hydraulic analysis of the whole Shuen Wan area, with the use of the hydraulic modeling, such that further increase in water level will jeopardize the safety of the nearby residents.
- The water level in Wai Ha River will continue to rise due to the closure of the mechanical gate at the exit with the increasing runoff due to the heavy rainfall. At its upstream near Tung Tsz Shan Road and Wai Ha Village, an overflow chamber will be constructed as the inlet of the box culvert. When the water level raises above the weir which is constructed to a pre-determined level according to the hydraulic analysis as mentioned above, excessive stormwater will overflow into the chamber which will then be conveyed to the box culvert, which serve as a bypass, underneath Tung Tsz Road and Ting Kok Road and discharge to Tolo Harbour directly while the remaining flow will still be running along the existing Wai Ha River.
- The box culvert will be designed with a capacity sufficient for conveying the overflow, which may be up to two-third of the entire runoff from the upper catchment of Wai Ha River under a 1 in 50 year storm event.
- At the same time, the runoff water will accumulate behind the mechanical gate and the water level will build up. When it reaches a pre-determined level it will be diverted through a flood relief pipe installed underneath Ting Kok Road to a floodwater pumping station at the east side of Ting Kok Road for discharging to the sea.
- After the severe storm and tide events have passed and with the release by both the box culvert and the floodwater pumping station, the tide level as well as the water level in both sides of the mechanical gates at the mouth of Wai Ha River will drop and soon return to normal. The mechanical gate will be opened and the runoff water will run through Wai Ha River as

before and discharge into the Tolo Harbour. Figure 1.5 shows the general layout of the proposed works.

- As such, the runoff from the whole Shuen Wan catchment will still be conveyed by the existing Wai Ha River and the CA will not be dried up at all times, and the inter-tidal characteristics of the CA can still be maintained during normal situation when the rainfall is not severe and the tide level is not high.

Consideration of Alternative Drainage Options

2.10 The following drainage options have been considered for relieving flooding at Shuen Wan before concluding the current design.

- Option 1 Do Nothing – No engineering works to the existing drainage system will be implemented under this option. Regular maintenance including desilting will be carried out to Wai Ha River.
- Option 2 Floodwall (or Protection Embankment) – Construction of a floodwall along south-east side of Tung Tsz Road or raising road level of Tung Tsz Road to retain floodwater from Wai Ha River during rainstorm event. Runoff generated at the northern side of Tung Tsz Road will be collected by a surface drain and convey to the proposed pumping station located to the east of Ting Kok Road and discharged to Tolo Harbour.
- Option 3 Upgrading of Wai Ha River – Widening and raising embankment at downstream of Wai Ha River to retain floodwater and prevent its overflow during rainstorm event.
- Option 4 Inverted Siphon – Construction of inverted siphon by means of trenchless method passing underneath the CA to intercept the excessive runoff coming from upstream of Wai Ha River. The intercepted runoff will then be conveyed to a proposed medium scale pumping station located to the east of Ting Kok Road. In order to prevent building up of water level in Wai Ha area by ingress of tidal water, a mechanical gate is proposed at the outfall of Wai Ha River. At the same time a diversion drain is proposed along Ting Kok Road to convey the residual runoff to the proposed pumping station for discharge.
- Option 5 Large Scale Pumping Station – Construction of a large scale pumping station, which pumping capacity is adequate to handle stormwater generated within Shuen Wan Catchment, to discharge the floodwater to Tolo Harbour.
- Option 6 Box Culvert – The scope of works of this option is outlined in para. 2.8.

2.11 The above alternatives have been examined and evaluated from different perspectives. The results of our evaluation in terms of technical practicality are presented in **Table 2.1** below:-

Table 2.1 Evaluation of Alternative for Drainage Improvement Works in Shuen Wan

DRAINAGE OPTION	EVALUATION	PRACTICALITY OF THE OPTION
Do nothing	Flooding problems will persist in long run. Regular maintenance including desilting works could not resolve the problem.	Not practicable
Floodwall	Floodwall will effectively prevent the residential areas to the north of Tung Tsz Road from flooding. However, this option will reduce the freeboard of flood level for the residential area in the southern side of Wai Ha River.	Practicable
Upgrading of Wai Ha River	Shuen Wan area is a low lying area, it would be necessary to extend the width of existing Wai Ha River to about 20m in order to provide the necessary hydraulic capacity and resolve the flooding problems. Wai Ha River is located in the middle of the CA and the proposed construction works within CA would induce severe adverse environmental impact, despite there is a need to resume substantial amount of private land within the CA for the widening works.	Not practicable
Inverted Siphon	Inverted siphon is able to serve the purpose by diverting the runoff collected in the upstream away from Wai Ha River. However, there would be significant problems on sedimentation inside the inverted siphon and it will be very difficult to carry out maintenance works inside the inverted siphon during emergency situation. Furthermore, there will be high risk of loss of ground water during construction of the tunnel, in the form of inverted siphon, which may seriously affect the habitat of the CA.	Not practicable
Large Scale Pumping Station	With sufficient pumping capacity, a large scale pumping station at downstream of Wai Ha River will effectively solve the flooding problems. However, such a huge pumping station would consume enormous amount of energy. In addition, the risk of flooding is still high as the whole scheme relies solely on the functioning of the pumping station and the consequence of any failure, such as power supply, would be disastrous.	Not practicable
Box Culvert	Box culvert will effectively divert the runoff collected at upstream away from Wai Ha River. This option will also provide extra protection to the residents at the southern side of Wai Ha River.	Practicable

2.12 In view of the above, only the floodwall and the box culvert options are considered practicable in solving the flooding problems in Shuen Wan.

2.13 A comparison of environmental impacts between the box culvert and floodwall options are shown in **Table 2.2** below.

Table 2.2 Comparison of Environmental Impacts from the Practicable Options

Drainage Options	Box Culvert	Floodwall
Total Area of Marshland in Study Area	16.2ha	
Area of Marshland to be affected / <i>Percentage of Affected Area</i>	0.3ha / 1.9%	0.28ha / 1.7%
Total Area of CA in Study Area	17.5ha	
Area of CA to be affected / <i>Percentage of Affected Area</i>	0.5ha / 2.9%	0.22ha / 1.3%
Ecological Impact	The works will encroach on the northern boundary of the CA which will impose direct ecological impacts on the habitat along the fringe of the CA. About 100m of the box culvert will be constructed adjacent to Wai Ha River.	The works will encroach on the northern boundary of the CA which will impose direct ecological impacts on the habitat along the fringe of the CA.
Noise Impact	The works site is close to residential area, which will inevitably induce noise impact during construction stage.	The works site is close to residential area, which will inevitably induce noise impact during construction stage.
Visual Impact	This option will not create visual impact to the public.	The floodwall or the protection embankment acts like a barrier which imposes adverse visual impact to the local residents.

2.14 It can be seen that the scale of environment impacts (particularly in ecological aspect) arising from the two options are very similar. For example, these two options both affect the fringe of the CA, and the works extents of both options only encroach on small percentages (1.3% to 2.9%) of the marshland and the CA in the study area.

2.15 The floodwall option is the preferred scheme in the previous study because of economic reasons. However, after lengthy consultations with the District Council members and local representatives, it is revealed that the construction of floodwall was strongly opposed because the floodwall would result in adverse visual impact and was alleged to affect the "Fung Shui" of the villages in the vicinity. The strong opposition makes this floodwall option socially unfeasible. The box culvert scheme is considered to be more favourable after taking social consideration into account as the adverse visual impacts incurred by the box culvert option are mostly temporary. By implementation of appropriate mitigation measures, the impacts can be mitigated and the residual visual impact is considered acceptable.

2.16 Although the floodwall and box culvert options would involve construction works to be carried out along Tung Tsz Road, these two alternatives have different approaches in tackling the flooding problems in Shuen Wan. The floodwall option would allow flooding to continue as before, but a physical barrier would be provided to prevent the extension of flooding area beyond the barrier. On the other hand, the box culvert would also allow certain extent of flooding to happen, but a large

portion of runoff would be diverted before getting into the low-lying area during heavy rainstorm which is considered to be a more sustainable solution in resolving the flooding problem.

- 2.17 Therefore, to improve the current flood protection standard of the drainage system in Shuen Wan, the preferred option is the box culvert option. This option will increase the drainage capacity while retaining majority of the river ecology at Wai Ha River, minimizing disturbance to the CA, visual intrusion and environmental impacts overall.

Recommendations on Preliminary Design of Drainage Improvement Works

- 2.18 The Project has been designed in accordance with DSD Stormwater Drainage Manual, DSD Technical Circular No. 2/2004 "Protection of natural rivers and streams from adverse impacts arising from construction works" and ETWB TC(W) No. 5/2005 "Protection of natural streams/rivers from adverse impacts arising from construction works". The proposed drainage system is classified as "Main Rural Drainage Channel" with a design return period of 1 in 50 years.
- 2.19 The design of the box culvert alignment has taken into account two key constraints: (1) Tung Tsz Road is the sole access to several villages located in the Shuen Wan area. Its traffic needs to be maintained in order to minimize the disruption to the local residents during construction stage of the Project; (2) its encroachment to the nearby marshland/Conservation Area should be minimised as far as possible. To strike a balance between these two requirements, the proposed box-culvert will be constructed partially underneath Tung Tsz Road. By doing so, its traffic can be maintained throughout the construction stage of the Project by maintaining a minimum road width of about 3.5m for the two way traffics. However, part of the works would inevitably affect a small area of the marsh habitat adjoining Tung Tsz Road. The ecological value of this part of the marsh to wildlife is reduced by disturbance from vehicular and pedestrian traffic on Tung Tsz Road. Appropriate measures have been recommended (refer to Section 7) to mitigate the ecological impact.
- 2.20 Due to the low lying nature of the Wai Ha area (the level at Tung Tsz Road is around 3.3mPD), the residual runoff collected by the drainage system cannot be discharged to Tolo Harbour by gravity. Therefore, a pumping station is proposed to pump the collected stormwater to Tolo Harbour.
- 2.21 The proposed mechanical gate is necessary to provide effective control of the backflow of sea water to Wai Ha River during high tide condition. At the same time, the diversion drain laid along Ting Kok Road is essential to divert the residual water to the proposed pumping station in order to maintain water level in the Wai Ha area within a certain level. These works would not give rise to insurmountable environmental impacts during construction and operation phases of the Project.
- 2.22 The proposed relief drain pipe at the northern side of Wai Ha Village would run through the village in the previous design. If this option was adopted, excessive construction noise impact at the village houses would be envisaged. About 54 dwellings would be exposed to elevated construction noise levels even with extensive noise mitigation measures in place. Under the chosen scheme, the relief drain pipe will be laid along the northeast side of the village and the affected dwellings will be reduced to about 4 with the use of alternative quieter construction method (refer to Section 3).

Consideration of Alternative Construction Method

- 2.23 A stretch of the proposed box culvert will interfere with the existing Wai Ha River. Earthworks including excavation by powered mechanical equipment, disposal of excavated soil by dump trucks and compaction by mechanical plant will be required. This is the commonly adopted construction method. The impact to environment is generally localized and temporary. The environmental impacts incurred by this conventional method can be mitigated by appropriated measures like restricting the excavation works to be carried out from October to April to minimize the adverse effects on the rivers.
- 2.24 Conventional construction method for box culvert involves formworks erection, reinforcement fixing and in-situ concreting. Alternative method using precast units has also been explored, however, the size of box-culvert is large which means the precast units require a large plant to handle and install.

Due to limitation of space, this option is not preferred since the installation of the precast units requires either occupying the remaining traffic lane or acquiring more space in the Conservation Area.

- 2.25 For the conventional open trench method, trench excavation supported by sheet piling is proposed so as to minimize the encroachment to the existing marshland. In order to limit the construction noise generated, percussive piling method is restricted for the installation of the sheet pile of the trench support and the piling foundation of the pumping station.
- 2.26 Majority of the pipe laying works will generally adopt the conventional open-trench method which involves trench excavation using powered mechanical equipment, installation of temporary trench supports and removal of existing pipes if required, followed by the laying of bedding and the proposed pipelines. The trench will then be backfilled, compacted and reinstated to the required standard.
- 2.27 Even with the adoption of alternative alignment, the pipe laying works would still lie in close proximity to the village houses and would induce unacceptable noise impacts. To minimize the noise impact, alternative construction method mainly involving manual operation and some small size equipment will be adopted for the section of pipe laying works near the village houses at Wai Ha Village.

Project Implementation

- 2.28 The selection of this scheme was completed in May 2005 and the detailed design will be completed by February 2007.

Task Description	Tentative/Actual Completion Date
Selection of the Scheme	May 2005
Detailed Design of Works	February 2007
Commencement of Works Contract	December 2007
Completion of the Contract	June 2010

Interactions with Other Projects

- 2.29 There will be another DSD Sewerage Project of title “Tolo Harbour Sewerage of Unsewered Areas Stage I Phase II” (hereinafter referred to as “the Sewerage Project”) will be carried out in San Tau Kok Village. This project is tentatively scheduled to start in November 2008 and complete in November 2010. Appendix 2.1 shows the layout plans for the Sewerage Project.
- 2.30 Another project which would possibly interface with this project would be the “Development of a Bathing Beach at Lung Mei, Tai Po”. The construction phase is expected to start in end of 2008 and tentatively scheduled for completion by 2010. Since its location is distant from (over 2km) the works proposed under this Project and the cumulative disturbance impact resulting from the two Projects is expected to be very minor.

Summary

- 2.31 To control the flooding of the low-lying area in Shuen Wan and minimize the risks to lives and properties of the villages, it is necessary to improve the current flood protection standard of the drainage system in Shuen Wan. Various options including (i) Do Nothing, (ii) Floodwall, (iii) Upgrading of Wai Ha River, (iv) Inverted Siphon, (v) Large Scale Pumping Station and (vi) Box culvert have been considered. Although the box culvert option would involve construction works encroaching the boundary of the CA in order to maintain the existing accessibility along Tung Tsz Road to various villages in Shuen Wan areas, after carefully considered the practicality and reasonableness of these options as mentioned in Table 2.1 and the social feasibility as discussed in Section 2.15 with a view to fulfil the requirement in EIAO-TM Annex 16 Section 3.1(a), this option

has been selected as the preferred option with the necessary mitigation measures to be further investigated and recommended in latter part of this EIA report.

3. CONSTRUCTION NOISE IMPACT

Introduction

- 3.1 This section presents an assessment of the potential noise impact during the construction phase of the proposed drainage improvement works.
- 3.2 Noise impacts during the construction phase would mainly be associated with the construction activities and the use of powered mechanical equipment (PME) for construction works. Appropriate mitigation measures have been recommended, where necessary, to alleviate the potential noise impacts to acceptable levels.

Environmental Legislation, Standards and Guidelines

- 3.3 The Noise Control Ordinance (NCO) and Environmental Impact Assessment Ordinance (EIAO) provide the statutory framework for noise control. Assessment procedures and standards are set out in the five Technical Memoranda (TMs) listed below:
- TM on Environmental Impact Assessment Process (EIAO-TM)
 - TM on Noise from Construction Work other than Percussive Piling (GW-TM)
 - TM on Noise from Percussive Piling (PP-TM)
 - TM on Noise from Construction Work in Designated Areas (DA-TM)
 - TM on Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM)
- 3.4 Daytime construction noise (excluding percussive piling) between the hours 0700 – 1900 on weekdays is controlled under the EIAO-TM. Annex 5 of the EIAO-TM sets out the construction noise limits, which are Leq(30 min) 75dB(A) for domestic premises and Leq(30 min) 70dB(A) for schools during normal hours (65dB(A) during examination periods) and all other places where unaided voice communication is required. Construction activities other than percussive piling using powered mechanical equipment (PME) undertaken at other times (i.e. during restricted hours) are under the control of the NCO.
- 3.5 According to the preliminary construction programme, no work would be carried out during restricted hours. Hence, noise impacts associated with the construction of the proposed Project would primarily be assessed against the noise criteria set out in Annex 5 of the EIAO-TM.
- 3.6 Based on the available design information for this Project, sheet pile would be driven by non-percussive means. Therefore the criteria set out in the PP-TM would not be applicable to this Project.
- 3.7 In case of any construction activities during restricted hours, or in future should the Contractor confirm the need for percussive piling, it is the Contractor's responsibility to ensure compliance with the NCO and the relevant TMs. The Contractor will be required to submit CNP application to the Noise Control Authority and abide by any conditions stated in the CNP, should one be issued.

Description of the Environment

3.8 The vicinity of the Shuen Wan Assessment Area is mostly rural in nature comprising village settlements (e.g. San Tau Kok Village, Po Sam Pai Village, Shuen Wan Chim Uk Village and Wai Ha Village), ponds and marsh areas. The plant nursery run by the Leisure and Cultural Services Department is situated at the southern side of San Tau Kok Village south of Tung Tsz Road. The existing noise climate in this area is dominated mostly by traffic noise along Tung Tsz Road and Ting Kok Road. The ambient noise level is expected to be moderate.

Noise Sensitive Receivers

3.9 Representative noise sensitive receivers (NSRs) within 300m from the project site boundary were identified for noise assessment. According to Annex 13 of the EIAO-TM, NSRs include the following:

- Residential uses – all domestic premises including temporary housing
- Institutional uses – including educational institutions
- Other uses such as hostels and country parks

3.10 **Table 3.1** summarises the selected NSRs for the noise impact assessment. Locations of representative NSRs are illustrated in **Figure 3.1**.

Table 3.1 Representative Noise Sensitive Receivers

NSR	Location	Use
SW1	14, Shuen Wan Chim Uk	Residential
SW2	2A, San Tau Kok	Residential
SW3	63, San Tau Kok	Residential
SW4	59, San Tau Kok	Residential
SW5	150, San Tau Kok	Residential
SW6	191, San Tau Kok	Residential
SW7	51, Wai Ha	Residential
SW8	Block 3A, Treasure Spot Garden	Residential
SW9	Block 15, Treasure Spot Garden	Residential
SW10	31, Wai Ha	Residential
*SWA1	Potential Future NSR at San Tau Kok Village	Residential
*SWA2	Potential Future NSR at Wai Ha	Residential

* denotes for potential future NSR

3.11 The areas adjacent to the proposed box culvert alignment are zoned as “Village” zone according to Outline Zoning Plan No. S/NE-TK/12. According to the information from Lands Department, there is a possibility that new village houses would be built at land within this zone (see **Figure 3.1**). An assessment point, namely SWA1, has been selected to represent the potentially worst affected future NSRs within this village zone for indicative construction noise assessment. The site visit conducted in April 2007 also revealed that several new village houses along Tung Tsz Road were under construction. Based on the location of these newly identified NSRs, an assessment point, namely SWA2 (between chainage 200m – 300m), has been added to the construction noise calculation. Several other new village houses were recorded near chainage 100m and between chainage 500m – 600m. However they were not considered to be worst affected by noise impacts from the proposed works. Hence noise impacts at those new village houses would be represented by adjacent assessment points which would be located closer to the works area. The location of this assessment point is shown in **Figure 3.1**.

Assessment Methodology

3.12 The methodology outlined in the Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM) was adopted for the construction noise assessment, and is summarised below:

- Locate the NSRs which will most likely be affected by noise from the construction work;
- Determine the items of Powered Mechanical Equipment (PME) for each discrete construction activity, based on available information or agreed plant inventories;
- Assign sound power levels (SWLs) to the proposed PME according to the GW-TM or other sources;
- Calculate distance attenuation and screening effects to NSRs from notional noise source;
- Predict construction noise levels at NSRs in the absence of any mitigation measures; and
- Include a 3 dB(A) façade correction to the predicted noise levels in order to account for the façade effect at each NSR.

3.13 Sound Power Levels (SWLs) of the equipment have been derived from Table 3 of the GW-TM. Where no Sound Power Level (SWL) is given in the GW-TM, reference has been made to BS 5228: Part 1:1997 *Noise Control on Construction and Open Sites* and previous similar studies or measurements taken at other sites in Hong Kong.

3.14 Correction due to distance attenuation was determined using the following standard formula:

$$\text{Distance Attenuation in dB(A)} = 20 \log D + 8 \quad \text{where D is the distance in meters}$$

3.15 All construction tasks undertaken within 300m of a given NSR at the same period were considered to contribute to cumulative noise impact at that NSR. Impact of noise sources from areas greater than this distance would be considered minor, and would thus be excluded from the assessment.

3.16 The construction noise impact was assessed based on the worst case scenario where all PME proposed for each construction task would be in use concurrently at any given time unless otherwise stated. The proposed construction plant lists for the unmitigated and mitigated scenarios are provided in **Appendices 3.1** and **3.2** respectively.

3.17 In order to provide more realistic calculations of the construction noise levels, reasonable assumptions for on-time percentage of certain PME have been made, as shown below.

Table 3.2 On-time Percentage Assumptions for Certain Items of PME

PME	Assumed on-time Percentages
Excavator / Loader	70
Dump Truck	30
Concrete Lorry Mixer	50
Vibratory Poker	70
Bar Bender / Cutter	70
Power Rammer	70
Breaker, Excavator Mounted (Hydraulic)	70
Vibratory Roller	50
Air Compressor	50

PME	Assumed on-time Percentages
Submersible Pump	100
Hand held breaker	30

- 3.18 The Project Proponent's design engineer confirmed that the assumption of on-time percentage and number of PME are considered to be practical in completing the works within the schedule.
- 3.19 Based on the above assumptions, the total SWL for each construction activity has been calculated, and is presented in **Appendix 3.1**.

Identification of Impacts

- 3.20 The construction tasks and sub-tasks for the proposed drainage improvement works at various sites together with the envisaged duration of each task are presented in **Table 3.3**.

Table 3.3 Construction Tasks for the Proposed Drainage Improvement Works

Construction Tasks	Construction Sub-tasks	Duration (Month)
Site Clearance	--	0 – 3
Box Culvert	<ul style="list-style-type: none"> • Excavation and Concreting • Backfilling and Road Restatement 	4 – 12 (Ch 0 – 350) 13 – 21 (Ch 350 – 700) 22 – 30 (Ch 700 – 1013)
Pumping Station	<ul style="list-style-type: none"> • Excavation • Construction of Pumping Station • Backfilling 	4 – 22
Pipe Laying at Wai Ha	<ul style="list-style-type: none"> • Excavation • Laying Pipe • Backfilling 	4 – 14
Pipe Laying at Ting Kok Road	<ul style="list-style-type: none"> • Excavation • Laying Pipe • Backfilling 	4 – 14
Installation of Mechanical Gate	--	15 - 20

- 3.21 The potential source of noise impact during the construction phase of the Project would be the use of PME for various construction activities as indicated in **Table 3.3**. The SWLs of PME for various construction activities are given in **Appendix 3.1**.
- 3.22 In general, the proposed construction activities would be small in scale. However, since NSRs were identified in close proximity to the proposed work areas, adverse noise impacts due to the use of PME would likely be expected at these receivers if no noise control measures are implemented.

Prediction and Evaluation of Impacts

- 3.23 Based on the proposed plant inventory as shown in **Appendix 3.1**, cumulative noise impacts arising from various construction activities were predicted.
- 3.24 Ranges of unmitigated construction noise levels at representative NSRs are presented in **Table 3.4**. Predicted construction noise levels and detailed calculation of construction noise level for the unmitigated scenario are provided in **Appendix 3.1**.

Table 3.4 Ranges of Unmitigated Construction Noise Levels

NSR ID	Range of Predicted Noise Levels, dB(A)	EIAO-TM Normal Daytime Construction Noise Criteria, dB(A)
SW1	60 – 88	75
SW2	65 – 78	75
SW3	66 – 81	75
SW4	65 – 84	75
SW5	65 – 89	75
SW6	62 – 89	75
SW7	66 – 86	75
SW8	65 – 101	75
SW9	63 – 105	75
SW10	59 – 96	75
*SWA1	66 – 93	75
*SWA2	68 – 91	75

* denotes for potential future NSRs

- 3.25 The assessment results showed that predicted cumulative noise levels at representative NSRs would range from 59 to 105dB(A). The maximum level of exceedance predicted would be about 30dB(A). Mitigation measures would be considered necessary in order to abate the construction noise impacts.

Mitigation of Adverse Environmental Impacts

- 3.26 The need for minimizing potential construction noise impacts on the NSRs in the vicinity of the works area for this Project has been considered during the design of the project, with the following key features included:
- Minimise the number of PME
 - Works would be implemented in phases, which could also help to reduce the number of PME required to be sit on-site
- 3.27 The adopted scheme as shown in **Figure 1.5** has been developed by striking a balance on the need for undertaking the drainage improvement works to alleviate the risk of flooding in the concerned area, for minimising the impacts to the Conservation Area nearby, as well as for addressing concerns from locals.
- 3.28 Although the construction noise impacts would be expected to be localised and temporary, alternative design options have been developed to address the construction noise issues. The discussion on alternative design consideration is presented in Section 2.
- 3.29 The construction noise assessment showed that, in the absence of any mitigation measures, there would be exceedance of the construction noise criteria at some of the NSRs. Various mitigation options have thus been considered, as per guidelines laid down in the *Environmental Impact Assessment Ordinance, Guidance Note No. 9/2004 "Preparation of Construction Noise Impact Assessment under the Environmental Impact Assessment Ordinance"* (GN 9/2004). Mitigation measures considered are discussed below.

Good Site Practice

- 3.30 Although the noise mitigation effects are easily quantifiable and the benefits may vary with site conditions and operating conditions, good site practices are easy to implement and do not impact upon the works schedule. The site practices listed below should be followed during each phase of construction:

- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction program;
- Silencers or mufflers on construction equipment should be utilized and should be properly maintained during the construction program;
- Mobile plant, if any, should be sited as far from NSRs as possible;
- Machines and plant (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- Plant known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from the nearby NSRs; and
- Material stockpiles and other structures should be effectively utilised, wherever practicable, in screening noise from on-site construction activities.

Adoption of Quieter PME

- 3.31 In order to alleviate the construction impacts on the NSRs, the adoption of quieter PME is recommended. The type of quieter PME adopted in this assessment is not a must that the Contractors have to use specific items of plant for the construction operations. The Contractors are allowed to use other type of quiet PME, which have the same total SWL, to meet their needs.
- 3.32 Noise data of the quieter PME adopted in the assessment were taken from the BS5228: Part 1:1997 (**Appendix 3.2**) and from the EPD website. A list of quieter PME recommended for adoption during the construction phase is presented in **Table 3.5**.

Table 3.5 Quieter PME Recommended for Adoption during Construction Phase

PME	Reference	SWL
Excavator / Loader	BS C3/97	105
Dump Truck	BS C9/39	103
Concrete Lorry Mixer	BS C6/23	100
Vibratory Poker	BS C6/32	100
Breaker, Excavator Mounted (Hydraulic)	BS C8/12	106
Vibratory Roller	Noise data of Quality PME from EPD Website	101

Use of Temporary Noise Barrier

- 3.33 Temporary noise barriers of about 3.5m high would be used mainly for screening of noise from the PME used for the construction of box culvert and site clearance. The Project Proponent's design engineer has taken into account the space requirement for barrier erection and confirmed the practicality of the use of temporary noise barrier.
- 3.34 In general, the use of temporary noise barriers can achieve a 5dB(A) reduction for movable plant, 10dB(A) for stationary plant, depending on the line of sight that could be blocked by the barriers when viewed from the NSR. The noise screening effects of temporary noise barriers considered in this assessment are shown in **Appendix 3.2**. **Figure 3.2** shows the typical section of the proposed temporary noise barriers used for site clearance and box culvert construction. Barrier material of surface mass in excess of 7kg/m² is recommended to achieve the predicted screening effect.

Further Mitigation Measures

Use of Quieter Alternative Construction Method

3.35 In view of the high noise exceedance level resulted from the proposed pipe laying works at Wai Ha Village, quieter alternative construction method (hereinafter referred to as “the Low Impact Method”) has been proposed. For this method, PME with lower impact would generally be used (e.g. mini backhoe). Also the PME would be of smaller in size rendering it possible to be enclosed by noise enclosure to further reduce its noise emission level (see below). **Table 3.6** presents the proposed PME for the Low Impact Method. The extent of pipe laying works where the Low Impact Method and conventional method would apply is shown in **Figure 3.5**.

Table 3.6 Plant Inventory for the Low Impact Method

Construction Sub-task	PME	Reference	SWL
Pipe laying at Wai Ha			
Excavation	Hand-held breaker	CNP024	108
	Air compressor	CNP002	102
	Mini backhoe	CNP082	94
Pipe Laying	Mini backhoe	CNP082	94
	Vibratory poker	BSC6/32	100
Backfilling	Vibratory poker	BSC6/32	100
	Vibratory roller	EPD Website: Quality PME	101

Noise Enclosures and Temporary Noise Barriers

- 3.36 To further alleviate the construction noise impact associated from the pipe laying works at Wai Ha, noise enclosure would be used for enclosing the PME as listed in Table 3.6 except the mini backhoe. The roof panels of the noise enclosure would be removed when the mini backhoe is used and the side panels would form a temporary noise barrier along the periphery of the works area. The conceptual design of the noise enclosure and the typical section of temporary noise barrier are shown in **Figures 3.3 and 3.4** respectively.
- 3.37 The noise enclosure can be made of materials with a surface mass of not less than 7kg/m² to achieve the maximum screening effect. For ventilation purpose, openings could be provided at the side of the enclosure facing towards the natural hillside and away from the NSRs. The noise enclosure should be designed to achieve at least 15dB(A) noise reduction for PME.
- 3.38 The materials for the temporary noise barriers would be the same as that for the noise enclosure as they would be the side panels of the enclosure. However, should alternative materials be used for the temporary noise barriers, the material should have a surface mass of not less than 7kg/m². The barrier should also be designed to achieve at least 5dB (A) noise reduction for the mini backhoe at 1-2/F of NSR SW8-9.

Mitigated Construction Noise Impacts

3.39 Mitigated construction noise levels were predicted at various NSRs (**Appendix 3.2** refers) taking into account the noise reduction provided by the above-mentioned mitigation measures. Calculation of construction noise for the mitigated scenario is provided in **Appendix 3.2**. The approximate extent of the proposed noise mitigation measures is illustrated in **Figure 3.5**. Ranges of mitigated construction noise levels predicted at representative NSRs are presented in **Table 3.7**.

Table 3.7 Mitigated Construction Noise Levels

NSR ID	Range of Predicted Noise Levels, dB(A)	EIAO-TM Normal Daytime Construction Noise Criteria, dB(A)
SW1	46-74	75
SW2	50-66	75
SW3	57-60	75
SW4	56-63	75
SW5	50-67	75
SW6	47-68	75
SW7	51-65	75
SW8-1/F	50-71	75
SW8-2/F	50-70	75
SW8-3/F	50-69	75
SW8-1-3/F (Conventional Method)	50-71	75
SW9-1/F	48-75	75
SW9-2/F	48-73	75
SW9-3/F	48-71	75
SW9-1-3/F (Conventional Method)	48-66	75
SW10	44-74	75
*SWA1	56-71	75
*SWA2	53-70	75

* denotes for potential future NSRs

- 3.40 As shown in **Table 3.7**, with the adoption of the above noise mitigation measures, construction noise levels at all representative NSRs would comply with the EIAO-TM daytime construction noise criteria of 75dB(A). It was envisaged that there would be no adverse residual impact at all NSRs.

Residual Environmental Impacts

- 3.41 After implementation of the above-mentioned noise mitigation measures, including the use of alternative quieter PME, construction method (the Low Impact Method), temporary noise barriers and noise enclosure, construction noise levels at all the identified NSRs would comply with the EIAO-TM daytime construction noise criteria and no adverse residual impact would be expected.
- 3.42 To ensure that the construction noise impacts would be well controlled, good site practices and noise management measures should be strictly implemented within all construction sites.

Cumulative Construction Noise Impact

- 3.43 A sewerage project, namely "Tolo Harbour Sewerage of Unsewered Areas Stage 1 Phase IIC" (hereinafter referred to as "the Sewerage Project"), was in design review stage. The construction works associated with this project were planned to start in November 2008 and for completion in November 2010, and would likely coincide with this Project. Minor excavation and pipe laying works would be carried out at San Tau Kok and Po Sam Pai (which is located to the north of San Tau Kok) for this sewerage project. Layout plans for the Sewerage Project are provided in **Appendix 2.1**.
- 3.44 As shown in **Appendix 2.1**, the Sewerage Project in San Tau Kok and Po Sam Pai which would likely be carried out concurrently with the proposed Project would give rise to cumulative construction noise impacts on NSRs. In particular, NSRs SW2 – SW6 at San Tau Kok Village located to the south of the works area of the Sewerage Project could be subject to cumulative construction noise impacts.

- 3.45 Details of the construction programme as well as plant inventory for the Sewerage Project were not available at the time of reporting. However, having reviewed the layout plan for the Sewerage Project, it is expected that construction activities associated with this Sewerage Project would be similar to those for the proposed Project but in a smaller scale. The Sewerage Project would be unlikely to result in insurmountable construction noise impacts at the NSRs identified for this Project.
- 3.46 With the recommended mitigation measures in place, the maximum construction noise levels at NSRs SW2-SW6 would be 68dB(A), which would be well below the EIAO-TM construction noise criteria for non-restricted hours. Having regard to this, it would be unlikely that the two projects would give rise to adverse cumulative construction noise impacts at the concerned NSRs.
- 3.47 Assuming that the maximum construction noise level due to the Sewerage Project would be similar to that predicted for the proposed Project (i.e. 68dB(A)) given their nature of works would be similar, the maximum predicted cumulative construction noise levels at NSRs could be calculated by the following equation in accordance with standard acoustic principle:

Cumulative construction noise levels from the two projects, dB(A)

$$= 10 \log [10^{(N1/10)} + 10^{(N2/10)}]$$

Where N1 = maximum predicted construction noise level due to the proposed Project
= 68dB(A)

N2 = assumed maximum construction noise level due to the Sewerage Project
= N1 = 68dB(A)

Cumulative construction noise levels from the two projects, dB(A)

$$= 10 \log [10^{(68/10)} + 10^{(68/10)}]$$

$$= 71\text{dB(A)}$$

- 3.48 As shown above, predicted cumulative construction noise levels would be about 71dB(A), which would comply with the EIAO-TM noise criteria for normal daytime construction activities. Early planning of the works schedule between Contractors for the two projects is recommended to minimize potential cumulative construction noise impact at the NSRs at San Tau Kok Village (SW2 – SW6). No exceedance of cumulative noise level of 75dB(A) would be resulted from the two projects.

Environmental Monitoring and Audit

- 3.49 Due to the potential construction noise impact to the nearby NSRs, it is recommended that EM&A for construction noise be carried out throughout the construction period of the Project. To ensure implementation of construction phase mitigation measures with consideration of practicability in local levels, the noise mitigation measures should be reviewed during the construction phase. The changes or alternative proposals should be reviewed and verified by the Environmental Team (ET) and Independent Environmental Checker (IEC).

Conclusion

- 3.50 Noise arising from the construction activities of the proposed Project would have potential impacts on the NSRs located in the vicinity of the proposed work areas. Unmitigated construction noise levels at the representative NSRs were predicted to be in the range of 59–105 dB(A), exceeding the EIAO-TM daytime construction noise limit of 75dB(A).
- 3.51 To mitigate the noise impacts due to the construction activities, mitigation measures including good site practices, quieter PME, temporary noise barriers, quieter alternative construction method (the Low Impact Method), noise enclosure and careful programming of noisy activities were considered.

After implementing these mitigation measures, there would not be any exceedance of the EIAO-TM daytime construction noise limit of 75dB(A). Thus, no adverse residual impact was predicted.

- 3.52 The Sewerage Project at San Tau Kok and Po Sam Pai would be conducted concurrently with the proposed Project. With the implementation of mitigation measures, the two projects would unlikely have adverse cumulative construction noise impacts at the concerned NSRs at San Tau Kok Village given the scale of works of the Sewerage Project would be small and predicted construction noise levels due to the proposed Project would be well below the EIAO-TM daytime construction noise criteria. To minimize the cumulative noise impact, early planning of the works schedule between Contractors for the two projects is recommended to minimize potential cumulative construction noise impact at the NSRs at San Tau Kok Village (SW2 – SW6). It is expected that no exceedance of cumulative noise level of 75dB(A) at the concerned NSRs at San Tau Kok Village would be resulted from these two projects.

4. AIR QUALITY IMPACT

Introduction

- 4.1 This Section presents an assessment of the potential air quality impacts pertinent to the construction phase of the Project, and recommends appropriate mitigation measures, where necessary.
- 4.2 Air quality impacts during construction phase would be mainly associated with dust and vehicle emissions from various construction activities. Appropriate mitigation measures have been recommended, where necessary, to alleviate the potential construction dust impacts to acceptable levels.

Environmental Legislation, Standards and Guidelines

- 4.3 The criteria for evaluating air quality impacts and the guidelines for air quality assessment are laid down in Annexes 4 and 12 of the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM), respectively.
- 4.4 The Air Pollution Control Ordinance (APCO) provides the statutory authority for controlling air pollutants from a variety of sources. The Ordinance includes a number of Air Quality Objectives (AQOs) which stipulate maximum concentrations for a range of pollutants, of which total suspended particulates (TSP) are relevant to this study. The relevant AQOs are listed in **Table 4.1**.

Table 4.1 Hong Kong Air Quality Objectives

Parameter	Maximum Average Concentration (μgm^{-3}) ¹	
	24-Hour ²	Annual ³
TSP	260	80

1. Measured at 298 K and 101.325 kPa.
2. Not to be exceeded more than once per year.
3. Arithmetic mean.

- 4.5 The EIAO-TM also stipulates that the hourly TSP level at sensitive receivers should not exceed 500 μgm^{-3} TSP (measured at 25°C and one atmosphere) for construction dust impact assessment. Mitigation measures from construction sites have been specified in the Air Pollution Control (Construction Dust) Regulations.

Description of the Environment

- 4.6 The Project is located in the Shuen Wan Area in Tai Po. According to the site survey conducted in November, 2005, the Project site was found to be mostly rural in nature comprising village settlements, ponds and marsh areas.
- 4.7 The existing air quality near the Project site would mainly be affected by emissions from vehicular traffic on nearby road networks, including Ting Kok Road and Tung Tsz Road. In the absence of in-situ monitoring data, reference is made to the annual average concentrations of major air pollutants measured at EPD's nearest monitoring stations (Tai Po) for the last 5 years. The 5-year annual

averages TSP levels at Tai Po station are $65\mu\text{gm}^{-3}$ according to *Air Quality in Hong Kong 2000-2003 and 2005*¹.

Air Sensitive Receivers

- 4.8 According to Annex 12 of the EIAO-TM, domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping center, place of public worship, library, court of law, sports stadium or performing arts center are considered as air sensitive receivers (ASRs). Any other premises or places having similar sensitivity (in terms of duration or number of people affected) to the air pollutants may also be considered to be sensitive receivers.
- 4.9 Based on the criteria set out in the EIAO-TM, representative ASRs have been identified close to the Project site. A brief description of the representative ASRs is presented in **Table 4.2** and the corresponding locations are shown on **Figure 4.1**.

Table 4.2 Representative Air Sensitive Receivers

ASR	Location	Nearest distance between ASR and the works boundary (m)	Land Use
ASW1	14, Shuen Wan Chim Uk	10	Residential
ASW2	2A, San Tau Kok	90	Residential
ASW3	63, San Tau Kok	40	Residential
ASW4	59, San Tau Kok	30	Residential
ASW5	150, San Tau Kok	15	Residential
ASW6	191, San Tau Kok	15	Residential
ASW7	51, Wai Ha	25	Residential
ASW8	Block 3A, Treasure Spot Garden	2	Residential
ASW9	Block 15, Treasure Spot Garden	2	Residential
ASW10	31, Wai Ha	5	Residential
*SWA1	Potential Future NSR at San Tau Kok Village	5	Residential
*SWA2	Potential Future NSR at Wai Ha	10	Residential

* denotes for possible future ASRs

Identification and Evaluation of Environmental Impacts

Construction Phase

- 4.10 Potential impacts arising from the construction of the proposed drainage works would include dust nuisance and gaseous emissions from the construction plant and vehicles. The major construction activities for the Project which would be potential sources of construction dust in the Study Area include earthworks and backfilling for the box culvert / laying pipe. It is anticipated that dust would be generated from excavation, material handling and wind erosion from the site.
- 4.11 The construction of box culvert and pipe laying will only involve minor excavation, which would have the potential to give rise to dust nuisance. However, the scale of construction works and hence the

¹ According to *Air Quality in Hong Kong 2004*, the annual average TSP value in 2004 at Tai Po Station was below its respective minimum data requirement of 66% for number of data within the period. The annual average TSP value for this year was not taken into account when determining the 5-year annual average TSP levels. The annual average TSP values for the year of 2000-2003 and 2005 were used in determining the 5-year annual average TSP levels.

number of construction plants employed would be limited. Significant dust emission arising from the construction activities is not expected. With the implementation of mitigation measures as stipulated in the Air Pollution Control (Construction Dust) Regulation, it would be unlikely that the proposed Project would result in adverse construction dust impact on the nearby ASRs.

Cumulative Construction Dust Impact

- 4.12 A sewerage project, namely "Tolo Harbour Sewerage of Unsewered Areas Stage 1 Phase IIC" (hereinafter referred to as "the Sewerage Project"), was in design review stage. The construction works associated with this project were planned to start in November 2008 and for completion in November 2010, and would likely coincide with this Project. Minor excavation and pipe laying works would be carried out at San Tau Kok and Po Sam Pai (which is located to the north of San Tau Kok) for this sewerage project. Layout plans for the Sewerage Project are provided in **Appendix 2.1**.
- 4.13 As discussed in **Section 3.44-3.46**, the Sewerage Project in San Tau Kok and Po Sam Pai would likely be carried out concurrently with the proposed Project. Hence, it would be likely that these two projects would result in cumulative construction dust impacts on ASRs particularly at San Tau Kok Village (e.g. ASRs ASW2-6) which are situated to the south of the proposed work sites for the Sewerage Project.
- 4.14 It is anticipated that the scale of the Sewerage Project would be small and the number of construction equipment employed would be limited given the small work spaces available. Insurmountable dust impact due to the Sewerage Project would not be expected. It is also noteworthy that it is mandatory for Contractors to implement dust suppression measures as stipulated in the Air Pollution Control (Construction Dust) Regulation. Hence, adverse cumulative construction dust impacts due to these two projects would not be anticipated

Operation Phase

- 4.15 Potential air quality impacts such as dust and odour would not be expected from the operation of the proposed drainage works.

Mitigation of Adverse Environmental Impacts

- 4.16 To ensure compliance with the guideline level and AQO at the ASRs, the *Air Pollution Control (Construction Dust) Regulation* should be implemented and good site practices should be incorporated in the contract clauses to minimize construction dust impact. A number of practical measures are listed below:
- Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved road, with complete coverage, particularly during dry weather;
 - Use of frequent watering for particularly dusty static construction areas and areas close to ASRs;
 - Tarpaulin covering of all dusty vehicle loads transported to, from and between site location;
 - Establishment and use of vehicle wheel and body washing facilities at the exit points of the site;
 - Routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs.
 - Stockpiled excavated materials should be covered with tarpaulin, and should be removed off-site within 24 hours to avoid any odour nuisance arising.

Residual Environmental Impacts

- 4.17 With the implementation of the proposed dust suppression measures, good site practices and a comprehensive EM&A programme, no adverse residual construction dust impact would be expected.

Environmental Monitoring and Audit

- 4.18 With the implementation of the mitigation measures as stipulated in the *Air Pollution Control (Construction Dust) Regulation*, good site practices and audit, the dust levels at all ASRs would be expected to meet the criteria of TSP. It is recommended weekly site audits be carried out in order to ensure the dust control measures are implemented and are working effectively.

Conclusion

- 4.19 Impacts arising from the construction of the Project would primarily relate to dust nuisance from land excavation works and gaseous emissions from the construction plant and vehicles. With the implementation of mitigation measures as stipulated in the *Air Pollution Control (Construction Dust) Regulation*, no adverse residual air quality impact associated with the construction of the proposed Project would be anticipated. It is also anticipated that there would be no adverse impact during the operation stage of the Project.

5. WATER QUALITY

Introduction

- 5.1 This section presents an assessment of the potential water quality impacts associated with the construction and operation phases of the proposed drainage improvement works in Shuen Wan. Recommendations for mitigation measures have been made, where necessary, to reduce the identified water quality impacts to an acceptable level.

Environmental Legislation and Standards

Water Pollution Control Ordinance (WPCO)

- 5.2 The Water Pollution Control Ordinance (Cap. 358), in existence since 1980, is the major legislation relating to the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, Hong Kong waters are divided into ten water control zones (WCZ). Corresponding statements of Water Quality Objectives (WQO) are stipulated for different water regimes (marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones) in the WCZ based on their beneficial uses. The study area is located within the Tolo Harbour and Channel WCZ.
- 5.3 River water quality is ranked according to its compliance with the WQOs. The annual compliance of the monthly water quality data with each of the water quality parameters is indicated by a percentage, with 100% compliance indicating that all 12 months' data are within the WQO. Details of the WQOs statement for the inland waters of the Tolo Harbour and Channel WCZ for the five key water quality parameters are listed in **Table 5.1**.

Table 5.1 Water Quality Objectives for Inland Waters

Parameters	Water Quality Objectives (WQOs)	Sub-zones to which the WQOs apply
pH	Waste discharges shall not cause the pH of waters of the subzone to exceed the range of 6.5 – 8.5 at any time	Shing Mun (A, B, C, F, G, H) sub-zones Lam Tsuen (C, D) sub-zone Tai Po (A, B, C) sub-zone
	Waste discharges shall not cause the pH of waters of the subzone to exceed the range of 6.0 – 9.0 at any time	Shing Mun (D, E, I)
Suspended solids (SS)	Waste discharges shall not cause the annual median of suspended solids in waters of the subzone to exceed 20 mg/L	Shing Mun (A, B, C, F, G, H) sub-zones Lam Tsuen (C, D) sub-zone Tai Po (A, B, C) sub-zone
	Waste discharges shall not cause the annual median of suspended solids in waters of the subzone to exceed 25 mg/L	Shing Mun (D, E, I)

Dissolved oxygen (DO)	Waste discharges shall not cause the level of dissolved oxygen in waters of the subzone to be less than 4 mg/L or 40% saturation (at 15°C) at any time	All watercourses
Chemical oxygen demand (COD)	<u>Waste discharges shall not cause the COD in waters of the subzone to exceed 15 mg/L at any time</u>	Shing Mun (B, F, G) sub-zone Lam Tsuen (C, D) sub-zone Tai Po (A) sub-zone
	Waste discharges shall not cause the COD in waters of the subzone to exceed 30 mg/L at any time	Shing Mun (A, C, D, E, H, I) Tai Po (B, C) sub-zone
5-day biochemical oxygen demand (BOD)	Waste discharges shall not cause the 5 days BOD in waters of the subzone to exceed 3 mg/L at any time	Shing Mun (B, F, G) sub-zone Lam Tsuen (C, D) sub-zone Tai Po (A) sub-zone
	Waste discharges shall not cause the 5 days BOD in waters of the subzone to exceed 5 mg/L at any time	Shing Mun (A, C, D, E, H, I) Tai Po (B, C) sub-zone

Note:

The subzones are delineated under Schedule 3 of Cap 358F Tolo Harbour and Channel Water Control Statement of Water Quality Objectives for Watercourses under the Water Pollution Control Ordinance. Within Shing Mun River catchment, below the water gathering ground, there are 9 subzones, namely SM(A) to SM(I). In Tai Po area, there are 3 subzones for the Tai Po River, namely TP(A) to TP(C), and 2 subzones for the Lam Tsuen River, namely LT(C) and LT(D).

Technical Memorandum

- 5.4 Besides setting the WQOs, the WPCO controls effluent discharging into the WCZs through a licensing system. A *Technical Memorandum (TM) on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* was issued under the WPCO which gives guidance on the permissible effluent discharges based on the type of receiving waters (foul sewers, storm water drains, inland and coastal waters). The limits control the physical, chemical and microbial quality of effluents. Under the TM, effluents discharged into inland waters are subject to standards for particular volumes of discharge. The discharge standard will vary with the use of downstream water. Any new effluent discharges during the construction phase would be required to comply with the terms and conditions of a discharge licence, issued by EPD, under the WPCO.

Practice Notes

- 5.5 A practice note (PN) for professional persons was issued by the EPD to provide environmental guidelines for handling and disposal of construction site discharges. The ProPECC PN 1/94 "*Construction Site Drainage*" provides good practice guidelines for dealing with various types of discharge from a construction site. Practices outlined in the PN should be followed as far as possible during construction to minimize the water quality impact due to construction site drainage.

Baseline Conditions

5.6 The water quality in the Wai Ha River (also referred to as Tung Tze Stream) is monitored under the EPD routine river water quality monitoring programme¹. A summary of the published EPD monitoring data collected in this river is presented in **Table 5.2**. River water quality monitoring data for the year 2004 at station TR6 showed the overall compliance rate of the Wai Ha River with the WQOs was 98%, with full compliance with the WQOs of pH, suspended solids, dissolved oxygen and BOD₅. An increase in the overall compliance rate of 3% from the preceding year was observed. An *E. coli* level of 1,400 cfu/100ml (annual geometric mean) was recorded. It was reported that the higher bacterial levels in this stream compared to other streams in the Tai Po Kau and Shuen Wan area could be attributed to faecal pollution from unsewered village houses nearby.

Table 5.2 Summary of Water Quality Monitoring Results for Tung Tze Stream in 2004

Parameter	Unit	Sampling Station
		TR6
Dissolved oxygen	mg/L	6.1 (4.9 – 8.3)
PH		7.4 (7.0 – 8.1)
Suspended solids	mg/L	8 (2 – 120)
5-day Biochemical Oxygen Demand	mg/L	2 (1 – 4)
Chemical Oxygen Demand	mg/L	14 (8 – 38)
Oil & grease	mg/L	0.5 (0.5 – 0.5)
Faecal coliforms	cfu/100mL	3,200 (56 – 38,000)
<i>E. coli</i>	cfu/100mL	1,400 (25 – 16,000)
Ammonia-nitrogen	mg/L	0.42 (0.08 – 1.20)
Nitrate-nitrogen	mg/L	0.24 (0.02 – 0.66)
Total Kjeldahl nitrogen, SP	mg/L	0.64 (0.24 – 1.60)
Ortho-phosphate	mg/L	0.05 (0.02 – 0.11)
Total phosphorus, SP	mg/L	0.11 (0.04 – 0.25)
Sulphide, SP	mg/L	0.02 (0.02 – 0.02)
Aluminium	µg/L	75 (50 – 750)
Cadmium	µg/L	0.1 (0.1 – 0.1)
Chromium	µg/L	2 (1 – 7)
Copper	µg/L	5 (2 – 20)
Lead	µg/L	1 (1 – 11)

¹ River Water Quality in Hong Kong in 2004, Environmental Protection Department, 2005.

		Sampling Station
Zinc	µg/L	10 (10 – 60)
Flow	L/s	NM

Notes:

1. Data presented are in annual medians of monthly samples, except those for faecal coliforms and E.coli which are in annual geometric means.
2. Figures in brackets are annual ranges.
3. SP – soluble and particulate fractions (i.e. total value).
4. NM – no measurement taken

Water Sensitive Receivers

5.7 Identified water sensitive receivers (WSR) within the assessment area are shown in **Figure 5.1** and are listed below:

- Wai Ha River at Shuen Wan;
- Fishponds at Shuen Wan;
- Non-gazetted beaches at Lung Mei and Sha Lan;
- Tai Po Industrial Estate Salt Water Intake;
- Yim Tin Tsai Fish Culture Zone (FCZ);
- Yim Tin Tsai (East) FCZ;
- Water sport centre at Tai Mei Tuk next to Plover Cove Reservoir.;
- Ting Kok Site of Special Scientific Interest (SSSI)
- Conservation Area (CA) at Tai Mei Tuk

5.8 The CA at Tai Mei Tuk encompasses freshwater and intertidal marshes west of Ting Kok Road. A description of the Ting Kok SSSI is provided in Section 7.29. Much of the SSSI is dominated by mangrove habitat.

Assessment Methodology

5.9 The assessment area for the water quality impact assessment is defined in the EIA Study Brief as all areas within 5 km from the designated project boundary.

5.10 The water sensitive receivers that may be affected by the construction works for the drainage improvement works in Shuen Wan were identified. The proposed method of construction and operational activities of the Project were reviewed, and potential sources of water quality impact that may arise during the construction and operation phases were described. This task included identifying pollutants from point discharges and non-point sources to surface run-off. All the identified sources of potential water quality impact were then evaluated and their impact significance determined. The need for mitigation measures to reduce any identified adverse impacts on water quality to acceptable levels was determined.

5.11 Potential cumulative water quality impacts from any concurrent construction projects located within 300m of the boundary of the proposed drainage improvement works were addressed.

Identification and Evaluation of Environmental Impacts

Construction Phase

- 5.12 Potential sources of water quality impact associated with the construction of the proposed drainage improvement works in Shuen Wan have been identified and include:
- construction site runoff and drainage;
 - general construction activities; and
 - sewage effluent produced by on-site workforce.
- 5.13 The above impacts are common to the construction of the proposed box culvert along Tung Tsz Road, floodwater pumping station at Shuen Wan, mechanical gate at Wai Ha River, relief drains in Wai Ha Village and drainage pipe along Ting Kok Road. Specific to the construction of the proposed box culvert would be potential impacts on water quality from the excavation works within the Wai Ha River at the junction of the box culvert and the existing stream course at the upstream end.

Construction Runoff and Drainage

- 5.14 Runoff from the construction works areas may contain increased loads of sediments, other suspended solids and contaminants. Potential sources of pollution from site drainage include:
- runoff and erosion from exposed soil surfaces, earth working areas and stockpiles;
 - release of grouting and cement materials with rain wash;
 - wash water from dust suppression sprays; and
 - fuel and lubricants from maintenance of construction vehicles and mechanical equipment.
- 5.15 Sediment laden runoff during construction works for the proposed drainage improvement works in Shuen Wan if uncontrolled may carry pollutants (adsorbed onto the particle surfaces) into the Wai Ha River. Similarly, sediment laden runoff during construction works for the proposed box culvert may enter the nearby fish ponds if uncontrolled. Associated effects which may arise include increased suspended solids concentrations in receiving waters. Mitigation measures should be implemented to control construction site runoff and drainage from the works areas, and to prevent runoff and drainage water with high levels of suspended solids from entering the Wai Ha River, fishponds and the receiving water body of Tolo Harbour. An additional mitigation measure would be deployed during the construction of the proposed box culvert next to Wai Ha River. The use of sand bags around the works area boundary would prevent surface runoff from entering the works trench and washout into the adjacent CA or Wai Ha River, as described in Section 5.29. Since the works trench would be surrounded by sand bags, any muddy water within the trench would be confined within the trench and would not discharge to the surrounding areas. Furthermore, sheet-pilings, which will be installed around the trench, are proposed to be extended above ground level for about 2m to serve as silt curtain to enclose the works site.
- 5.16 The proposed drainage improvement works in Shuen Wan are minor in scale with limited excavation works and earth working areas. With the implementation of adequate construction site drainage and provision of silt removal facilities as described in Section 5.28, it is anticipated that unacceptable water quality impacts would not arise. The Sha Lan non-gazetted beach and Yim Tin Tsai (East) FCZ are located approximately 0.5 km and 1.5 km, respectively, from the proposed minor drainage improvement works in Shuen Wan and therefore adverse water quality impacts would not be expected at these WSR. The Tai Po Industrial Estate Salt Water Intake is located a considerable distance away, around the headland of Yim Tin Tsai (refer to **Figure 5.1**), and thus would not be expected to be affected by the drainage improvement works.

General Construction Activities

- 5.17 On-site construction activities may cause water pollution from the following:
- uncontrolled discharge of debris and rubbish such as packaging, construction materials and refuse; and
 - spillages of liquids stored on-site, such as oil, diesel and solvents etc, are likely to result in water quality impacts if they enter the nearby watercourse or fish ponds.
- 5.18 Good construction and site management practices should be observed, as detailed in Sections 5.30 & 5.31, to ensure that litter, fuels and solvents do not enter the Wai Ha River, fish ponds and the coastal waters of Inner Tolo Harbour.

Sewage Effluents

- 5.19 Domestic sewage would be generated from the workforce during the construction phase. However, this temporary sewage can be adequately treated by interim sewage treatment facilities, such as portable chemical toilets, which can be installed within the construction site. It is unlikely that sewage generated from the site would have a significant water quality impact, provided that sewage is not discharged directly to the river channel, and chemical toilets are used and properly maintained.

River Channel Excavation Works

- 5.20 A short section of the proposed box culvert would be constructed within the existing channel of the Wai Ha River. The length of the affected river channel section would be limited to approximately 130 m at the junction of the box culvert and the river channel at the upstream end near Wai Ha village. In order to minimize the potential impacts on water quality, the excavation works within the river channel would be carried out in dry condition. A bund would be constructed in the middle of the channel to surround the area to be excavated and the water flow diverted to one half of the channel. Excavation of the channel would be carried out from October to April in dry condition. Excavation works would be small-scale and carried out by land-based plant, and dredging would not be required. Potential impacts on downstream water quality would be minimized by restricting the excavation works to within an enclosed dry section of the channel.
- 5.21 This works arrangement would provide a dry zone for excavation works within the river channel and would prevent the transportation of suspended sediment downstream. With the implementation of the working method controls as described above, it is anticipated that unacceptable water quality impacts would not arise at the identified WSR within Tolo Harbour, including the fish ponds at Shuen Wan, Wai Ha River and Shuen Wan CA, during the excavation works.
- 5.22 Furthermore, the remaining WSR not mentioned above are located a considerable distance from the point where the Wai Ha River enters Tolo Harbour (the nearest WSR of Sha Lan non-gazetted beach is located approximately 0.5 km from the river mouth). Potential indirect impacts on wetland habitats within the recognized areas of conservation interest, i.e. Ting Kok SSSI and Tai Mei Tuk CA, due to sedimentation were expected to be temporary and very minor given these sites would be distant from the works area of this Project (Ting Kok SSSI and Tai Mei Tuk CA are located 1km and 3km away from the proposed works respectively). The monitoring of downstream river water quality during the construction activities would therefore be considered not warranted.
- 5.23 The disposal of any slurry water would need to comply with the TM on Effluent Discharge Standards under the WPCO.

Potential Cumulative Impacts

- 5.24 The sewerage project “Tolo Harbour Sewerage of Unsewered Areas Stage 1 Phase IIC” would be concurrent with the Project. Sewerage works are proposed at the villages of San Tau Kok and Po Sam Pai. The proposed sewerage works would involve land-based construction activities and would be minor in scale. As such, no cumulative impacts on water quality would be anticipated during the concurrent works for the sewerage project and the drainage improvement works at Shuen Wan.

Operation Phase

- 5.25 The potential for water quality impacts during the operation phase of the proposed drainage improvement works may result from the following:
- maintenance and desilting of the box culvert.
- 5.26 Silt and grit removed from the box culvert would require disposal off-site to a designated landfill site. Care should be exercised during the desilting activities to minimize potential water quality impacts on the adjacent Wai Ha River and CA from any spillage of material. No adverse water quality impact would be expected on the Ting Kok SSSI during the desilting activities given the small scale and localized nature of the desilting activities.
- 5.27 Under normal condition, the flow will be discharged via the original outfall located near Shuen Wan Chim Uk. During a severe rainstorm event, the mechanical gate installed at the original outfall will be closed and the flow will be diverted by the box-culvert from upstream and directly discharged to Tolo Harbour. At the same time, residual runoff in Wai Ha River and the CA will be conveyed to the proposed pumping station through the drainage pipe along Ting Kok Road and eventually discharged to Tolo Harbour. As such, the discharge point would only be changed during a severe rainstorm event, which is predicted to be an infrequent event. Given that the location of the two proposed outfalls are close to the existing outfall which is located at about 250m away, no change in the flow regime from the discharge of runoff in Tolo Harbour would be expected, and potential indirect impacts on the mangrove and marine habitat during a severe rainstorm event are expected to be very low, as discussed in Section 7.

Mitigation Measures

- 5.28 Proposed mitigation measures for containing and minimizing water quality impacts are summarised below.

Construction Phase

Construction Run-off and Drainage

- 5.29 The site practices outlined in ProPECC PN 1/94 “Construction Site Drainage” should be followed as far as practicable during the drainage improvement works in order to minimise surface runoff and to control erosion, and also to retain and reduce any suspended solids prior to discharge. These practices include the following items and shall be implemented as an erosion control plan during the construction phase:
- Before commencing any site formation work, all sewer and drainage connections should be sealed to prevent debris, soil, sand etc. from entering public sewers/drains.
 - Temporary ditches should be provided to facilitate run-off discharge into appropriate watercourses, via a silt retention pond. No site run-off should enter the fishponds at Shuen Wan.
 - Sand/silt removal facilities such as sand traps, silt traps and sediment basins should be provided to remove sand/silt particles from runoff to meet the requirements of the Technical Memorandum standard under the Water Pollution Control Ordinance. The design of silt removal facilities should be based on the guidelines provided in ProPECC PN 1/94. All drainage

facilities and erosion and sediment control structures should be inspected monthly and maintained to ensure proper and efficient operation at all times and particularly during rainstorms.

- Water pumped out from excavated pits should be discharged into silt removal facilities.
- During rainstorms, exposed slope/soil surfaces should be covered by a tarpaulin or other means, as far as practicable. Other measures that need to be implemented before, during, and after rainstorms are summarized in ProPECC PN 1/94.
- Exposed soil areas should be minimized to reduce potential for increased siltation and contamination of runoff.
- Earthwork final surfaces should be well compacted and subsequent permanent work or surface protection should be immediately performed to reduce the potential of soil erosion.
- Open stockpiles of construction materials or construction wastes on-site of more than 50 m³ should be covered with tarpaulin or similar fabric during rainstorms.

5.30 With standard water pollution control measures set out in ProPECC PN1/94 in place, it is anticipated that the construction phase discharges would comply with the WPCO requirements. In addition to the above measures, further precautionary measures for controlling potential water quality impact due to the proposed works close to the Conservation Area would be required in order to safeguard the known sites of high ecological value during the construction phase, particularly during the rainy season as there is a risk that intense rainfall events may result in discharge of turbid drainage water. The contractor should implement the following mitigation measures:

- For the construction of the box culvert next to the existing channel of the Wai Ha River, sand bags should be deployed around the boundary of the works trench to prevent muddy water ingress into the adjacent CA or Wai Ha River. As an effective measure, sand bags should be used to surround the excavated trench. Generally, the sand bags will be placed up to a height of 300mm to provide adequate allowance for the built-up water level during rainstorm event. With sand bags in place, surface runoff will be intercepted and flow to Wai Ha River or collected by the existing drainage system as usual.
- Sheet-piles, which would be installed around the works trench near the Conservation Area, would be extended above ground level for about 2m to serve as hoardings to isolate the works site.
- Tarpulin sheets would be used to cover the excavation areas during heavy rainstorms. This would prevent the ingress of rainwater into the trench minimising the risk of muddy water getting into Wai Ha River and the adjacent Conservation Area.
- Any concrete washing water would be contained inside the works site surrounded by the extended sheet piles. A pump sump at the bottom of the trench would be provided to pump any excess water during concrete washing.
- Stockpiling the excavated materials adjacent to the Conservation Area would not be allowed. The excavated materials would be either removed off site immediately after excavation, or stockpile at location(s) away from the Conservation Area. The stockpile locations shall be approved by the site engineer.

General Construction Activities

5.31 Debris and refuse generated on-site should be collected, handled and disposed of properly to avoid entering the Wai Ha River and fish ponds at Shuen Wan. Stockpiles of cement and other construction materials should be kept covered when not being used.

- 5.32 Oils and fuels should only be used and stored in designated areas which have pollution prevention facilities. To prevent spillage of fuels and solvents to nearby water bodies, all fuel tanks and storage areas should be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank. The bund should be drained of rainwater after a rain event.

Sewage from Construction Workforce

- 5.33 Temporary sanitary facilities, such as portable chemical toilets, should be employed on-site. A licensed contractor would be responsible for appropriate disposal and maintenance of these facilities.

River Channel Excavation Works

- 5.34 The excavation works within the upstream end of the existing river channel of the Wai Ha River for the construction of the proposed box culvert shall be carried out in dry condition. Containment measures such as bunds and barriers shall be used within the affected length of the river channel and the excavation works restricted to within an enclosed dry section of the channel (refer to **Figure 5.2**). The excavation works shall be restricted to the period from October to April.

Cumulative Impacts due to other Projects

- 5.35 There will be another DSD Sewerage Project of title "Tolo Harbour Sewerage of Unsewered Areas Stage I Phase II" (hereinafter referred to as "the Sewerage Project") carried out in San Tau Kok Village. This project is tentatively scheduled to start in November 2008 and completed in November 2010. Since works associated with this project would largely be land-based and in limited scale, adverse cumulative impact would not be envisaged.
- 5.36 Another project which would possibly interface with this project would be the "Development of a Bathing Beach at Lung Mei, Tai Po" project. Since its location is remote to works proposed under this Project (>300m), it is not included in the current water quality impact assessment according to the EIA Study Brief.

Residual Environmental Impacts

- 5.37 With the full implementation of the recommended mitigation measures for the construction of the proposed Project, no unacceptable residual impacts on water quality are anticipated. It is recommended that regular audits of the implementation of the recommended mitigation measures at all work areas for the drainage improvement works in Shuen Wan be carried out during the construction phase.

Environmental Monitoring and Audit Requirements

- 5.38 The water quality assessment has identified that the key issue in terms of potential water quality impacts would be related to excavation works for the construction of the box culvert within the exiting river channel. To minimize potential impacts on water quality, the excavation works would be carried out in dry condition through the use of the recommended working method controls. No unacceptable water quality impact was predicted at the identified WSR and therefore the monitoring of downstream water quality within the Wai Ha River during the construction phase was not considered warranted. It was recommended that regular site audits be undertaken to inspect the construction activities at all works areas to ensure the recommended mitigation measures are properly implemented.

Conclusion

- 5.39 The key issue in terms of water quality would be related to excavation works for the section of the proposed box culvert within the existing river channel of Wai Ha River. To minimize potential impacts on water quality, working method controls have been recommended. Excavation works within the affected length of the river channel should be carried out in from October to April and in dry condition by use of containment measures within the channel. The recommended mitigation measure should be enforced by the provision of specifications of pollution control measures into works contracts.
- 5.40 Other potential sources of water quality impact associated with the drainage improvement works in Shuen Wan comprised construction site runoff and drainage; debris, refuse and liquid spillages from general construction activities; and sewage effluents from the construction workforce. Minimisation of water quality deterioration could be achieved through implementing adequate mitigation measures such as control measures on the runoff and drainage from the works areas to minimise construction run-off. Proper site management and good housekeeping practices would also be required to ensure that construction wastes and materials would not enter the Wai Ha River or fish ponds at Shuen Wan. Sewage effluent arising from the construction workforce would also require appropriate treatment through provision of portable toilets.
- 5.41 As such, with the implementation of the recommended mitigation measures, the construction works for the proposed drainage improvement works in Shuen Wan would not be anticipated to result in unacceptable impacts on water quality. Site inspections should be undertaken routinely to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

6. WASTE MANAGEMENT IMPLICATIONS

Introduction

- 6.1 This section identifies the types of wastes that are likely to be generated during the construction of the proposed drainage improvement works and evaluates the potential environmental impacts that may result from the handling and disposal of these waste arisings. The main solid waste management implications would be related to excavated material from the construction of the box culvert along Tung Tsz Road. Mitigation measures and good site practices, including waste handling, storage and disposal were recommended with reference to the applicable waste legislation and guidelines.

Environmental Legislation and Standards

- 6.2 The following legislation relates to the handling, treatment and disposal of wastes in the Hong Kong SAR and was used in assessing potential impacts:
- Waste Disposal Ordinance (Cap. 354);
 - Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354);
 - Land (Miscellaneous Provisions) Ordinance (Cap. 28);
 - Public Health and Municipal Services Ordinance (Cap. 132) - Public Cleansing and Prevention of Nuisances Regulation.

Waste Management

- 6.3 The Waste Disposal Ordinance (WDO) prohibits the unauthorised disposal of wastes. Construction waste is not directly defined in the WDO but is considered to fall within the category of "trade waste". Trade waste is defined as waste from any trade, manufacturer or business, or any waste building, or civil engineering materials, but does not include animal waste. Under the WDO, wastes can be disposed of at sites licensed by the EPD.
- 6.4 Under the regulation of WDO, the Chemical Waste (General) Regulation 1992 provides regulations for chemical waste control, and administers the possession, storage, collection, transport and disposal of chemical wastes. The Environmental Protection Department (EPD) has also issued a 'guideline' document, the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes (1992), which details how the Contractor should comply with the regulations on chemical wastes.
- 6.5 The Public Cleansing and Prevention of Nuisances Regulation provides control on illegal tipping of wastes on unauthorised (unlicensed) sites.

Construction and Demolition (C&D) Materials

- 6.6 The current policy related to the dumping of C&D material is documented in the Works Branch Technical Circular No. 2/93, 'Public Dump'. Construction and demolition materials that are wholly inert, namely public fill, should not be disposed of to landfill, but taken to public filling areas, which usually form part of reclamation schemes. The Land (Miscellaneous Provisions) Ordinance requires that dumping licences are obtained by individuals or companies who deliver public fill to public filling areas. The Civil Engineering & Development Department (CEDD) issues the licences under delegated powers from the Director of Lands.
- 6.7 Under the Waste Disposal (Charges for Disposal of Construction Waste) Regulation, enacted in January 2005, construction waste delivered to a landfill for disposal must not contain more than 50% by weight of inert material. Construction waste delivered to a sorting facility for disposal must

contain more than 50% by weight of inert material, and construction waste delivered to a public fill reception facility for disposal must consist entirely of inert material.

- 6.8 Measures have recently been introduced under Environment, Transport and Works Bureau (ETWB) TCW No. 33/2002 to enhance the management of construction and demolition material including rock, and to minimize its generation at source. The enhancement measures include: (i) drawing up a Construction and Demolition Material Management Plan (C&DMMP) at an early design stage to minimize C&D material generation and encourage proper management of such material; (ii) vetting of the C&DMMP prior to upgrading of the project to Category A in the Public Works Programme; and (iii) providing the contractor with information from the C&DMMP in order to facilitate him in the preparation of the Waste Management Plan (WMP) and to minimize C&D material generation during construction. Projects generating C&D material less than 50,000m³ or importing fill material less than 50,000m³ are exempt from the C&DMMP.

Assessment Methodology

- 6.9 The methodology for assessing potential waste management impacts during the construction phase of the Project included the following tasks:
- estimation of the types and quantities of wastes to be generated as a result of construction activities;
 - assessment of potential impacts from the management of solid wastes with respect to potential hazards, air and odour emissions, noise and wastewater discharges;
 - evaluation of the opportunities for reducing waste generation;
 - identification of disposal options for each type of waste;
 - assessment of impacts on the capacity of waste collection, transfer and disposal facilities.

Identification and Evaluation of Environmental Impacts

Construction Phase

- 6.10 The construction activities to be carried out for the proposed Project would generate a variety of wastes that can be divided into distinct categories based on their composition and ultimate method of disposal. The identified waste types include:
- construction and demolition (C&D) materials;
 - chemical waste; and
 - general refuse.
- 6.11 The nature of each type of waste arising is described in the following section, together with an evaluation of the potential environmental impacts associated with these waste arisings.

Construction and Demolition (C&D) Materials

- 6.12 Construction of the proposed drainage improvement works in Shuen Wan would generate construction and demolition (C&D) materials from excavation works for the construction of the box culvert, pumping station, relief drains and drainage pipe. The total volume of excavated material to be generated from the drainage improvement works was estimated to be approximately 86,580 m³. A breakdown of the estimated volumes of C&D material is presented in Table 6.1 below.
- 6.13 The excavation works for the construction of box culvert would generate approximately 71,000 m³ of excavated material. Part of the existing Tung Tsz Road would be required to be demolished during

the construction phase. In addition, part of Ting Kok Road would be broken up for the construction of the box culvert.

- 6.14 It is anticipated that approximately 21,700 m³ of excavated material would be of suitable characteristics for reuse on-site as fill material. Artificial hard material would not be reused on-site. Surplus excavated material would be transported by trucks to the public filling area designated by the Civil Engineering and Development Department (CEDD).

Table 6.1 Summary of C&D Material Volumes

Location	Excavated material (other than rock & artificial hard material (m ³) ⁽¹⁾	Excavated rock (m ³)	Excavated artificial hard material (m ³) ⁽²⁾	Total C&D material (m ³)	C&D material to be reused on site (m ³)	C&D material to be delivered to and reused in public filling area designated by CEDD (m ³)
Box Culvert (along Tung Tsz Road)	34,240	35,500	1,260	71,000	13,050	57,950
Floodwater Pumping Station at Shuen Wan	4,370	2,920	10	7,300	4,230	3,070
Mechanical Gate	-	-	-	-	-	-
Relief Drains (in Wai Ha Village)	1,400	1,190	210	2,800	1,400	1,400
Drainage Pipe (along Ting Kok Road)	5,380	0	100	5,480	3,020	2,460
Total	45,390	39,610	1,580	86,580	21,700	64,880

Notes:

(1) Fill material comprising sandy clay to sandy silt with gravels and cobbles

(2) Concrete pavement and asphalt material

Chemical Waste

- 6.15 The maintenance and servicing of construction plant and equipment may possibly generate some chemical wastes, for instance, cleaning fluids, solvents, lubrication oil and fuel. Maintenance of vehicles may also involve the use of a variety of chemicals, oil and lubricants.
- 6.16 Since the drainage improvement works would be carried out in close proximity to the Wai Ha River, the coastal waters of Inner Tolo Harbour and residential dwellings, chemical wastes arising during the construction phase may pose environmental, health and safety hazards if not stored and disposed of in an appropriate manner as stipulated in the Waste Disposal (Chemical Waste) (General) Regulations. The potential hazards include:
- toxic effects to workers;
 - adverse impacts on water quality from spills and associated adverse impacts on fresh water biota; and
 - fire hazards.

- 6.17 Materials classified as chemical wastes will require special handling and storage arrangements before removal for appropriate treatment at the Chemical Waste Treatment Facility at Tsing Yi. Wherever possible opportunities should be taken to reuse and recycle materials. Mitigation and control requirements for chemical wastes are detailed in Section 6.27. Provided that the handling, storage and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts are not expected to result.

General Refuse

- 6.18 Throughout construction, the workforce would generate general refuse comprising food scraps, waste paper, empty containers, etc. Release of general refuse into the Wai Ha River channel and the coastal waters of Inner Tolo Harbour should not be permitted as introduction of these wastes is likely to have detrimental effects on water quality in the area. Rapid and effective collection of site wastes would be required to prevent waste materials being blown around by wind, flushed or leached into the aquatic environment or ecological sensitive areas, and odour nuisance. The work sites may also attract pests and vermin if the waste storage area is not well maintained and cleaned regularly. Disposal of refuse at sites other than approved waste transfer or disposal facilities can also result in similar impacts.
- 6.19 With the implementation of the recommended waste management practices at the site, adverse environmental impacts would not arise from the storage, handling and transportation of refuse.

Mitigation Measures

Good Site Practices

- 6.20 Appropriate waste handling, transportation and disposal methods for all waste arisings generated during the construction works should be implemented to ensure that construction wastes do not enter the Wai Ha River channel and coastal waters of Inner Tolo Harbour, and to minimize potential impacts where works areas are located close to ecological sensitive receivers.
- 6.21 It is not anticipated that adverse waste management related impacts would arise, provided that good site practices are strictly followed. Recommendations for good site practices during the construction activities include:
- Nomination of approved personnel, such as a site manager, to be responsible for good site practices and making arrangements for collection of all wastes generated at the site and effective disposal to an appropriate facility.
 - Training of site personnel in proper waste management and chemical waste handling procedures.
 - Provision of sufficient waste disposal points and regular collection for disposal.
 - Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers.
 - Separation of chemical wastes for special handling and appropriate treatment at the Chemical Waste Treatment Facility.
 - Regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors.
 - A Waste Management Plan should be prepared and submitted to the Engineer for approval. One may make reference to ETWB TCW No. 19/2005 for details.
 - A recording system for the amount of wastes generated, recycled and disposed (including the disposal sites) should be proposed.

- 6.22 In order to monitor the disposal of C&D material at public filling areas, as appropriate, and to control fly tipping, a trip-ticket system should be included as one of the contractual requirements. One may make reference to ETWB TCW No. 31/2004 for details. The use of a trip-ticket system would be required to avoid any illegal or unplanned dumping of waste generated by the Project, particularly at works areas close to ecological sensitive receivers.

Waste Reduction Measures

- 6.23 Good management and control can prevent the generation of significant amounts of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practices. Recommendations to achieve waste reduction include:
- Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal.
 - To encourage collection of aluminium cans by individual collectors, separate labelled bins shall be provided to segregate this waste from other general refuse generated by the work force.
 - Any unused chemicals or those with remaining functional capacity shall be recycled.
 - Maximising the use of reusable steel formwork to reduce the amount of C&D material.
 - Proper storage and site practices to minimise the potential for damage or contamination of construction materials.
 - Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste.
- 6.24 In addition to the above good site practices and waste reduction measures, specific mitigation measures are recommended below for the identified waste arisings to minimise environmental impacts during handling, transportation and disposal of these wastes.

Construction and Demolition Material

- 6.25 To minimise off-site disposal of C&D material, the excavated material with suitable characteristics/size should be reused on-site as fill material as far as practicable, such as for backfilling of the box culvert and drainage pipe works. Suitable areas should be designated within the works site boundaries for temporary stockpiling of C&D material. Within stockpile areas, the following measures should be taken to control potential environmental impacts or nuisance:
- covering material during heavy rainfall;
 - locating stockpiles to minimise potential visual impacts; and
 - minimizing land intake of stockpile areas as far as possible.
- 6.26 When disposing C&D material at a public filling area, the material shall only consist of soil, rock, concrete, brick, cement plaster/mortar, inert building debris, aggregates and asphalt. The material shall be free from marine mud, household refuse, plastic, metals, industrial and chemical waste, animal and vegetable matter, and other material considered to be unsuitable by the Filling Supervisor.

Chemical Wastes

- 6.27 If chemical wastes are produced at the construction site, the Contractor would be required to register with the EPD as a Chemical Waste Producer and to follow the guidelines stated in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately. Appropriate labels should be securely attached on each chemical waste container

indicating the corresponding chemical characteristics of the chemical waste, such as explosives, flammable, oxidizing, irritant, toxic, harmful, corrosive, etc. The Contractor shall use a licensed collector to transport and dispose of the chemical wastes generated at the Chemical Waste Treatment Centre at Tsing Yi, or other licenced facility, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation.

General Refuse

- 6.28 General refuse should be stored in enclosed bins or compaction units separate from C&D material. A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D material. An enclosed and covered area is preferred to reduce the occurrence of 'wind blown' light material.

Evaluation of Residual Impacts

- 6.29 With the implementation of the recommended mitigation measures for the handling, transportation and disposal of the identified waste arisings, residual impacts would not be expected during the construction of the proposed drainage improvement works in Shuen Wan.

Environmental Audit

- 6.30 Waste management would be the contractor's responsibility to ensure that all wastes produced during the construction of the Project are handled, stored and disposed of in accordance with good waste management practices and EPD's regulations and requirements. The recommended mitigation measures should form the basis of the site Waste Management Plan to be developed by the Contractor at the construction stage.

Conclusion

- 6.31 The main waste arising during the construction phase would be excavated material from the construction of the box culvert along Tung Tsz Road, floodwater pumping station at Shuen Wan, relief drains in Wai Ha Village and drainage pipe along Ting Kok Road. The excavated material would comprise fill, rock and artificial hard material. It was recommended that the excavated material with suitable characteristics be reused on-site, as far as practicable, as backfill material. Surplus excavated material would require disposal at the designated public filling area.
- 6.32 Other wastes generated by the construction activities for the drainage improvement works are likely to include general refuse from the workforce and chemical wastes from plant and vehicle maintenance. Provided that these identified waste arisings are to be handled, transported and disposed of using the recommended methods and that good site practices are to be strictly followed, adverse environmental impacts are not anticipated during the construction works. The recommended mitigation measures should form the basis of the Waste Management Plan to be developed by the Contractor.

7. ECOLOGICAL IMPACT

Introduction

- 7.1 The following section presents the results of an ecological assessment of potential impacts resulting from the Project. A literature review and field surveys were undertaken to identify ecological sensitive receivers, and the ecological importance of habitats/species potentially affected by proposed works was evaluated. The scale of possible ecological impacts resulting from the proposed works was assessed, and necessary mitigation measures and ecological monitoring and audit requirements were identified.
- 7.2 The Project consists of drainage improvement works that would be carried out in various locations in Tai Po Shuen Wan. Assessment of potential terrestrial and marine ecological impacts covers the following proposed drainage works:
- Construction of twin cells box-culvert along Tung Tsz Road;
 - Construction of a floodwater pumping station at Shuen Wan
 - Replacement of mechanical gate at Wai Ha River;
 - Construction of about 280m of relief drains in Wai Ha Village
 - Construction of about 260m drainage pipe along Ting Kok Road
- 7.3 The location of these proposed works are detailed in **Figure 1.5**.

Environmental Legislation, Standards and Guidelines

- 7.4 Guidelines, standards, documents and HKSAR Government ordinances and regulations listed in the following sections were referred to during the course of the ecological impact assessment.
- 7.5 The *Country Parks Ordinance* (Cap. 208) provides for the designation and management of country parks and special areas. Country parks are designated for the purpose of nature conservation, countryside recreation and outdoor education. Special Areas are created mainly for the purpose of nature conservation.
- 7.6 The *Forests and Countryside Ordinance* (Cap. 96) prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. Related subsidiary Regulations prohibit the selling or possession of listed restricted and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended on 11 June 1993 under the *Forestry (Amendment) Regulation 1993* made under *Section 3* of the *Forests and Countryside Ordinance*.
- 7.7 Under the *Wild Animals Protection Ordinance* (Cap. 170), designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals, including marine cetaceans, are protected under this Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1992.
- 7.8 The amended *Town Planning Ordinance* (Cap. 131) provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment. The authority responsible for administering the *Town Planning Ordinance* is the Town Planning Board.

- 7.9 *Chapter 10* of the *HKPSG* covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also describes enforcement issues. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.
- 7.10 *Annex 16* of the *EIAO TM* sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating habitat and ecological impact.
- 7.11 *EIAO Guidance Note No. 6/2002* clarifies the requirements of ecological assessments under the *EIAO*.
- 7.12 *EIAO Guidance Note No. 7/2002* provides general guidelines for conducting ecological baseline surveys in order to fulfil requirements stipulated in the *EIAO TM*.
- 7.13 *List of Wild Animals Under State Protection* details Class I and Class II protected animal species under Mainland Chinese Legislation.
- 7.14 *List of Wild Plants Under State Protection* details Class I and Class II protected plant species under Mainland Chinese Legislation.
- 7.15 The *International Union for Conservation of Nature and Natural Resources* (IUCN) Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction. The IUCN Red List also includes information on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme.

Assessment Methodology

Literature Review

- 7.16 Existing relevant ecological literature covering the proposed works areas was reviewed, as provided in the reference list at the end of this section.

Terrestrial Ecological Surveys

- 7.17 To supplement existing data and fill identified data gaps, four-season terrestrial ecology surveys covering both the wet and dry seasons were conducted from August 2002 to July 2003 in accordance with Section 3.4.5.3 (iii) of the Study Brief. The surveys covered areas within 500m of the proposed works areas (**Figures 7.1** refers). Although the alignment of the latest proposed box culvert in Shuen Wan approximates to the original proposed flood wall, additional ecological baseline update surveys covered the representative sites of important habitats within the study area were conducted from September 2005 to December 2005 including both wet and dry seasons to cover the existing habitat, vegetation and wildlife. The purpose of the update surveys is to check the validity of the detailed survey data previously collected for the EIA study. The surveys focused on the potentially impacted areas, particularly Conservation Area, and species compositions of the areas were also updated. Relevant updated ecological literature covering the areas was also reviewed.

7.18 The following ecological surveys were conducted in the Assessment Area:

Habitat/Vegetation Surveys

7.19 Habitats inside the Assessment Area were identified and mapped. Plant species, relative abundance and growth forms were recorded. Surveys were conducted in September 2002 (wet season), December 2002 (dry season), March 2003 (dry season), September 2005, October 2005 (wet season) and December 2005 (dry season). Identification of species and status in Hong Kong were also made with reference to Hong Kong Herbarium (2004) and Corlett *et al.* (2000).

Avifauna Surveys

7.20 Avifaunal surveys covering the wet and dry seasons were conducted. Night survey was also conducted to record nocturnal avifauna. Surveys were conducted on a monthly basis from August 2002 to July 2003, October 2005 and December 2005, in addition to a night survey. Species present and relative abundance of species was recorded.

Herpetofauna & Mammal Surveys

7.21 Herpetofauna/mammal surveys of Assessment Area were conducted. Species presence and relative species abundance were recorded by direct observation, searching potential microhabitats, listening for calling animals, and searching for signs of animal activity (e.g., burrows, scats etc.). The herpetofauna/mammal surveys covered the wet (August 2002, May 2003, and October 2005) and dry seasons (November 2002 and December 2005), and were conducted during the day and night.

Terrestrial Insect Surveys

7.22 Surveys of adult butterflies and odonates were conducted at the Assessment Area in August 2002, May 2003, June 2003, October 2005, and December 2005. Species presence and relative species abundance were recorded by direct observation.

Freshwater Community Surveys

7.23 Surveys of fish populations in the affected rivers/streams were conducted using hand nets at various microhabitats. Surveys of freshwater macroinvertebrate populations in the affected rivers/streams were conducted using a 500µm mesh D-framed net. Fish and macroinvertebrate populations were surveyed in January 2003 and December 2005.

Marine Ecological Surveys

7.24 Surveys of intertidal and subtidal habitats including mangrove and mudflat/sandflat habitats in the Assessment Area were undertaken. Vegetation surveys were conducted on mangrove stands.

Intertidal Surveys

7.25 At each location, a representative section of the intertidal was surveyed at low tide along transects laid perpendicular to the shore. Species present and relative species abundance were recorded.

Subtidal Surveys

- 7.26 A reconnaissance swim by divers parallel to the shore over approximately 400m was conducted at each location to visually survey the sub-tidal seabed at low tide. Species present and relative species abundance were recorded.

Impact Assessment

- 7.27 Ecological significance of habitats and recorded species, and potential ecological impacts arising from the Project were assessed following *EIAO TM Annex 16* guidelines and evaluated based on criteria in *EIAO TM Annex 8*.

Baseline Conditions

Sites of Conservation Interest

- 7.28 The locations of recognised areas of conservation interest within the Assessment Area are described in the following paragraphs.

Sites of Special Scientific Interest (SSSI)

- 7.29 Two SSSI's are located in the Assessment Area. The Ting Kok SSSI was designated in 1985, and covers approximately 37.5ha of intertidal habitats. The site lies approximately 50m east of the nearest works area proposed under this Project (construction of floodwater pumping station). Much of the SSSI is dominated by mangrove habitat, and is used extensively by biology teachers to demonstrate transect sampling of plant succession. The Shuen Wan Egretty SSSI encompasses a small *Fung Shui* woodland situated behind the villages of Shuen Wan Tsim Uk and Shuen Wan Li Uk. It was designated in 1994 to protect a colony of egrets and herons that utilise the woodland as a breeding colony. Shuen Wan Egretty SSSI is adjacent to the proposed mechanical gate at Wai Ha River.
- 7.30 Breeding activity at the Shuen Wan Egretty SSSI appears to have undergone a drastic decline in the mid 1990's. A review of records presented in the Hong Kong Bird Report (1994-97) reveals that over 300 birds from 5 species were confirmed breeding at the colony in 1995. By 1996, only 10 pairs of Chinese Pond Heron were confirmed breeding at the site, with no breeding activity confirmed since 1997 (Wong & Kwok, 2001; Wong, 2002; Wong, 2003, Anon, 2004). Lee *et al.* (2004) later reported AFCD records of Shuen Wan Egretty re-used with a small number of ardeids (5-6 pairs) breeding at the site. Anon (2005) confirmed six nests of Chinese Pond Heron were found in Chim Uk of Shuen Wan.

Country Parks (CP)

- 7.31 Pat Sing Leng Country Park lies over 600m from the closest proposed works area in the Assessment Area, and would not be affected by the proposed works.

Coastal Protection Areas (CPA)

- 7.32 A stretch of coastline between Ting Kok SSSI and Ting Kok Road within the Assessment Area is zoned as CPA under the Ting Kok OZP (OZP No. S/NE-TK/11). The intention of this zoning is to retain areas of natural coastline, and also to serve as a buffer between Ting Kok SSSI and nearby developments. It would not be affected by the proposed works.

Conservation Areas (CA)

- 7.33 Under the Ting Kok OZP (OZP No. S/NE-TK/11), one area within the Assessment Area is zoned CA. The CA encompasses freshwater and intertidal marshes west of Ting Kok Road; which have been zoned CA to conserve their ecological value. Other, more disturbed habitats (e.g., roads, houses) fall under the CA along the zone boundary. The construction of twin cells box-culvert along Tung Tsz Road would be constructed partially within this CA.

Habitat Type and Vegetation

- 7.34 Field surveys identified eleven habitat types within the Assessment Area, comprising: Rivers and Streams, Cultivated/Abandoned Land, Secondary Woodland, *Fung Shui* Woodland, Developed Areas/Village Areas, Plantation/Landscape Planting, Fishponds, Shrubland, Marshes, Mangrove, and Marine. Habitat map is given in **Figure 7.1**. Representative photographs of habitats are given in **Appendix 7.1** (it should be noted that the photograph of sub-tidal habitat is not available due to the low visibility under turbid water during the survey). Photographs of species of conservation interest are given in **Appendix 7.2**. Plant species recorded in each Assessment Area are listed in **Appendix 7.3**. A more detailed description of habitats recorded in the Assessment Area is given in the following sections.

Rivers & Streams

- 7.35 Wai Ha River originates in the hills of Pat Sin Leng Country Park in the north-west of the Assessment Area and runs through a mixture of secondary woodland, cultivated land, marshes and fish ponds before entering coastal waters in the east of the Assessment Area. The river channel is generally open with a low gradient and slow to moderate water flow. The mid section of the stream course passes through a woodland fringe where riparian trees (e.g., *Cleistocalyx operculata*, *Bischofia trifoliata* and *Litsea monopetala*) are well established. Approximately one third of the length of the stream channel within the Assessment Area is tidally influenced. The lower stream has been extensively modified, with sections of the stream bank partially or completely lined with concrete. The riverbed was largely natural with a cobble/pebble substratum. A rare climber species *Mucuna championii* was recorded along Wai Ha River approximately 20m south of the proposed works area of twin cells box-culvert along Tung Tsz Road. *M. championii* is listed as endangered in China (Hu *et al*, 2003) and endemic to Hong Kong (Corlett *et al*, 2000).

Secondary Woodland

- 7.36 Small patches of woodland habitat occur throughout the Assessment Area, with the largest woodland covering the hill to the southwest. Secondary woodlands in the Assessment Area were relatively mature and moderately diverse. Dominant tree species included *Machilus spp.*, *Castanopsis fissa*, *Ficus spp.*, camphor trees and Euphorbiaceae species. Two plant species of conservation interest, the tree *Aquilaria sinensis*, was recorded from secondary woodland habitat approximately 200m south of the proposed works area of twin cells box-culvert along Tung Tsz Road. Another protected shrub species *Pavetta hongkongensis*, was recorded within the works area of proposed box-culvert. *P. hongkongensis* is common in woodland habitats throughout Hong Kong, but is protected under local legislation (Cap. 96). Although common in Hong Kong, *A. sinensis* is endemic to China, where it is threatened by habitat loss. It is a Class II protected species under Chinese Legislation, and is listed as vulnerable in the IUCN Red List of Threatened Species (Sun, 1998).

Fung Shui Woodland

- 7.37 Two areas of *Fung Shui* woodland occur within the Assessment Area. One small woodland was located to the north of San Tau Kok Village, the other woodland was recorded behind the villages of Shuen Wan Chim Uk and Shuen Wan Lei Uk. Dominant mature trees at the two woodlands were similar and comprised mainly of *Cinnamomum camphora*. Other species recorded include *Machilus chekiangensis*, *Schefflera octophylla*, *Macaranga tanarius*, *Ficus variegata*, *Ficus hispida*, *Sterculia lanceolata* and *Byttneria aspera*. Two species of conservation interest were recorded from this habitat, the protected shrub *Pavetta hongkongensis*, and the IUCN listed tree *Aquilaria sinensis*.

Cultivated/Abandoned Land

- 7.38 Small areas of actively cultivated land were recorded from the Assessment Area, including a government plant nursery. The majority of cultivated land in the Assessment Area was abandoned, and dominated by common herbs and shrubs (e.g., *Amaranthus viridis*, *Colocasia esculenta*, *Commelina nudiflora*, *Bidens alba*, *Mikania micrantha* and *Microstegium ciliatum*), along with occasional trees (e.g., *Celtis sinensis*, *Macaranga tanarius*). No rare or protected plant species were recorded from this habitat type.

Developed/Village Areas

- 7.39 Vegetation in these habitats was generally limited to planted ornamental and fruiting species (e.g., *Acacia* spp., *Dimocarpus longan*), common native species (e.g., *Alocasia macrorrhiza*, *Macaranga tanarius*) and exotic weeds (e.g., *Ipomoea cairica*, *Lantana camara*). No plant species of conservation interest were recorded from this habitat type.

Plantation/Landscape Planting

- 7.40 Vegetation of these habitats recorded mostly from man-made slope of the Assessment Area was dominated by exotic tree species including *Eucalyptus* spp., *Lophostemon confertus*, *Acacia mangium*, *Acacia confusa*, *Acacia auriculiformis* and *Pinus elliotii*. No plant species of conservation interest were recorded from this habitat type.

Fishponds

- 7.41 Three large fishponds were recorded in the Assessment Area, adjacent to Wai Ha River. Two of the ponds to the north of the River had been developed for use by recreational anglers, with boardwalks constructed around the pond bunds. As such, vegetation in and around these two ponds was extremely limited. The third pond was not actively managed and therefore subject to less disturbance. No plant species of conservation interest were recorded from fishpond habitats.

Shrubland

- 7.42 Areas of shrubland were recorded on hillsides in the north and east of the Assessment Area. The habitat supported a typical compliment of common and widespread shrubland species (e.g., *Blechnum orientale*, *Dicranopteris petata*, *Rhodomyrtus tomentosa*). No plant species of conservation interest were recorded from shrubland habitats.

Marshes

- 7.43 One relatively large area of marsh was recorded in the Assessment Area. The marsh covered an area of abandoned fishponds and agricultural land stretching from Wai Ha in the north to Ha Tei Ha and Shuen Wan Lei Uk in the south. Much of this habitat was tidally influenced, as indicated by the presence of mangal species such as *Kandelia obovata*, *Aegiceras corniculatum*, and the fern *Acrostichum aureum*. Other areas of the marsh appeared to be freshwater in nature, such as the area bordered by Wai Ha village to the west and Tung Tsz Road to the south. No plant species of conservation interest were recorded from this habitat. The total area of marsh habitats recorded within the Assessment Area is approximately 16ha.

Mangrove

- 7.44 Mangrove habitats were recorded along the shoreline of the Assessment Area, with the most extensive stands found to the north of the Assessment Area, within the Ting Kok SSSI. In the south of the Assessment Area (towards the mouth of Wai Ha River), mangrove communities were limited to occasional small trees at the back of the shore. Within Ting Kok SSSI, the mangal trees were generally small in size, with trunk diameters mostly less than 6cm and height less than 2m. The diversity of mangal species within the mangrove was relatively high, and included *Kandelia obovata*, *Excoecaria agallocha*, *Aegiceras corniculatum*, *Bruguiera gymnorrhiza*, *Avicennia marina*, *Lumnitzera racemosa* and *Acanthus illicifolius*. Mangrove-associates such as the small trees *Hibiscus tiliaceus* and *Thespesia populnea*, the shrub *Pandanus tectorius* and the climbers *Clerodendrum inerme* and *Derris trifoliata* were recorded at the landward margin of the mangrove, along with occasional plants of the seaside species *Suaeda australis*.

Marine Habitats

- 7.45 At the fringes of the mangroves near Shuen Wan marine habitat comprised tidally-exposed gently sloping flats. At low tidal levels, these wave-sheltered intertidal flats extend some 60 to 150m from the high water mark to expose a rich community of bivalves, gastropods and crustaceans. These sheltered flats comprised sandy silty flats interspersed with cobbles. The flats near Shuen Wan were used by shore-combers, presumably from nearby villages who rake the flats to collect edible clams and crabs.
- 7.46 Subtidal marine habitat adjacent to the river mouths at Shuen Wan comprises extensive areas of shallow water (generally <2m deep at low tide within 200m of the river mouths). The seabed comprising a mixture of sand and shell debris and small boulders.

Fauna

- 7.47 Fauna recorded in the Assessment Area during the surveys is listed in **Appendix 7.4**.

Avifauna

- 7.48 A total of 60 avifaunal species were recorded during the field surveys. Within the Assessment Area, disturbed habitats such as developed areas, villages and cultivated land were relatively common. Avifaunal records reflected this, with species typical of urban/rural habitats (Chinese Bulbul, *Pycnonotus sinensis*; Red-whiskered bulbul, *Pycnonotus jocosus* and Eurasian Tree Sparrow, *Passer montanus*) being commonly recorded. In total, 12 avifaunal species of conservation interest were recorded from the Assessment Areas during recent field surveys. These species are listed in **Table 7.2b**, and described in the following paragraphs.

Cormorant

- 7.49 Great Cormorants (*Phalacrocorax carbo*) are common winter visitors to Hong Kong, with highest counts in the Deep Bay Area of several thousand individuals thought to comprise approximately 1% of the Northern Hemisphere population (Carey *et al.*, 2001). Most birds feed in Deep Bay, but significant numbers have also been recorded feeding in the fishponds in the NWNT (*ibid*). Records of 1-5 Cormorants were made from marine habitat in the Assessment Area during the surveys.

Ardeids

- 7.50 Five ardeid species of conservation interest (Chinese Pond Heron, *Ardeola bacchus*; Great Egret, *Casmerodius alba*; Intermediate Egret, *Mesophoyx intermedia*; Grey Heron, *Ardea cinerea*; and Little Egret, *Egretta garzetta*) were recorded in the Assessment Area with the highest numbers observed at marsh and coastal habitats. The populations of these species that occur in Hong Kong are considered of conservation importance. Chinese Pond Heron, Great Egret, Grey Heron and Little Egret were very common (the maximum numbers of the former 3 species recorded were not more than 10 individuals and approximately 20 for Little Egret) in the marsh habitats along the shoreline of the assessment area, while Intermediate Egret (the maximum number recorded is 2 individuals) was only recorded from the shores near Po Sam Pai.

Raptors

- 7.51 One raptor of conservation interest (Osprey, *Pandion haliaetus*) was recorded from the marsh and marine habitats and it is not common in the Assessment Area. Ospreys is a locally common winter visitor to Hong Kong, with occasional records during the summer (Carey *et al.*, 2001). Most records are from the Inner Deep Bay Area. The population in Hong Kong is considered of regional conservation concern, due to the species' restricted regional occurrence (Fellowes *et al.*, 2002).

Waders

- 7.52 Two Sandpipers of conservation interest (Marsh Sandpiper, *Tringa stagnatilis* and Wood Sandpiper, *Tringa glareola*) were recorded during field surveys. Both species are common passage migrants and winter visitors to Hong Kong, with small numbers of Marsh Sandpiper recorded from the summer months (Carey *et al.*, 2001). Fellowes *et al.* (2002) consider Marsh Sandpipers to be of regional conservation significance, because of a restricted regional distribution, only one individual was recorded from lower Wai Ha River. Wood Sandpipers are considered to be of local conservation concern, due to a restricted distribution in Hong Kong (Fellowes *et al.* 2002). It is not common in the assessment area and only 2 individuals were recorded from marsh habitat during the surveys.

Other Birds

- 7.53 Zitting Cisticola (*Cisticola juncidis*) is a common winter visitor and passage migrant to Hong Kong, with a small breeding population restricted to the Northern New Territories (Carey *et al.*, 2001). The species is widespread in open areas of long grass, but is most abundant at such places as Long Valley and areas of fishponds/filled fishponds (*ibid*). Fellowes *et al.* (2002) consider the species of local conservation concern, given its restricted local distribution. Records of single birds were made from marsh habitats of the Assessment Area.
- 7.54 Red-billed Starling (*Sturnus sericeus*) is a winter visitor to Hong Kong. Preferred habitats of the starling include open lowland areas and coastal mangroves, where they can often be found in large flocks (Viney *et al.*, 2005). Other studies have shown they also use fishpond bunds as foraging sites (Aspinwall, 1997). However, the species can be found in virtually any lowland habitat aside from densely populated urban areas during the winter season. Red-billed Starlings are considered of global conservation concern by Fellowes *et al.* (2002) due to a restricted global population. Records of over 40 birds observed in December 2005 at Shuen Wan Marsh.

- 7.55 Collared Crows (*Corvus torquatus*) have a restricted and declining local population (Carey *et al.*, 2001), and are considered of local conservation concern by Fellowes *et al.* (2002). The Crows have been recorded from widespread coastal habitats, including occasional reports from relatively disturbed areas (Carey *et al.*, 2001). A single Collared Crow was recorded on the fringe of marsh, and coastal areas of Shuen Wan Egretty SSSI and along Ting Kok Road in the Assessment Area.

Mammals

- 7.56 Evidence of two wild mammal species was recorded during the surveys; Wild Boar (*Sus scrofa*), and Japanese Pipit (*Pipistrellus abramus*). These species are protected under Hong Kong Law (*Wild Animals Protection Ordinance* (Cap. 170)).

Herpetofauna

- 7.57 A total of 5 amphibian and 7 reptile species were recorded from the Assessment Area during the surveys. Although most of the species are locally common and widespread, a reptile species (Chinese Forest Skink, *Ateuchosaurus chinensis*) that is relatively uncommon in Hong Kong, but have a wide local and regional distribution, was recorded from the Assessment Area.
- 7.58 One reptiles (Indo-Chinese Rat Snake, *Ptyas korros*) of conservation interest was recorded from the Assessment Area. Regional populations of Indo Chinese Rat Snake are thought to be in drastic decline due to over-collection for human consumption. The large, secure populations of the species in Hong Kong are therefore considered important in a regional context (Fellowes *et al.*, 2002).

Terrestrial Invertebrates

- 7.59 A total of 16 dragonfly species were recorded from the Assessment Area during the surveys. Aside from the locally uncommon damselfly *Agriocnemis femina*, all of the species recorded have a common/fairly common and widespread distribution.
- 7.60 During recent field surveys, 22 butterfly species were recorded from the Assessment Area. The majority of these species are common and widespread in Hong Kong, and no species of conservation interest were recorded.

Freshwater Fish

- 7.61 In total, 10 species of fish were recorded from stream and river habitats during the surveys. Fish encountered included common native stream species (e.g. *Rhinogobius duospilus*), and exotic species (e.g. *Gambusia affinis*, *Sarotherodon massambicus*)

Freshwater Invertebrates

- 7.62 Freshwater invertebrate communities recorded within the Assessment Area comprised of Mollusk, Crustacea, Insecta, Turbellaria, and Annelida. In total, 37 invertebrate taxa were recorded. Freshwater shrimps especially *Caridina cantonensis*, snail *Brotia hainanensis*, caddisfly Hydropsychidae, mayfly larvae *Baetis* sp. and Diptera larvae were numerically abundant.

Marine Fauna

Intertidal Communities

- 7.63 The flats at Shuen Wan supported species typical of sheltered flats in Hong Kong dominated by mud and sand snails (*Batillaria* spp and *Cerithidea* spp.) and the oyster (*Saccostrea cucullata*) attached to cobbles. 30 species were recorded from Shuen Wan flats comprising marine snails, barnacles, bivalves (clams, oysters and mussels), crabs, sea slaters, anemones and sea slugs (**Appendix 7.4**). None of the species recorded were of recognised conservation interest.
- 7.64 General observations along the lowest tidal reaches at Shuen Wan recorded swimming crabs

(*Portunus* spp and *Charybdis* spp.). Within the concrete walled 'estuary' of the Wai Ha River, colonies of the circular 'pearl oysters' *Pinctada marensii* were common. The common crab *Metagrapsus messor* was also common on the high shore in front of the Wai Ha River mouth opening.

Subtidal Communities

- 7.65 Despite the presence of hard substrate (small rocks and boulders), the subtidal areas adjacent to Shuen Wan, were not observed to support corals. No individual colonies of either hard or soft corals were recorded during underwater surveys.
- 7.66 In the subtidal area off Shuen Wan, sea urchins (*Salmacis sphaeroides*) and crabs were frequently encountered. None of the species recorded were considered to be of conservation interest.

Ecological Value

- 7.67 In accordance with the *EIAO TM Annex 8* criteria, the ecological importance of recorded habitats has been evaluated in **Tables 7.1a-7.1f** below.

Table 7.1a Ecological Value of Rivers & Streams in the Assessment areas

Criteria	Rivers & Streams
Naturalness	Wai Ha River is largely natural. The section potentially affected by the proposed works retains some natural characteristics, but have been affected by channelisation and water pollution.
Size	Moderate
Diversity	Moderate
Rarity	Marsh Sandpiper (<i>Tringa stagnatilis</i>) recorded from the lower Wai Ha River. Hong Kong Mucuna (<i>Mucuna championii</i>) recorded along bank at the upstream of the River.
Recreatability	Previously modified streams and rivers have moderate recreatability.
Fragmentation	N/A
Ecological linkage	Wai Ha River falls partially within the Shuen Wan Marsh CA, and discharges into Tolo Harbour adjacent to Shuen Wan Egrettry SSSI.
Potential value	With appropriate management and removal of pollution sources, the ecological value of all streams and rivers could be increased.
Nursery ground	No record of significant nursery or breeding ground was found in the surveys.
Age	N/A
Abundance/Richness of Wildlife	Low-moderate.
Ecological value	Low-moderate

Table 7.1b Ecological Value of Secondary Woodland and Fung Shui Woodland in the Assessment Areas

Criteria	Secondary woodland	Fung Shui Woodland
Naturalness	Secondary woodland habitats within the Assessment Area were relatively unmodified.	Fung Shui woodland habitats within the Assessment Area were relatively unmodified.
Size	Moderate.	Habitat limited to small patches in the Assessment Area.
Diversity	Moderate to high.	Moderate to high.

Criteria	Secondary woodland	<i>Fung Shui</i> Woodland
Rarity	<i>Aquilaria sinensis</i> and <i>Pavetta hongkongensis</i> recorded from secondary woodland in the Assessment Area.	Red-billed Starling (<i>Sturnus sericeus</i>) and Collared Crow (<i>Corvus torquatus</i>) recorded from this habitat. <i>Aquilaria sinensis</i> and <i>Pavetta hongkongensis</i> recorded from <i>Fung Shui</i> woodland in the Assessment Area.
Re-creatability	Moderate. Woodland habitat can be re-created, but would take 30-50 years to reach maturity.	Low to moderate. Woodland habitat can be re-created, but would take 50 years or more to mature.
Fragmentation	Habitat distributed in small patches in the Assessment Area.	Habitat distributed in small patches in the Assessment Area.
Ecological linkage	Habitat is not structurally or functionally linked to any high ecological value resources.	<i>Fung Shui</i> woodland at the Assessment Area zoned as Shuen Wan Egretty SSSI.
Potential value	Low-moderate.	Low-moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the surveys.	Historical records of a large breeding colony of ardeids at <i>Fung Shui</i> woodland (Shuen Wan Egretty SSSI). The woodland may still support a small population (5-6 pairs) of herons/egrets.
Age	Habitats are estimated to be from 30-50 years old.	Habitats are estimated to be over 50 years old.
Abundance/Richness of Wildlife	Moderate.	Moderate.
Ecological value	Moderate	Moderate-High

Table 7.1c Ecological Value of Cultivated/Abandoned Land and Village/Developed Area Habitats in the Assessment Areas

Criteria	Cultivated/Abandoned Land	Village/Developed Areas
Naturalness	Created habitat.	Created habitat.
Size	Moderate	Moderate.
Diversity	Low.	Low.
Rarity	Red-billed Starling (<i>Sturnus sericeus</i>) recorded from this habitat type.	No significant records.
Re-creatability	N/A	N/A
Fragmentation	Habitat is fragmented.	Habitat is fragmented.
Ecological linkage	Habitat at the Assessment Area falls partially within Shuen Wan Marsh CA and CPA.	Habitat at the Assessment Area falls partially within Shuen Wan Marsh CA.
Potential value	Moderate.	Moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the surveys.	No record of significant nursery or breeding ground was found in the surveys.
Age	N/a.	N/a.
Abundance/Richness of Wildlife	Low.	Low.
Ecological value	Low	Very Low

Table 7.1d Ecological Value of Plantation/Landscape Planting and Fishponds in the Assessment Areas

Criteria	Plantation/Landscape Planting	Fishponds
Naturalness	Created habitat.	Created habitat.
Size	Small-moderate.	Small.

Criteria	Plantation/Landscape Planting	Fishponds
Diversity	Low.	Low.
Rarity	Indo-Chinese Rat Snake (<i>Ptyas korros</i>) recorded from plantation habitat in the Assessment Area.	Chinese Pond Heron (<i>Ardeola bacchus</i>), Grey Heron (<i>Ardea cinerea</i>), Little Egret (<i>Egretta garzetta</i>) and Red-billed Starling (<i>Sturnus sericeus</i>) recorded from fishponds in the Assessment Area.
Re-creatability	High.	Easily re-created in suitable lowland areas.
Fragmentation	Habitat not fragmented.	Habitat limited to small patches at the Assessment Area.
Ecological linkage	Habitat is not structurally or functionally linked to any high ecological value resources.	Fishpond habitat adjacent to Shuen Wan Marsh CA.
Potential value	Moderate.	Moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the surveys.	No record of significant nursery or breeding ground was found in the surveys.
Age	Estimated to be 10 years old.	N/A.
Abundance/Richness of Wildlife	Low.	Low-moderate.
Ecological value	Low	Low

Table 7.1e Ecological Value of Shrubland and Marshes in the Assessment Areas

Criteria	Shrubland	Marshes
Naturalness	Shrubland habitat largely natural, but maintained by hill-fires.	Habitat formed from abandoned fishponds and agricultural land.
Size	Small-moderate.	Moderate-large.
Diversity	Low-moderate.	Moderate diversity of avifauna.
Rarity	No species of conservation interest recorded from the habitat.	Chinese Pond Heron (<i>Ardeola bacchus</i>), Great Egret (<i>Casmerodius alba</i>), Grey Heron (<i>Ardea cinerea</i>), Little Egret (<i>Egretta garzetta</i>), Osprey (<i>Pandion haliaetus</i>), Wood Sandpiper (<i>Tringa glareola</i>), Zitting Cisticola (<i>Cisticola juncidis</i>), Collared Crow (<i>Corvus torquatus</i>) and Red-billed Starling (<i>Sturnus sericeus</i>) recorded from marsh habitat. Freshwater and brackish marshes are rare habitat types in Hong Kong.
Re-creatability	Moderate.	Low.
Fragmentation	Habitat is not fragmented.	Habitat is largely unfragmented, although Tung Tsz Road separates northern part of marsh from tidally influenced areas to the south.
Ecological linkage	Habitat is not structurally or functionally linked to any high ecological value resources.	Habitat falls partially within Shuen Wan Marsh CA in the Assessment Area.
Potential value	Moderate.	Moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the surveys.	No record of significant nursery or breeding ground was found in the surveys.

Criteria	Shrubland	Marshes
Age	Estimated to be 5-15yrs old.	Unknown.
Abundance/Richness of Wildlife	Low-moderate.	Moderate-high.
Ecological value	Low-moderate	Moderate-High

Table 7.1f Ecological Value of Mangrove and Marine Habitats in the Assessment Areas

Criteria	Mangrove	Marine
Naturalness	Mangrove habitat, located to the east of Ting Kok Road along the coast of Tolo Harbour, in the Assessment Area is largely natural with limited human disturbance.	Marine habitat is largely natural but has been much affected by excessive nutrient levels / eutrophication pressures.
Size	The mangrove habitat is large (approximately 3.5ha) and is contiguous with adjacent mangrove at Ting Kok. Next to the Wai Ha River, mangrove is limited to occasional small trees along the backshore.	Intertidal flats are moderate in size extending 60-150m in width. Subtidal area is large.
Diversity	The mangrove habitat is of moderate to high floristic diversity compared to other mangroves in Hong Kong.	Marine habitat at the Assessment Area is of moderate diversity.
Rarity	No mangrove species or associates recorded were considered rare. Great Egret (<i>Casmerodius alba</i>), Grey Heron (<i>Ardea cinerea</i>) and Little Egret (<i>Egretta garzetta</i>) were recorded from mangrove habitat in the Assessment Area.	No intertidal or subtidal marine organisms recorded were considered rare. Great Cormorant (<i>Phalacrocorax carbo</i>), Chinese Pond Heron (<i>Ardeola bacchus</i>), Great Egret (<i>Casmerodius alba</i>), Intermediate Egret (<i>Mesophoyx intermedia</i>), Grey Heron (<i>Ardea cinerea</i>), Little Egret (<i>Egretta garzetta</i>), Osprey (<i>Pandion haliaetus</i>) and Wood Sandpiper (<i>Tringa glareola</i>) were recorded from intertidal habitats in the Assessment Area.
Re-creatability	Mangroves can be formed by planting.	Habitat can be recreated and recolonised.
Fragmentation	There are other similar habitats in the Tolo embayment.	Habitat is not fragmented.
Ecological linkage	Mangrove habitats at the Assessment Area fall partially within Ting Kok SSSI/ and CPA.	Marine habitat at the Assessment Area fall partially within the Ting Kok SSSI.
Potential value	Moderate.	Improvements in water quality in Tolo Harbour may result in increased habitat value. Area is currently a proposed Fisheries Protection Area.
Nursery ground	Although no significant records, during tidal inundation mangroves are reported to fulfil a nursery role for many species.	No record of significant nursery or breeding ground was found in the surveys.
Age	N/A	N/A
Abundance/Richness of Wildlife	Moderate.	Low.
Ecological value	Moderate-High	Moderate

- 7.68 Wai Ha River was found to be largely natural watercourses, but supported few species of conservation interest, and low-moderate diverse aquatic communities. The watercourse was considered of low-moderate ecological value.
- 7.69 Secondary woodland habitat in the Assessment Area was found to be relatively mature, supported moderately diverse plant communities (including some species of conservation interest). Secondary woodland habitat within the Assessment Area was considered of moderate ecological value.
- 7.70 *Fung Shui* woodland habitat within the Assessment Area was found to be mature, support moderate-high diverse plant communities (including some species of conservation interest), in addition to some faunal species of conservation interest in the Assessment Area. The *Fung Shui* woodland may also support a small breeding colony of ardeids. Overall, *Fung Shui* woodland habitats within the Assessment Area were considered of moderate-high ecological value.
- 7.71 Cultivated land and plantation habitat were recorded from the Assessment Area. Only two species of conservation interest was recorded from these habitat types, and species diversity was relatively low in both habitat types. Cultivated land and plantations were considered of low ecological value.
- 7.72 Village/Developed Areas were found to be highly modified habitats supporting no species of conservation interest, and were considered of very low ecological value.
- 7.73 Fishponds in Hong Kong (such as the Inner Deep Bay Area) are generally considered of high ecological value, largely because of the important foraging habitat they provide for water-birds such as ardeids. However, fishponds recorded from the Assessment Area were found to provide a poor feeding resource for birds. At the Assessment Area, two of the fishponds had been developed for recreational angling, and the third abandoned pond was adjacent to a village area. Although avifauna of conservation interest were occasionally recorded from the ponds, the high levels of disturbance limited the value of these habitats as a foraging ground for birds. Fishponds at the Assessment Area were considered of low ecological value.
- 7.74 Shrubland habitat within the Assessment Area was found to support a low-moderate diversity of plants, and no species of conservation interest. This habitat was considered of low-moderate ecological value.
- 7.75 The marsh in the Assessment Area was considered of moderate-high ecological value. The habitat was found to support a relatively diverse avifaunal community, including eight species of conservation interest.
- 7.76 The Assessment Area supported extensive areas of mangrove that were considered to have moderate-high ecological value.
- 7.77 Marine habitat in the Assessment Area supported a moderate abundance and diversity of fauna as well as being feeding habitats for notable avifauna and were considered to be of moderate ecological importance.
- 7.78 In accordance with the EIAO TM Annex 8 criteria, species of conservation interest recorded in the Assessment Areas are evaluated in **Tables 7.2a and 7.2b** below.

Table 7.2a Evaluation of Floral Species of Conservation Interest Recorded Within Assessment Areas

Species	Growth Form	Protection Status	Distribution	Rarity*
Hong Kong Pavetta (<i>Pavetta hongkongensis</i>)	Shrub	Protected. Listed under Cap. 96	Widely distributed in woodland habitats across Hong Kong.	Common
Incense Tree (<i>Aquilaria sinensis</i>)	Tree	Category II Protected Species in China. Listed as vulnerable under IUCN Red List of Threatened Species**	Widely distributed in woodland habitats across Hong Kong.	Common
Hong Kong Mucuna (<i>Mucuna championii</i>)	Woody Climber	Not Protected. List as endangered in China***	In lowland broad-leaved evergreen forest***	Rare. Endemic to Hong Kong.

Source: *Corlett *et al.* 2000, **Sun, W. 1998, ***Hu *et al.* 2003

Table 7.2b Evaluation of Faunal Species of Conservation Interest Recorded Within Assessment Areas

Species	Protection Status	Distribution/Rarity*	Conservation Status**
Avifauna			
Great Cormorant (<i>Phalacrocorax carbo</i>)	See note 1	Local but not uncommon	PRC
Chinese Pond Heron (<i>Ardeola bacchus</i>)	See note 1	Common & widespread	PRC
Grey Heron (<i>Ardea cinerea</i>)	See note 1	Local but not uncommon	PRC
Great Egret (<i>Casmerodius alba</i>)	See note 1	Local but not uncommon	PRC
Little Egret (<i>Egretta garzetta</i>)	See note 1	Common & widespread	PRC
Intermediate Egret (<i>Mesophoyx intermedia</i>)	See note 1	Rare	RC
Osprey (<i>Pandion haliaetus</i>)	See note 1	Local but not uncommon	RC
Wood Sandpiper (<i>Tringa glareola</i>)	See note 1	Local but not uncommon	LC
Marsh Sandpiper (<i>Tringa stagnatilis</i>)	See note 1	Local but not uncommon	RC
Zitting Cisticola (<i>Cisticola juncidis</i>)	See note 1	Local but not uncommon	LC
Red-billed Starling (<i>Sturnus sericeus</i>)	See note 1	Local but not uncommon	GC
Collared Crow (<i>Corvus torquatus</i>)	See note 1	Uncommon	LC
Mammals			
Japanese Pipistrelle (<i>Pipistrellus abramus</i>)	Protected. Listed in Cap. 170.	Locally common	(LC)

Species	Protection Status	Distribution/Rarity*	Conservation Status**
Herpetofauna			
Indo-Chinese Rat Snake (<i>Ptyas korros</i>)	Not protected	Common & widespread	PRC

Note 1 – All wild birds are protected under the *Wild Animals Protection Ordinance (Cap.170)*

* - Information taken from various sources including Karsen *et al.*, (1998), Carey *et al.* (2001) and Fellowes *et al.* (2002).

** LC – Local Concern (Habitat loss/damage in Hong Kong would pose significant threat to local survival); PRC – Potential Regional Concern (Large, secure populations in Hong Kong are of regional significance); RC – Regional Concern (Habitat loss/damage in Hong Kong would pose significant threat to regional survival); PGC – Potential Global Concern (Large, secure populations in Hong Kong are of global significance); GC – Global Concern (Habitat loss/damage in Hong Kong would pose significant threat to global survival). Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence. Refer to Fellowes *et al.* (2002) for further explanation of status.

Identification of Ecological Impacts

- 7.79 Several potential ecological impacts resulting from construction and operation phase activities have been identified, and are outlined in the following sections.

Impacts to Terrestrial Ecology

Construction Phase

- 7.80 Direct loss of habitats resulting from other proposed works under this Project. Habitat loss is summarised in **Table 7.3** below:

Table 7.3 Habitats directly affected by proposed works

Habitat Type	Twin cell box-culvert along Tung Tsz Road	Floodwater pumping station at Shuen Wan	Mechanical gate at Wai Ha River	280m relief drain in Wai Ha Village	260m drainage pipe along Ting Kok Road	Total
Village/ Developed Area	1.03ha	-	<0.02ha	0.15ha	0.13ha	1.33ha
Cultivated/ Abandoned Land	0.20ha	0.19ha	-	-	-	0.39ha
Marsh	0.30ha	-	-	-	-	0.30ha
Secondary Woodland	0.08ha	-	-	-	-	0.08ha
Stream (artificially modified section)	100m	-	-	-	-	100m
Stream (natural section)	30m	-	-	-	-	30m

- 7.81 Indirect impact to aquatic communities downstream of Wai Ha River and the adjacent marsh due to increased sedimentation during the excavation and construction of box-culvert in works areas - Increased sedimentation can have a number of adverse effects on aquatic communities. In addition

to direct physical damage (particularly to small invertebrate taxon) caused by larger particles (e.g., sand/gravel), small particles (e.g., silt) can clog the respiratory and feeding organs of fish and invertebrates. Increases in turbidity caused by high sediment levels can inhibit photosynthesis by aquatic plants, and impede feeding and other activities in animals that are largely dependant on sight (e.g., some fish species). Dudgeon (1995) studied the effects of increased sedimentation on the macroinvertebrate community of a Hong Kong River, and found substantial decreases in species richness resulting from the impact. A similar response to increased sediment inputs in an Indonesian River was reported by Yule (1995).

- 7.82 Indirect impact to habitats close to works areas through potential spills of oils and other pollutants during construction phase - Potential spillage of oils/chemicals could lead to direct lethal/non-lethal effects on aquatic organisms, terrestrial animals and avifauna foraging on the site.
- 7.83 Indirect impacts to habitats and associated fauna adjacent to works areas resulting from increased human activities/disturbance such as noise-generating construction plant - Potential disturbance to avifauna in the Assessment Area would be key concern. Noisy construction phase activities and general increases in human activity could disturb wildlife utilising habitats close to the works areas. Potential disturbance effects may include the avoidance of areas adjacent to the works area, and reductions in wildlife density close to the source of disturbance.
- 7.84 Indirect disturbance to habitats would result from storage or dumping of construction material.

Operation Phase

- 7.85 Potential direct and indirect impacts to aquatic and riparian communities in newly established channels would result from routine maintenance works such as removal of accumulated sediments and control of vegetation.

Impacts to Marine Ecology

Construction Phase

- 7.86 Indirect impact to habitats close to works areas through potential spills of oils and other pollutants during construction phase - Potential spillage of oils/chemicals could lead to direct lethal/non-lethal effects on aquatic organisms, terrestrial animals and avifauna foraging on the site.

Operation Phase

- 7.87 The higher storm discharge into coastal waters from the improved drainage channels as well as from operation of proposed Pumping Station may also have indirect impact on mangrove and marine habitat adjacent to the discharge portal.

Impact Evaluation

Impacts to Habitats

- 7.88 Potential ecological impacts to habitats aside from rivers/streams have been evaluated according to Table 1 of Annex 8 of the *EIAO TM*, and are summarised in **Tables 7.4a-7.4e** below.

Table 7.4a Overall Impact Evaluation of Secondary Woodland and *Fung Shui* Woodland

Evaluation Criteria	Secondary Woodland	<i>Fung Shui</i> Woodland
Habitat quality	The habitat quality is moderate.	The habitat quality is moderate-high.
Species	Direct impact to Hong Kong Pavetta (<i>Pavetta hongkongensis</i>) and potential indirect impact to the wildlife.	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife, including ardeids breeding at <i>Fung Shui</i> woodland (Shuen Wan Egretty SSSI).
Size/Abundance	Direct impact to thin strip of secondary woodland habitat (0.08ha) dominated by fruit tree along the Wai Ha River in the Assessment Area	No direct impact to this habitat type.
Duration	Loss of habitat would be permanent. Indirect impacts such as noise disturbance would be largely limited to the construction phase.	Indirect impacts such as noise disturbance would be largely limited to the construction phase.
Reversibility	Loss of habitat would not be reversible. Indirect disturbance impacts would be temporary and reversible.	Indirect disturbance impacts would be temporary and reversible.
Magnitude	The scale of the impact is considered low.	The scale of the impact is considered low.
Overall impact conclusion	Low	Low

Table 7.4b Overall Impact Evaluation of Cultivated/Abandoned Land and Village/Developed Area Habitats

Evaluation Criteria	Cultivated/Abandoned Land	Village/Developed Area
Habitat quality	The habitat quality is low.	The habitat quality is low.
Species	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.
Size/Abundance	Loss of small area of cultivated land (0.39ha) in the Assessment Area.	Loss of small area of village/developed area (1.33ha) in the Assessment Area.
Duration	Loss of habitat would be permanent. Indirect impacts such as noise disturbance would be largely limited to the construction phase.	Loss of habitat would be permanent. Indirect impacts such as noise disturbance would be largely limited to the construction phase.
Reversibility	Loss of habitat would not be reversible. Indirect disturbance impacts would be temporary and reversible.	Loss of habitat would not be reversible. Indirect disturbance impacts would be temporary and reversible.
Magnitude	The scale of the impact is considered low.	The scale of the impact is considered low.
Overall impact conclusion	Very Low	Very Low

Table 7.4c Overall Impact Evaluation of Plantation/Landscape Planting and Fishpond Habitats

Evaluation Criteria	Plantation/Landscape Planting	Fishpond
Habitat quality	The habitat quality is low.	The habitat quality is low.
Species	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.
Size/Abundance	No direct impact to this habitat type.	No direct impact to this habitat type.
Duration	Indirect impacts such as noise disturbance would be largely limited to the construction phase.	Indirect impacts such as noise disturbance would be largely limited to the construction phase.
Reversibility	Indirect disturbance impacts would be temporary and reversible.	Indirect disturbance impacts would be temporary and reversible.
Magnitude	No direct impact to this habitat type.	The scale of the impact is considered very low.
Overall impact conclusion	Very Low	Very Low

Table 7.4d Overall Impact Evaluation of Shrubland and Marsh Habitats

Evaluation Criteria	Shrubland	Marshes
Habitat quality	The habitat quality is low-moderate.	The habitat quality of marshland is moderate-high.
Species	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.
Size/Abundance	No direct impact to this habitat type.	Loss of small area of marsh margin (0.30ha) along the edge of Tung Tsz Road. Less than 2% of the total marsh habitats in the Assessment Area.
Duration	Indirect impacts such as noise disturbance would be largely limited to the construction phase.	Loss of habitat would be permanent. Indirect impacts such as noise disturbance would be largely limited to the construction phase.
Reversibility	Indirect disturbance impacts would be temporary and reversible.	Loss of habitat would not be reversible. Indirect impacts such as noise disturbance would be largely limited to the construction phase.
Magnitude	The scale of the impact is considered very low.	The scale of the impact is considered low.
Overall impact conclusion	Very Low	Low to moderate

Table 7.4e Overall Impact Evaluation of Mangrove and Marine Habitats

Evaluation Criteria	Mangrove	Marine
Habitat quality	The habitat quality is moderate-high.	Habitat quality is moderate.
Species	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.
Size/Abundance	No direct impact to this habitat type.	No direct impact to this habitat type.
Duration	Indirect impacts such as noise disturbance would be largely limited to the construction phase.	Indirect impacts such as noise disturbance would be largely limited to the construction phase.
Reversibility	Indirect disturbance impacts would be temporary and reversible.	Indirect disturbance impacts would be temporary and reversible.
Magnitude	The scale of the impact is considered low.	The scale of the impact is considered low.
Overall impact conclusion	Low	Very Low

Construction Phase Impacts

Habitat Loss

- 7.89 Direct impacts to habitats other than streams/ivers (discussed in Sections 7.88 above) would be largely limited to small areas of low ecological value habitat (cultivated land and village/developed areas). The most substantial impact identified would be the loss of small area of marsh margin located next to Tung Tsz Road. Habitat loss in the Assessment Area is summarised in the following paragraphs.
- 7.90 The key direct impact predicted in the Assessment Area would be direct impacts to approximately 0.3ha of marsh margin resulting from the construction of twin cell box-culvert along Tung Tsz Road. The scale of this impact is limited to some extent because the area of marsh affected is relatively small (less than 2% of the total marsh habitat recorded in the Assessment Area). Furthermore, the value of this part of the marsh to wildlife is reduced by disturbance from existing busy vehicular and pedestrian traffic on Tung Tsz Road.
- 7.91 Nevertheless, it is recognised that the proposed works would reduce the overall size of the marsh, impacting the ecological function and value of the habitat as a feeding resource for avifauna of conservation interest and other wildlife. As such, the impact is considered low to moderate in scale, and would require mitigation.
- 7.92 In addition to impacts to marsh, a total of approximately 1.72ha of low ecological value cultivated land, village and developed area would be affected by works in the Assessment Area. These impacts are considered minor in scale.
- 7.93 A very small area (0.08ha) of secondary woodland dominated by fruit tree along the edge of the existing Tung Tsz Road would also be affected by the works. Direct impact to a few individuals of a plant species of conservation interest (Hong Kong Pavetta, *Pavetta hongkongensis*) would be anticipated. The impact is considered minor in scale, and mitigation measure would be implemented to the minimise impact.

Indirect Impacts Due to Increased Sedimentation

- 7.94 The excavation works of the proposed twin cell box culvert carried out in the Wai Ha River channel would be restricted to commence from October to April and the works would be enclosed in the dry section of the river.

- 7.95 As a precautionary measure, sheet-pilings, which will be installed around the trench of excavation (as shown in Figure 5.2), are proposed to be extended above ground level for ~2m to act as hoarding to isolate the works site. Together with the proposed sand bags of 300mm high to be provided along the edge of the trench adjacent to the extended sheet-pilings to provide adequate allowance for the built-up water within trench during rainstorm event.. With sand bags in place, surface runoff will be intercepted and directed to the existing drainage system. Furthermore, tarpaulin sheets may be used to cover the excavation works during heavy rainstorm. That would minimize the ingress of water into the trench by precipitation. Without ingress of water, the risk of muddy water getting into Wai Ha River and the adjacent CA area would be minimized. Any concrete washing water will be contained inside the works site surrounded by sheet-pilings. A pump sump at the bottom of the trench will be provided to facilitate the pumping of excess water during concrete washing. To minimize the cumulative impact, the trenching works for the construction of the proposed box culvert will be carried out in phases, with a trench length of not more than 120m in each phase. The trench will be backfilled and compacted with suitable materials upon completion of each phase of the construction works.
- 7.96 Excavation works of the box culvert along Tung Tsz Road and Wai Ha River would be temporary suspended during the periods of heavy rain. The Contractor will not be allowed to stockpile the excavated material adjacent to the CA area. The excavated material would be either removed off site immediately after excavation, or stockpile at location(s) away from the CA area, which shall be approved by the site engineer. Sedimentation impacts would be further controlled through standard good site practices and the implementation of adequate construction site drainage and provision of sediment removal facilities as described in Section 5.27, it is anticipated that impact on Wai Ha River and the marsh habitat at the Assessment Area due to sedimentation would not arise.
- 7.97 With the implementation of the above mitigation measures as well as interception and treatment of muddy water and surface run-off at source, there is little potential for sediment release due to containment of excavation works in enclosed dry sections of the riverbed, impacts due to sedimentation in mangrove and marine habitats were anticipated to be temporary and very minor.

Indirect Impacts Due to Construction Phase Disturbance

- 7.98 Indirect impacts to habitats and associated communities adjacent to the works areas could result from increased human activities/disturbance during the construction phase. Such impacts would arise from noise-generating machinery, general increases in human activity, and the storage or dumping of construction material. Of particular concern would be potential disturbance to avifauna foraging in marsh and marine habitats in the Assessment Area. Birds recorded from these habitats included several species of conservation interest, including Great Cormorant (*Phalacrocorax carbo*), several ardeid species (e.g., Great Egret, *Casmerodius alba*), Osprey (*Pandion haliaetus*) and Wood Sandpiper (*Tringa glareola*). Additionally, construction phase activities associated with mechanical gate at Wai Ha River and drainage pipe along Ting Kok Road could disturb the small number of ardeids that may breed at the adjacent *Fung Shui* woodland (Shuen Wan Egretrey SSSI). Overall, construction phase disturbance in the Assessment Area is considered a potentially minor-moderate impact. Although disturbance could occur, it is not considered a severe impact for the following reasons:
- The works would be conducted in close proximity to existing sources of disturbance (e.g., Tung Tsz and Ting Kok Roads).
 - The proposed works are relatively small in scale.
 - The works would be temporary in nature.
- 7.99 In Shenzhen Western Corridor EIA, it was also concluded that the ardeids species, such as Chinese Pond Heron, Great Egret, Little Egret and Grey Heron recorded from marsh habitat within the Assessment Area, are known to be tolerant to noise and disturbance. And it is also substantiated by the findings of the 2-year ecological monitoring project for the construction stage impacts of the Shenzhen River Regulation Project, it was observed that the total densities of Chinese Pond Heron,

Great Egret, Little Egret and Grey Heron within 100m from the new embankment of the channelised Shenzhen River were similar in construction and operation phases. In case that indirect disturbance to ardeids were to occur, there are suitable adequate nearby alternative habitats and potential foraging sites available in the remaining marsh and marine habitats located in Ha Tei Ha and Ting Kok SSSI respectively..

Operation Phase Impacts

Discharge of Storm-water

- 7.100 The increase in stormwater discharge into the semi-estuarine Tolo Harbour waters due to drainage improvement is not anticipated to adversely affect marine ecology. According to the water quality assessment, there is not expected to be significant impact on water quality during flood events. Indirect impacts on mangrove and marine habitat during operation phase flood events are expected to be very low.

Impact on Marshland

- 7.101 No direct impact on the ecological function of the existing Shuen Wan Marsh would be resulted due to the operation of twin-cell box culvert. The proposed box culvert would be operated to allow only the excessive stormwater overflow into the chamber which will then be conveyed to the box culvert while the remaining flow will still be running along the existing Wai Ha River and would subsequently flood and nourish the marshland in a way similar to the existing flood events. The operating mechanism of the box culvert is presented in Section. 2.9 in detail.

Impacts to Rivers & Streams

- 7.102 The proposed improvement works to Wai Ha River have been considered to avoid major impacts to natural section of the stream. Direct impacts to the stream would be localised and limited to the demolition and reconstruction of existing concrete lined wing-walls adjacent to Tung Tsz Road, construction of weir and construction of additional box culverts under the road. Under this design, impacts would be limited to the artificially modified channel lined with masonry wall that is already highly disturbed and a short section of relatively natural stream habitat. The construction works would be confined to only one side of the river bank adjacent to Tung Tsz Road. A twin cell box culvert would be constructed at the upstream to intercept stormwater of Wai Ha River during severe rainfall event (**Appendix 7.5** illustrates the existing condition of the proposed intercept point). The existing masonry wall with low ecological value as well as part of the natural river bank would be demolished and reinstated to its original condition or lined with rock-filled gabion. The new channel banks would be trapezoidal in cross-section. Pits would be provided in the gabion bank to allow for planting and establishment of riparian vegetation. Some new sections of riverbed would be created in the intercept point due to the construction of box culvert, which would be lined with natural materials such as cobbles and boulders. The existing natural riverbed and substrates would be retained and the depth of the new channel bed would be varied to re-create the pool-riffle sequence found in the natural sections of the existing river.
- 7.103 Potential ecological impacts to rivers/streams from construction/operational phase activities have been evaluated according to Table 1 of Annex 8 of the EIAO TM, and are summarised in Table 7.4f below.

Table 7.4f Overall Impact Evaluation to Rivers and Streams

Evaluation Criteria	Rivers and Streams
Habitat quality	Low-moderate
Species	Potential temporary disturbance to Marsh Sandpiper at lower Wai Ha River.

Evaluation Criteria	Rivers and Streams
Size/Abundance	A section of 100m artificially modified channel lined with masonry wall and 30m natural stream at upper Wai Ha River would be affected.
Duration	Direct impacts would be permanent. Indirect construction disturbance impacts would last for the duration of the construction phase.
Reversibility	Direct impacts to river habitat would not be reversible. Construction phase disturbance impacts would be temporary and reversible.
Magnitude	The scale of the impacts is considered low.
Overall impact conclusion	Low

Construction Phase

Direct Impacts

- 7.104 Impacts to Wai Ha River are considered minor in scale during and immediately after the construction phase. Direct impacts to Wai Ha River would be limited to localised disturbance to aquatic and riparian communities. This would include the removal of riparian vegetation as well as potential direct impacts and disturbance to aquatic fauna in the affected stream section. Overall impacts to the watercourse are rated minor in scale only, as the design of reconstructed channel section replacing the affected stream/modified channel sections would provide a suitable habitat for the existing aquatic communities. Following the re-establishment of aquatic and riparian habitats, it is expected the artificially modified section (100m) would be positively enhanced and longer-term impacts on the natural stream section (30m) would be relatively minor.

Indirect Impacts Due to Increased Sedimentation

- 7.105 Construction methods described in Section 5 of this report would serve to limit impacts to aquatic communities in the affected rivers/streams due to increased sedimentation. The excavation works for channels in Wai Ha River would be carried out from October to April, with construction carried out by land-based plant. Impacts would be further minimised by restricting the excavation works to an enclosed dry section of the river. The containment measures such as bunds and barriers would be used within the river to minimize the impacts upon the downstream water body.
- 7.106 With these measures in place, sedimentation is expected to have only local and temporary effects on water quality and aquatic ecology. These impacts are therefore considered relatively minor.

Indirect Impacts Due to Construction Phase Habitat Loss and Disturbance

- 7.107 Impacts to waterfowl and other wildlife using the rivers would result from temporary loss of feeding habitats and disturbance caused by increased human activity and noisy construction phase activities. These impacts are considered minor, as construction phase disturbance impacts would be temporary in nature. It is expected the Marsh Sandpiper recorded from the lower Wai Ha River located near the river mouth would not be affected by the construction activities at the upper Wai Ha River. Furthermore, as works would be confined to relatively short sections of Wai Ha River, wildlife (in particular avifauna) potentially displaced or disturbed by the proposed works would be able to utilise less disturbed river sections during the construction phase.
- 7.108 Indirect impacts resulting from potential spills of oils and other pollutants during construction phase are considered relatively minor. Standard good construction practice and simple operational phase mitigation measures would limit the scale and incidence of potential impacts.

Operation Phase Impacts

- 7.109 Operation phase activities at the newly box-culvert and associate structures (such as weir) would include periodic maintenance works such as clearance of overgrown vegetation and de-silting works. These works are expected to cause only temporary and local disturbance to aquatic communities and other wildlife using the river, and are therefore considered a minor impact.

Impacts to Species of Conservation Interest

- 7.110 Potential impacts to species of conservation interest are described in Sections 7.88-7.109 above, and summarised in **Table 7.5** below.

Table 7.5 Overall Impact Evaluations to Species of Conservation Interest

Species of Conservation Interest		Construction Phase Impacts		Operation Phase Impacts	
Common Name	Scientific Name	Description	Evaluation	Description	Evaluation
Flora					
Hong Kong Pavetta	<i>Pavetta hongkongensis</i>	Recorded from secondary woodland and <i>Fung Shui</i> woodland habitats in the Assessment Area. Individuals of this species recorded within the footprint of the proposed culvert. Individuals within this area would be directly impacted.	Low-moderate	No impact.	No Impact
Incense Tree	<i>Aquilaria sinensis</i>	Recorded from secondary woodland and <i>Fung Shui</i> woodland habitats in the Assessment Area. Individuals sufficiently distant from proposed works areas (200m). No impact predicted.	No Impact	Individuals sufficiently distant from proposed works areas (200m). No impact predicted.	No Impact
Hong Kong Mucuna	<i>Mucuna championii</i>	Recorded along the bank of Wai Ha River. Individuals sufficiently distant from proposed works areas (20m). No impact predicted.	No Impact	Individuals sufficiently distant from proposed works areas (20m). No impact predicted.	No Impact
Fauna					
Avifauna					
Great Cormorant	<i>Phalacrocorax carbo</i>	Recorded from marine habitats in the Assessment Area. Construction phase disturbance impacts expected to be minor.	Very Low	No impact.	No Impact
Chinese Pond Heron	<i>Ardeola bacchus</i>	Chinese Pond Heron recorded from fishpond, marsh and marine habitats within the Assessment Area. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Grey Heron	<i>Ardea cinerea</i>	Grey Heron recorded from marsh, fishpond and marine habitats within the Assessment Area. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Great Egret	<i>Casmerodius alba</i>	Great Egret recorded from marsh, mangrove and marine habitats within the Assessment Areas. Impacts anticipated to result from disturbance	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low

Species of Conservation Interest		Construction Phase Impacts		Operation Phase Impacts	
Common Name	Scientific Name	Description	Evaluation	Description	Evaluation
		caused by increased human activity and noisy construction phase activities.			
Little Egret	<i>Egretta garzetta</i>	Little Egret recorded from river/stream, fishpond, marsh, mangrove and marine habitats within the Assessment Areas. . Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Intermediate Egret	<i>Mesophoyx intermedia</i>	Intermediate Egret recorded from marine habitat within the Assessment Area. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low	No impact.	No Impact
Osprey	<i>Pandion haliaetus</i>	Osprey recorded from marsh and marine habitats. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Wood Sandpiper	<i>Tringa glareola</i>	Recorded from marsh habitat. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Recorded from Lower Wai Ha River. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	No impact	No Impact
Zitting Cisticola	<i>Cisticola juncidis</i>	Recorded from marsh habitat. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Red-billed Starling	<i>Sturnus sericeus</i>	Recorded from fishpond, <i>Fung Shui</i> woodland, cultivated/abandoned land and marsh habitats within the Assessment Area. Red-billed Starlings are found in a variety of lowland habitats, and have no specialised habitat requirements. Starlings potentially disturbed by construction	Low	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low

Species of Conservation Interest		Construction Phase Impacts		Operation Phase Impacts	
Common Name	Scientific Name	Description	Evaluation	Description	Evaluation
		phase activities would therefore be likely to relocate to nearby lowland habitats. Potential disturbance impacts are therefore considered minor.			
Collared Crow	<i>Corvus torquatus</i>	Recorded from <i>Fung Shui</i> woodland and marsh habitat. Impacts anticipated to result from disturbance caused by increased human activity and noisy construction phase activities.	Low-moderate	Minor impact resulting from loss of small area of foraging habitat at Shuen Wan Marsh.	Very Low
Herpetofauna					
Indo-Chinese Rat Snake	<i>Ptyas korros</i>	Rat Snakes are common and widespread in Hong Kong with no specialised habitat requirements. Snakes potentially disturbed by construction phase activities would therefore be likely to relocate to nearby areas further from the source of disturbance. Potential disturbance impacts are therefore considered minor.	Very Low	No impact	No Impact

Cumulative Impacts

- 7.111 The proposed drainage improvement works discussed in this Chapter are scheduled to begin in December 2007 and completed in June 2010. One other Project in the Assessment Area, "Tolo Harbour Sewerage of Unsewered Areas Stage 1 Phase II C" (hereinafter referred to as "the Sewerage Project") is under design review, sewerage works at San Tau Kok and Po Sam Pai are planned to start in November 2008 for completion in November 2010. Because of the overlap in construction programmes of the two Projects, there may be some scope for cumulative disturbance. However, the Sewerage Project would be small in scale and largely be confined to relatively small and localised village habitat at the north of Tung Tsz Road. It is therefore anticipated that cumulative disturbance impact resulting from the two Projects would be very minor.
- 7.112 Another project which would possibly interface with this project would be the "Development of a Bathing Beach at Lung Mei, Tai Po" project. The construction phase is expected to start in end of 2008 and tentatively scheduled for completion by 2010. Since its location is remote (over 2km) to works proposed under this Project and the cumulative disturbance impact resulting from the two Projects is expected to be very minor.

Mitigation of Adverse Environmental Impacts

- 7.113 Following *EIAOTM Annex 16* guidelines, mitigation measures are proposed in this section to avoid, minimise and compensate for identified ecological impacts.

Avoidance/ Minimising

- 7.114 Wherever possible, proposed drainage improvement works have been designed to avoid or minimise direct impacts to areas of recognised conservation importance in the Assessment Area including CA, CPA, and SSSI.
- 7.115 The following measures should be implemented to minimise identified ecological impacts during the construction and operation phase.

Construction Phase

- 7.116 The proposed twin cell box-culvert constructed partially underneath Tung Tsz Road has been designed to reduce the footprint of the proposed works from 0.35ha to 0.3ha, thereby minimising direct impacts to marsh habitat and the CA.
- 7.117 The construction of intercept point of twin cell box culvert at the upstream of Wai Ha River would be confined to only one side of the river bank. Impact to natural stream section would be minimized as the most part of box culvert construction works would be conducted in the existing artificially modified channel which lined with masonry wall. To restore and enhance the ecological value of the stream, the affected river bank would be reinstated to its original condition or lined with rock-filled gabion. Planting pits would be provided in the gabion bank to allow the re-establishment of riparian vegetation. The existing natural riverbed and substrates would be retained and the natural pool-riffle sequence would be re-created in the new channel bed.
- 7.118 All works carried out within the existing river channel at Wai Ha River should be carried out from October to April, with construction carried out by land-based plant. Works within river/stream channels should be restricted to an enclosed dry section of the river, with containment measures such as bunds and barriers used within the river to minimize the impacts upon the downstream water body. Site runoff should be directed towards regularly cleaned and maintained silt traps and oil/grease separators to minimise the risk of sedimentation and pollution of river water. The silt and oil/grease separators should be appropriately designed for the local drainage and ground conditions.

To minimize leakage and loss of sediments during excavation in narrow channels, tightly sealed closed grab excavators should be deployed where material to be handled is wet.

- 7.119 The construction of the proposed box-culvert would have the potential to directly impact a few individuals of a plant species of conservation interest (Hong Kong Pavetta, *Pavetta hongkongensis*). The affected individuals should be transplanted to a suitable nearby habitat prior to the construction phase. The proposed location for transplantation is provided in **Figure 7.2**. A detailed vegetation survey of the affected species of conservation interest should be conducted by a suitably qualified botanist/ecologist to identify the affected individuals in order to provide details for transplantation scheme. Transplantation methodology should be agreed with Agriculture, Fisheries and Conservation Department (AFCD). Transplantation should be supervised by a suitably qualified botanist/horticulturalist.
- 7.120 Noise mitigation measures such as the use of quieter construction plant and temporary noise barriers (see Section 3) should be implemented to minimise disturbance to habitats adjacent to the works areas. In addition, temporary noise barriers should be used during the construction of the box-culvert along Tung Tsz Road, the floodwater pumping station, the mechanical gate, and drainage pipe to minimise potential construction phase disturbance to ardeids that may breed in Shuen Wan Egretty SSSI, and avifauna foraging in marsh habitat. Noise generating construction works near the Shuen Wan Egretty SSSI should be avoided as far as practicable during the breeding season (March to June) of the ardeids. Works near the SSSI (i.e. installation of mechanical gate) could be restricted to be executed outside the breeding season by provision of special conditions in the contract document. To further minimise construction noise impact to the marshland and prevent tipping, storage of construction material and encroachment of personnel into the marshland area, hoardings with minimum height of 2m should be set up along the south side of the proposed box culvert works area adjacent to the marsh, extending at least 20m at both ends, throughout the construction period.
- 7.121 Standard good site practice measures should be implemented throughout the construction phase. The measures should include:
- Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural or moderate-high ecological value habitats.
 - Construction activities should be restricted to work areas that would be clearly demarcated. The work areas should be reinstated after completion of the works.
 - Waste skips should be provided to collect general refuse and construction wastes. The wastes would be disposed of timely and properly off-site.
 - General drainage arrangements should include sediment and oil traps to collect and control construction site run-off.
 - Open burning on works sites is illegal, and should be strictly prohibited.

Operation Phase

- 7.122 Potential operational phase activities in newly box-culvert would be limited to regular maintenance such as de-silting. Impacts to aquatic communities in the nearby water channel resulting from these activities are expected to be minor. Nevertheless, the following measures are recommended to minimise potential impacts resulting from operational phase activities:
- To minimise sedimentation, de-silting should be limited to the dry season.
 - Waste material produced during de-silting should be disposed of in a timely and appropriate manner.

Compensation

- 7.123 Planting of trees should be provided within the project area to compensate for the unavoidable loss of approximately 0.08ha of secondary woodland habitat that would be affected by the drainage improvement works. This would be provided for in the compensatory areas presented in Section 7.124. Planting of trees and other vegetation within project area along the banks of Wai Ha River and Tung Tsz Road would also provide compensation for unavoidable tree-felling and loss of riparian vegetation resulting from the proposed works. The compensatory planting should make use of native plant species with flowers/fruits attractive to wildlife.
- 7.124 Compensation would be required for the loss of a small area of marsh margin (about 0.30ha) resulting from the construction of the box-culvert along Tung Tsz Road. An existing low ecological value recreational fishpond (area of about 0.8ha) on government land adjacent to the marsh (**Figure 7.2** refers) is proposed to be made use of as a compensation for the marsh as well as secondary woodland habitats loss (0.08ha). The pond would be enhanced by removing boardwalks around the existing pond, and restoring vegetation along the pond bunds, and it would be re-profiled to provide areas of shallow water (approximately 15-50cm deep). Screen planting of shrubs and trees along the south-eastern bund of the pond would be implemented to minimise disturbance to avifauna and other wildlife from the adjacent recreational fishpond. The enhanced pond is expected to provide a moderate-high ecological value wetland habitat. A conceptual layout for the proposed ecological compensation is illustrated in **Figure 7.2**, and further details should be developed at the detailed design stage to be agreed with AFCD, where the design would aim to provide compensation habitat that could blend with the surrounding marsh habitat with inter-tidal characteristics and become self sustainable in longer term. The proposed compensatory habitat will form part of the scope of works under this drainage improvement project. The works on compensatory habitat will commence together with other proposed drainage improvement works in Shuen Wan, and the compensatory habitat is expected to be put in operation within 12 months after commencement of the construction works, such that the overall ecological value of the Shuen Wan area could be compensated at the soonest.

Residual Environmental Impacts

- 7.125 Potential impacts to avifauna, in particular ardeid, in the Assessment Area would be a key issue of this Project. With the implementation of the recommended mitigation measures (e.g. use of hoarding, temporary noise barriers), the disturbance impacts in construction phase to wildlife would be temporary, and the residual ecological impact would be very low and it is considered environmentally acceptable. The proposed 0.8ha compensatory habitats would adequately mitigate the direct impact due to the loss of small areas of marsh margin and secondary woodland habitats (about 0.3ha and 0.08ha respectively). There would be a positive residual impact to wildlife utilising the affected marsh, with a gain of about 0.4ha of marsh habitat.
- 7.126 Residual impacts to other low ecological value habitats resulting from the proposed works would include the loss of approximately 0.39ha of cultivated/abandoned land. These impacts are considered minor.
- 7.127 Overall, the residual ecological impact on cultivated/abandoned land would be very minor and environmentally acceptable.

Environmental Monitoring and Audit Requirements

- 7.128 An Environmental Monitoring and Audit (EM&A) programme is recommended to verify the accuracy of the predictions of the ecological assessment study, to check on the compliance with the EIA study recommendations, to monitor the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action. Under the EM&A

programme, the proper implementation of mitigation measures recommended in Section 7.114-7.124 should be monitored and audited.

- 7.129 Following transplantation, the health and condition of individuals of the plant species of conservation interest affected by the proposed works should be monitored by a qualified botanist/ecologist. Monitoring would cover 12-month period following transplantation, and be conducted once a week in the first 3 months and at least once per month in the remaining of monitoring period. The Contractor would be responsible for the maintenance of the compensatory habitats during the establishment period which should normally last for 12 months. AFCD has agreed that they could take up the subsequent maintenance of the compensatory habitat after the establishment period/completion of the project, and details of the subsequent maintenance would be agreed between AFCD and the project proponent at the design stage of the project.
- 7.130 A specific monitoring programme of the compensatory habitats is recommended to provide data on the establishment of marsh communities, and allow an assessment of the relative success of mitigation measures to be made. Baseline data should be collected before the commencement of construction phase, with monitoring conducted during the construction phase and after the completion of works. Monitoring should be conducted by qualified ecologist(s) with relevant experience.

Conclusions

- 7.131 The proposed works in Shuen Wan form part of the drainage improvement works under the recommendation given in the Sha Tin and Tai Po Drainage Master Plan (DMP) Study. According to the results of the study, the low-lying land in the vicinity of Wai Ha River, part of it has been designated as Conservation Area (CA), will be subject to high risk of flooding during severe storm and high tide events. Flooding is considered beneficial to the natural habitat in the CA, however, if the flood level kept increasing and the affected area extended beyond Tung Tsz Road, it would impose high risks to lives and properties of the neighbouring villages with a population over 2,000. Thus, flooding in Wai Ha River would need to be controlled.
- 7.132 The objective of this project in Shuen Wan area is to develop an optimum solution to relieve the flooding problems there. After careful evaluation, it is considered that the box culvert is the most practical and socially acceptable solution for relieving flooding at Shuen Wan. The need of the project and the consideration of alternative drainage options are discussed in details in Section 2.
- 7.133 The results of ecological surveys on terrestrial and marine ecological resources undertaken in this study identified 11 habitat types within the assessment area comprising rivers & streams, *Fung Shui* woodland, cultivated/abandoned land, developed/village areas, plantation/landscape planting, fishponds, shrubland, marshes, mangrove and marine habitats. The identified marshes, mangrove, *Fung Shui* woodland are considered to have moderate-high ecological value. The secondary woodland and marine habitat are of moderate ecological value while river and shrubland is low-moderate, and all other habitats were regarded as of low to very low value. A Conservation Area (CA) comprised of freshwater and intertidal marshland was identified within the proposed works area.
- 7.134 Three species of flora and fourteen fauna of conservation interest have been recorded from the Assessment Area.
- 7.135 An ecological impact assessment was conducted, based on a literature review and field surveys. Continuous ecological inputs were provided to the project design, to avoid and minimise ecological impacts as much as practicable. The key issue in terms of ecological impacts would involve habitat loss, direct impact on one flora species of conservation interest and indirect disturbance impacts to nearby habitats and the associated communities due to the proposed works.
- 7.136 Potential permanent habitat loss resulting from the proposed works would involve 0.3ha marsh margin, 0.08ha secondary woodland and approximately 30m natural stream habitat. The overall ecological impact to secondary woodland and natural stream would be low and that for marsh

habitat is considered low to moderate. To mitigate for the habitat loss, a low ecological value recreational fishpond area (approximately 0.8ha) adjacent to the marsh would be used to provide moderate-high ecological value compensatory habitats. The proposed compensatory habitat will form part of the scope of works under this drainage improvement project.

- 7.137 A few individuals of a plant species of conservation interest (Hong Kong Pavetta, *Pavetta hongkongensis*) would be affected by the proposed works and the impact to the species is rated as low to moderate. The affected individuals would be transplanted to a suitable nearby habitats prior to the construction phase. A detailed vegetation survey would be conducted to provide details for transplantation scheme. The transplantation procedure would be regularly monitored.
- 7.138 Disturbance impacts to habitats and associated communities adjacent to the works areas that could result from increased human activities/disturbance during the construction phase. Such impacts would arise from excavation work, noise-generating machinery, and general increases in human activity. Noise mitigation measures including the use of quiet construction plant, hoarding and temporary noise barriers would be implemented to minimise disturbance to habitats adjacent to the works areas.
- 7.139 With the implementation of the recommended mitigation measures, the residual ecological impact resulting from the proposed drainage improvement works would be very minor and environmentally acceptable. The implementation of all mitigation measures would be subject to regular audit.
- 7.140 Potential operational phase activities in newly box-culvert would be limited to regular maintenance such as de-silting. With mitigation measures in place, impacts to aquatic communities in the nearby water channel resulting from these activities are expected to be minor.

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8. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

Introduction

- 8.1 This Landscape and Visual Impact Assessment (LVIA) covers the proposed drainage improvement works to intercept part of the flow of the existing Wai Ha River at Tung Tsz Road near Tung Tsz Shan Road to the sea of Plover Cove. This section assesses the potential landscape and visual impact due to the construction and operation of the proposed work in accordance with the Environmental Impact Assessment Ordinance (EIAO).
- 8.2 **Figure 8.1** shows the location for the project. **Figure 8.2** shows an existing aerial view of Shuen Wan and Plover Cove area.

Project Description

- 8.3 The Project consists of drainage improvement works that would be carried out in various locations in and around Shuen Wan, Tai Po:
- Construction of a twin cells box-culvert along Tung Tsz Road;
 - Construction of a floodwater pumping station at Shuen Wan;
 - Replacement of a mechanical gate at Wai Ha River;
 - Construction of about 280m of relief drains in Wai Ha Village;
 - Construction of about 260m drainage pipe along Ting Kok Road.
- 8.4 Full description and justification for the need of the project is provided in **Section 2** of this EIA report.

Review of Planning and Development Control Framework

- 8.5 A review of the existing and planned development framework for the proposed works and for the surroundings has been considered. It aims to identify issues for the neighbouring planned land uses, to identify potential resources and sensitive receivers, and to ensure a high compatibility between the proposed works and the surroundings.
- 8.6 Approved Tai Po Outline Zoning Plan (OZP) No.: S/TP/19 and Draft Ting Kok OZP No.: S/NE-TK/11 has been examined. The works area is located within Green Belt (GB), Village Type Development (V), Conservation Area (CA) and Government / Institution / Community (G/IC). Agricultural (AGR) land, Site of Special Scientific Interest (SSSI) and Coastal Protection Area (CPA) is also found within the 300m Landscape Impact study area (refer to **Figure 8.3**).
- 8.7 There will be another Sewerage Project of title "Tolo Harbour Sewerage of Unsewered Areas Stage I Phase II" (hereinafter referred to as "the Sewerage Project") to be carried out in San Tau Kok Village, which is identified with possible interaction with the Project. Details refer to **Section 2** of this EIA report.

Environmental Legislation and Standards

- 8.8 The following are considered:
- Approved Tai Po OZP No.: S/TP/19 and Draft Ting Kok OZP No.: S/NE-TK/11 and the Town Planning Ordinance

- Environmental Impact Assessment Ordinance, Annexes 10 and 18 of Environmental Impact Assessment Ordinance (EIAO) Technical Memorandum and EIAO Guidance Note No. 8/2002 – setting up guidelines for preparation of Landscape and Visual Impact Assessment under EIAO.
- The Forests and Countryside Ordinance (Cap96) – prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on government land. Its subsidiary regulations prohibit the picking, felling or possession of listed rare and protected plant species
- The Forestry Regulations – made under Section 3 of the Forests and Countryside Ordinance (Cap. 96), defined the list of protected species in Hong Kong
- Government General Regulation 740 – sets out restrictions on the preservation and felling of trees in Hong Kong
- ETWB TCW No. 29/2004 Registration of Old and Valuable Trees and Guidelines for their Preservation – provides priority protection to the trees in the Register. Furthermore, the Government has already put in place a comprehensive range of administrative and legislative measures to preserve trees on Government land.
- ETWB TCW No. 5/2005 Protection of natural streams/rivers from adverse impacts arising from construction works – clarify and strengthen the existing measures for protection of natural streams / rivers from government projects and private developments
- ETWB TCW No.14/2004 Maintenance of Stormwater Drainage Systems and Natural Watercourses – sets out the departmental responsibilities for the maintenance of stormwater drainage systems and natural watercourses in government and private lands, as well as the main watercourses designated under the Land Drainage Ordinance
- ETWB TCW No. 2/2004 Maintenance of Vegetation and Hard Landscape Features – sets out the government departmental responsibilities for maintenance of vegetation and hard landscape features
- ETWB TCW No. 14/2002 Management and Maintenance of Natural Vegetation and Landscape Works, and Tree Preservation – defines and outlines the management and maintenance responsibilities for natural vegetation and landscape works, and the authorities for tree preservation and felling
- ETWB TCW No. 7/2002 Tree planting in Public Works – affirms the advocated policy on tree planting which adopts a flexible and balanced approach in the planning and design of public works
- DSD Technical Circular No. 2/2004 Protection of natural rivers and streams from adverse impacts arising from construction works – provides guidelines for the planning and execution of construction works
- Technical Report of Landscape Value Mapping in Hong Kong by Planning Department – establishes the essential landscape baseline information which provides a systematic reference framework to facilitate landscape assessment and broad environmental assessment of major projects at territorial level.

Methodology of Assessment of Landscape Impacts

8.9 The assessment of landscape impacts has adopted the following process:

- Identification of the baseline Landscape Resources (LR) and Landscape Character Area (LCA) found within the study boundary defined by the Study Brief. This was firstly prepared by desktop research study on aerial photos and topographical maps, then by site visits and photo-taking for verification.

- Assessment of “Sensitivity to Change” to the LR and LCA. This is affected by factors including: (i) whether the resource is common or rare; (ii) whether it is considered to be of local, regional, national or global importance; (iii) whether there are any statutory or regulatory limitations / requirements relating to the resource; (iv) the quality of the resource; (v) the maturity of the resource, and (vi) the ability of the resource to accommodate changes. Rating is classified as below:
 - High:** Important LR or LCA of particularly distinctive characteristics or high importance, and is sensitive to relatively small changes
 - Medium:** LR or LCA of moderate landscape characteristics and value, and is reasonably tolerant to change
 - Low:** LR or LCA with low landscape characteristics and value, and is largely tolerant to change

- Assessment of “Magnitude of Change” for landscape impacts. This is affected by factors including: (i) the physical extent of impact; (ii) the landscape context of impact and (iii) the time-scale of impact, such as whether it is temporary (short, medium or long term), permanent with reversible potentials, or irreversibly permanent. Magnitude of Change is separately considered for construction phase and operation phase. Rating is classified as below:
 - Large:** LR or LCA will suffer a major change.
 - Intermediate:** LR or LCA will suffer a moderate change.
 - Small:** LR or LCA will suffer a barely perceptible change.
 - Negligible:** LR or LCA will suffer no discernible change.

- Assessment of the “Impact Significance Threshold Before Mitigation” for landscape impacts. The assessment of landscape impacts during construction and operation is produced by synthesizing the “Sensitivity to Change” and “Magnitude of Change” for various LR and LCA according to **Table 8.1**. The degree of significance is divided into four thresholds, depending on the combination:
 - Substantial:** Adverse / beneficial impact where the proposal will cause significant deterioration or improvement in existing landscape quality
 - Moderate:** Adverse / beneficial impact where the proposal will cause a noticeable deterioration or improvement in existing landscape quality
 - Slight:** Adverse / beneficial impact where the proposal will cause barely perceptible deterioration or improvement in existing landscape quality
 - Insubstantial:** No discernible change in the existing landscape quality

Table 8.1 Matrix for Impact Significance Threshold Before Mitigation: Relationship between Sensitivity to Change and Magnitude of Change

Sensitivity To Change Magnitude of Change	Low	Medium	High
Large	Slight/Moderate	Moderate/Substantial	Substantial
Intermediate	Slight/Moderate	Moderate	Moderate/Substantial
Small	Insubstantial /Slight	Slight/Moderate	Slight/Moderate
Negligible	Insubstantial	Insubstantial	Insubstantial

- Identification of potential Mitigation Measures. This part is also separated into construction phase and operation phase, with proposing measures for preventing or minimizing unavoidable adverse impacts and / or generating beneficial long-term impacts. A table for the mitigation measures is provided. The relevant department responsible for the funding/ implementation and management/ maintenance of the mitigation measures are also identified.
- Identification of “Residual Impact Significance Threshold After Mitigation” for landscape impacts. This part indicates the accumulative influence to LR and LCA after applying mitigation measures, with an assumption that all proposed measures and guidelines will be fully implemented. Like the “Impact Significance Before Mitigation”, the rating has been divided into the construction phase and operation phase.

Methodology of Assessment of Visual Impacts

8.10 The assessment of visual impacts has adopted the following process:

- Identification of Zones of Visual Influence (ZVI) and Visually Sensitive Receivers Groups (VSRs) during construction and operation. A ZVI has been established by a desktop study of topographic maps, street maps, photographs and site visits to determine the possible VSRs at different locations.
- Assessment of the “Sensitivity to change” of the VSRs. Factors include:
 - The type of VSRs, such as viewers who are residents, workers, road travellers or recreation engagers. Those people viewing from home are considered to be highly sensitive because the view directly affects their general quality of daily life. Those people viewing from their workplace are considered to be only moderately sensitive as it is less important factor for their quality of life. The degree however depends on whether the workplace is industrial, retail or commercial. Those people who take part in outdoor leisure activity may have varying sensitivity depending on the type of recreation. Those people who are travelling on roads or streets will also have varying sensitivity depending on the speed of travel.
 - Population of viewers. This is to consider the overall population of viewers in the VSRs.

- Other factors to be considered (as required by EIAO GN 8/2002) include the value and quality of existing views, the availability and amenity of alternative views, the duration and frequency of view, and the degree of visibility.
- Rating for “Sensitivity to change” of the VSRs is classified as below:
 - High:** The VSR is highly sensitive to any change in their viewing experience.
 - Medium:** The VSR is moderately sensitive to any change in their viewing experience.
 - Low:** The VSR is only slightly sensitive to any change in their viewing experience.
- Assessment of the potential “Magnitude of Impact”. Factors include:
 - the compatibility with the surrounding landscape
 - the duration of the impact
 - the reversibility of the impact
 - the scale of the impact and distance of the source of impact from the viewer
 - the degree of visibility of the impact, and the degree to which the impact dominates the field of vision of the viewer.
- The magnitude of visual impacts during different stages of construction and during operation has also been separately considered, with rating as below:
 - Large:** The VSRs would suffer a major change in their viewing experience.
 - Intermediate:** The VSRs would suffer a moderate change in their viewing experience.
 - Small:** The VSRs would suffer a small change in their viewing experience.
 - Negligible:** The VSRs would suffer no discernible change in their viewing experience.
- Prediction of “Impact Significance Threshold Before Mitigation” for visual impacts. Same as that for the landscape impact assessment, it aims to synthesize the “Sensitivity to Change” and “Magnitude of Change” for various VSRs according to **Table 8.1** to assess the visual impacts in a matrix. The degree of significance has been divided into four thresholds again:
 - Substantial:** Adverse / beneficial impact where the proposal would cause significant deterioration or improvement in existing visual quality
 - Moderate:** Adverse / beneficial impact where the proposal would cause a noticeable deterioration or improvement in existing visual quality
 - Slight:** Adverse / beneficial impact where the proposal would cause barely perceptible deterioration or improvement in existing visual quality
 - Insubstantial:** No discernible change in the existing visual quality
- Identification of potential Mitigation Measures. This part is also separated into construction phase and operation phase, with proposing measures for preventing or minimizing unavoidable adverse impacts and / or generating beneficial long-term impacts. A table for the mitigation measures is provided. The agencies responsible for the funding/ implementation and management/ maintenance of the mitigation measures are also identified.

- Identification of “Residual Impact Significance Threshold After Mitigation” for visual impacts. This part indicates the accumulative influence to VSRs after applying mitigation measures, with an assumption that all proposed measures and guidelines will be fully implemented. Like the “Impact Significance Before Mitigation”, the rating has been divided into the construction phase and operation phase.
- Preparation of Photomontage. To illustrate and compare the visual impact of proposed works with and without mitigation, computer-simulated views (i.e., photomontages) from selected VSRs have been generated. Photomontages after mitigation at Day 1 and at Year 10 have also been produced.

Baseline Study

- 8.11 Landscape baseline review comprises of the identification of all existing Landscape Resources (LR) and Landscape Character Areas (LCA) within 300m from the project. They are mapped in **Figures 8.4** and **8.10**. Illustrative photos showing them are presented in **Figures 8.5** to **8.9** (for LR) and **Figures 8.11** to **8.13** (for LCA). In terms of the visual aspect, Visually Sensitive Receivers (VSRs) within the Zones of Visual Influence (ZVI) of the project are mapped in **Figures 8.14**. Illustrative photos showing them are presented in **Figures 8.15** to **8.19**, and the views from each VSR are presented in **Figures 8.20** to **8.23**.

Landscape Resource

- 8.12 There are a variety of landscape resources within the study boundary. Due to the natural to semi-natural environment, for many LRs, reference should be made to the Ecology section (**Section 7** of this EIA report). LRs are identified and described as follows:

LR1 – Roadside Amenity Planting

- 8.13 This LR is a combination of ornamental to semi-natural vegetation along roads for aesthetics, with area approx. 1.3ha. It consists of both native and exotic species, including *Albizia lebbek*, *Bauhinia* spp., *Bombax malabaricum*, *Casuarina equisetifolia*, *Celtis sinensis*, *Ficus* spp., *Macaranga tanarius*, *Melaleuca leucadendron*. Many of the trees seems quite young and small, probably planted in recent years after various roadworks and utility works along Ting Kok Road. Therefore, the sensitivity to change is Low.

LR2 – Nursery

- 8.14 This LR refers to the planting found within the Tung Tsz Nursery operated by LCSD near the junction between Ting Kok Road and Tung Tsz Road, with area approx. 3.2ha. It consists of a mix of common, native and exotic trees and palms. Since the trees are not mature nor with special landscape quality, the sensitivity to change is Low.

LR2A – Open Space Planting

- 8.15 This LR refers to the planting found within a small public children playground operated by LCSD near the junction between Ting Kok Road and Tung Tsz Road, with area approx. 0.09ha. It consists of a mix of common, native and exotic trees and palms. Since the trees are not mature nor with special landscape quality, the sensitivity to change is Low.

LR3 – Disturbed Vegetation and Farmland

- 8.16 This LR consists of mostly vegetation found within and among villages and farmlands, of which a large fraction has been abandoned and overgrown with grasses and low groundcovers, with area approx. 22.4ha. Some trees are planted for ornamental and fruiting purposes while some are self-seeded on disturbed land. Trees are few as most areas have been occupied by houses or hardpaved. Tree species include *Bauhinia* spp., Banana trees, *Celtis sinensis*, *Cinnamomum* spp., *Dimocarpus longan*, *Leucaena leucocephala*, *Macaranga tanarius*, and *Schefflera* spp.. Since the trees are not mature nor with special landscape quality, the sensitivity to change is Low.

LR4 – Manmade Slope Vegetation

- 8.17 This LR consists of vegetation on stabilized or enhanced slopes, dominated by woodland mix common to Hong Kong's public manmade slopes, with area approx. 2.9ha. Since the trees are not mature nor with special landscape quality, the sensitivity to change is Low.

LR5 – Shrubland

- 8.18 This LR refers to areas comprised of mostly shrubs and grasses with few trees, with area approx. 7.5ha. Since the vegetation are not mature nor with special landscape quality, the sensitivity to change is Low.

LR6 – Secondary Woodland

- 8.19 This LR consists of rather mature woodlands with certain degree of human disturbances, which are more visible for areas closer to the villages, with area approx. 7.5ha. There are a variety of trees species, including *Machilus* spp., *Castanopsis fissa*, *Ficus* spp., *Cinnamomum camphora*, *Bischofia trifoliata*, *Sapium* spp., *Litsea* spp., *Sterculia lanceolata*, *Dimocarpus longan*, *Ilex* spp., *Antidesma* spp.. Two species of conservation interest were recorded from this habitat, including the protected shrub *Pavetta hongkongensis*, and the IUCN listed tree *Aquilaria sinensis*. The sensitivity to change is therefore High.

LR6A – Disturbed Woodland

- 8.20 This LR is a subset of LR6; it is likely to be the remains of part of the larger woodlands in the area, with area approx. 2.3ha. Its vegetation maturity and species pattern resembles those in LR6, except these woodlands are smaller in size and are isolated by years of developments of villages, farmlands, roads, and slope works. There also apparent human disturbances, such as erection of temporary shelters and planting of fruit trees, inside the woodlands. Some *Dimocarpus longan* have grown quite large in size, suggesting human disturbances years ago when the land was first inhabited for agricultural uses. The sensitivity to change is therefore Medium.

LR7 – Fung Shui Woodland

- 8.21 This LR consists of mature woodlands located near villages and referred by villagers to have "fung shui" significance, with area approx. 2.7ha. Trees are mostly *Cinnamomum camphora*, along with other species including *Machilus* spp., *Schefflera* spp., *Macaranga tanarius*, *Ficus variegata*, *Ficus hispida*, and *Sterculia lanceolata*. Two species of conservation interest were recorded from this habitat, including the protected shrub *Pavetta hongkongensis*, and the IUCN listed tree *Aquilaria sinensis*. The sensitivity to change is hence High.

LR8 – Fish Pond

- 8.22 This LR refers to fishponds that have been abandoned or used for recreational purposes, with area approx. 4.0ha. There are very few trees along the edge of the water. Since the vegetation are not mature nor with special landscape quality, the sensitivity to change is Low.

LR9 – Marsh and Stream

- 8.23 This LR consists of natural to semi-natural brackish marshes, which are formed by a combination of effects from nature and human, with area approx. 12.2ha. The marshes are fed by a small natural to semi-natural stream run across the study boundary and also by probably salt water pressed in by high water table. The marshes may be once fish ponds now abandoned. They are large in size with few trees. The edge of the marsh along Tung Tsz Road is relatively raised and dry, with mostly grasses and occasional trees, including *Hibiscus tiliaceus* and *Leucaena leucocephala*. There are also some occasional soil berms, probably from previous fish pond dragging. The marshes fall within the boundary of a Conversation Area. Reference to the Ecology section (**Section 7** of this EIA report) should be made for this particular LR. The sensitivity to change is therefore High.

LR10 – Mangrove

- 8.24 This LR consists of a part of the larger mangrove habitat system (including Ting Kok SSSI) extended outside the study boundary along the shore of Plover Cover, with area approx. 1.2ha. Although the mangrove trees are generally small in size, there are a high variety of species, suggesting the sensitive nature of the LR. Reference to the Ecology section of this EIA report should be made for this particular LR. The sensitivity to change is therefore High.

LR11 – Natural Seashore

- 8.25 This LR consists of an extensive area of natural seaside vegetation, shallow shores and beaches with aggregate textures from coarse sand to cobbles with slight to little human disturbances, with area approx. 1.1ha. Tree species are mostly *Hibiscus tiliaceus* and *Macaranga tanarius* with a mix of grasses and low groundcovers further inland. There have been some slight human disturbances. The sensitivity to change is therefore High.

LR12 – Manmade Seashore

- 8.26 While most of the seashore is natural, a manmade rocky seashore is found along the proposed concrete pipe, with area approx. 0.4ha. It may be formed during the construction or widening of Ting Kok Road years ago. Planted to self-seeded vegetation has occupied the planting verge between Ting Kok Road and the rocky seashore. Tree species are similar to that in LR11. Since the vegetation are not mature nor with special landscape quality, the sensitivity to change is Low.

Landscape Character Area

- 8.27 The Study Area is located in a sub-urban environment with village settlement clustered along roads and with high-quality naturalistic environment at Plover Clove. The overall landscape character is generally tranquil with view to the hilly landscape of Pat Sin Leng as background. LCAs are identified and described as follows:

LCA1 – Naturalistic Sea Bay

- 8.28 Fresh air, calm sea, and coastlines of mangroves, beaches, and small seaside woodlands characterize the natural beauty of the place. The space is open, defined by the horizon, distant islands and hilly landscape of Pat Sin Leng. Often screened by seaside vegetation from Ting Kok Road, the area feels separated from human disturbance. Since it is considered as distinctive character, the sensitivity to change is High.

LCA2 – Suburban Road

- 8.29 Ornamental to semi-natural roadside vegetation, gentle vehicular traffic, occasional stores, village houses, and low-density residential developments characterize this section of Ting Kok Road. With a cycle track running continuously further down Ting Kok Road to Tai Mei Tuk where several bicycle rental shops are located, the area is a favourite cycling route during weekends. The space gives a

strong sense of suburban environment. Since the area is reasonably tolerant to change, the sensitivity is Medium.

LCA3 – Marshes and Fish Ponds

- 8.30 This LCA is dominated by abandoned fish ponds and natural to semi-natural brackish marshes. Due to its relative flat topography and low vegetation, the area provides open view to the surroundings beyond the study boundary. With significant bird gathering at certain seasons, the space is uncommon in Hong Kong and somewhat spiritual. Since it is considered as distinctive character, the sensitivity to change is High.

LCA4 – Villages

- 8.31 The area is dominated by semi-natural, disturbed vegetation, villages typical to New Territories and revegetated manmade slopes. Developments are located along the road up the hill with occasional small roads T-out to reach small clusters of village houses behind vegetation, giving a sense of uncertainty. There has been fast growing of village houses within the neighbourhood, cutting into existing vegetation. The area is somewhat poorly maintained with occasional soil dumping, construction activities, incomplete roadworks, giving a sense of untidiness. Since the area is largely tolerant to change, the sensitivity is Low.

LCA5 – Natural Hillside

- 8.32 This LCA is characterized by hills with steep topography, limited access and relatively lower human activities/ disturbances. As a 'background' landscape, it makes an important contribution to the overall semi-natural environment of the villages. Since it is considered as distinctive character, the sensitivity to change is High.

Visually Sensitive Receiver

- 8.33 The proposed works will be visible from a number of locations in the Plover Cove area and even from as far as Pat Sin Leng. However, due to relative small scale of works, a distant VSR may not be able to perceive the works even a line of sight exists. Existing vegetation, low-lying topography and linear nature of the proposed works also decrease the visibility. No VSR will be able to view at the same time the proposed box culvert and the pump house/ concrete pipe along the shore. VSRs are identified and described as follows:

VSR1- Sam Mun Tsai

- 8.34 This VSR consists of mainly residents of village houses and low-density developments in Sam Mun Tsai, including Springdale Garden and Luen Yick Fishermen Village. There are also some weekend visitors and local tourists to the areas. It will have a distant view to the proposed pump house and concrete pipe along the shore of Plover Cove, but no view to the box culvert. Some of the view is blocked by topography near Shuen Wan Chim Uk. The population of sensitive receivers is Low. Sensitivity is Medium.

VSR2- Villages at Wai Ha

- 8.35 This VSR consists of mainly villagers at Wai Ha houses and travellers along Tung Tsz Road, which leads to Tung Tsz Scout Centre and other villages further up the hill. It will have a full, close view to the construction of the proposed box culvert, but no view to the proposed pump house and concrete pipe along the shore. The population of sensitive receivers is Low. Sensitivity is Low.

VSR3 – Villa Paloma

- 8.36 Residents of the low-density development Villa Paloma are particularly identified. The VSR has a high-quality naturalistic open view to Plover Cove and distant hilly landscape of Pat Sin Leng. It will have a clear view to the proposed concrete pipe along the shore, a partial view to the proposed pump house and no view to the construction of the proposed box culvert. The population of sensitive receivers is Low but the sensitivity is High.

VSR4 – Northwest Shore of Plover Cove

- 8.37 This VSR consists of infrequent local people to the shoreline for sightseeing, bird watching, fishing and clam-picking (which may be, of course, not appropriate within SSSI). It has a high-quality naturalistic view to the shoreline, beaches, mangroves and landscapes in the Plover Cove area. It will have a full clear view to the concrete pipe along the shore, a partial view to the proposed pump house and no view to the construction of the proposed box culvert. The population of sensitive receivers is Low and the sensitivity is Low too.

VSR5 – Ting Kok Road near Tung Tsz Nursery

- 8.38 This VSR consists of road-users of Ting Kok Road, which leads further down the road to various natural attractions of New Territories northeast. Due to existing vegetation growth along the shore, there are in fact quite few spots along the road that have open view to Plover Cove. It will have a full, close view to the proposed pump house, and partial view to the construction of the proposed box culvert and the concrete pipe along the shore. The population of sensitive receivers is moderate. Sensitivity is Medium.

VSR6 – Northeast Shore of Plover Cove

- 8.39 This VSR consist of infrequent local people getting to the shore for sightseeing, bird watching and fishing. It has a similar high-quality view to the surroundings like VSR4. It will have a full but distant view to the proposed pump house and no view to the construction of the proposed box culvert. The population of sensitive receivers is low. Sensitivity is Low.

VSR7 – Villages at San Tau Kok

- 8.40 The nature of this VSR is similar to that of VSR2, except it has views to existing wetlands, which increases the overall visual quality. It is also more populated than VSR2, and the sensitivity is High.

VSR8 – Ma Shi Chau & Yeung Chau

- 8.41 This VSR consists of infrequent hikers, campers, fishermen and yachters, who get to these islands. It has high-quality naturalistic view to the Plover Cove area. The receiver population is low, and the sensitivity is Low.

VSR9 – Tai Mei Tuk

- 8.42 This VSR consists of mostly local tourists and users of the water sport centre within. It is a favourite spot for families and friends and the area can get quite crowd during weekends. It has high-quality naturalistic view to the Plover Cove area. Although a line of sight exists, the viewing distance to the proposed work is too large to perceive. Sensitivity is Medium.

VSR11 – Plover Cove

- 8.43 This VSR consists of recreational users of the sea of Plover Cove. Boat-riding and yachting can become quite frequent during weekends. It has high-quality naturalistic view to the Plover Cove area. The receiver population is somewhat low on average. Sensitivity is Medium.

Landscape Impact Assessment (Before Mitigation)

8.44 A broad tree survey was conducted. Based on the preliminary design of the Project and the tree survey results, there would be 290 trees affected, 99 trees felling, 168 trees retained and 23 trees transplanted. There is no Old and Valuable Tree in the project area. The broad tree survey results including the tree survey schedules and plans are provided in **Appendix 8.1** for reference.

8.45 Impact to Individual LR or LCA is described below:

LR1 – Roadside Amenity Planting

8.46 Since there is only a small physical extent (approx. 0.01ha) to be affected during construction and operation, the magnitude of change is Small and hence the impact is Slight.

LR2 – Nursery

8.47 The proposed box culvert will cut through the existing nursery, causing disturbance of approx. 0.23ha for the area of resources. The magnitude of change during construction would be Large, inducing a Moderate impact. During operation, as the box culvert will be underground and will even support the growth of the trees, the nursery's operation can be restored, resulting in Intermediate magnitude of change, and therefore Slight impact.

LR2A – Open Space Planting

8.48 No work is carried out within this LR. However, in view of locating close to the proposed work and might be slightly affected by the construction work, the magnitude of change would be Small during construction and the impact would be Slight. During Operation, the magnitude of change would be Negligible and impact would be Insubstantial.

LR3 – Disturbed Vegetation and Farmland

8.49 0.2ha of the area is affected by the proposed work. Therefore the magnitude of change is Intermediate during construction. However, since the sensitivity would be Low, the impact during construction would be Slight. During operation, natural colonization of vegetation will take place, therefore, the magnitude of change would be Small and impact would be Slight also.

LR4 – Manmade Slope Vegetation

8.50 No work is carried out within this LR, therefore the magnitude of change is Negligible and the impact is also Insubstantial.

LR5 – Shrubland

8.51 No work is carried out within this LR, therefore the magnitude of change is Negligible and the impact is also Insubstantial.

LR6 – Secondary Woodland

8.52 No work is carried out within this LR, therefore the magnitude of change is Negligible and the impact is also Insubstantial.

LR6A – Disturbed Woodland

8.53 Despite years of development and disturbance from village development, a strip of existing woodland remains along a stream (or along Tung Tsz Road) near Wai Ha Village remains. This small strip of woodland (approx. 0.17ha) will be affected by the construction of the proposed box culvert. Trees will need to be either felled or transplanted. However, as the area is relatively small

and the LR is of Medium sensitivity, the magnitude of change during construction would be Intermediate, and the impact to the LR shall be Moderate as a whole. During operation, the permanent loss of vegetation will continue to induce Intermediate magnitude of change, and hence Moderate impact also.

LR7 – Fung Shui Woodland

- 8.54 No work is carried out within this LR, therefore the magnitude of change is Negligible and the impact is also Insubstantial.

LR8 – Fish Pond

- 8.55 No work is carried out within this LR. However, in view of locating close to the proposed work and might be slightly affected by the construction work, the magnitude of change would be Small during construction and the impact would be Slight. During Operation, the magnitude of change would be Negligible and impact would be Insubstantial.

LR9 – Marsh and Stream

- 8.56 The proposed construction will affect the edge of the marsh (approx. 0.38ha) where currently covered by mostly grasses and few small trees. Without proper mitigations, it may contaminate the water, affecting the sensitive ecosystem of the entire marshes. The magnitude of change would be Large and hence the impact during construction shall be Substantial. The proposed works will cause an immediate loss of existing vegetation along the edge of the marsh. But due to the small number of trees involved, the magnitude of change would be Intermediate and hence impact during operation shall be Moderate.

LR10 – Mangrove

- 8.57 No work is carried out within this LR. However, in view of locating close to the proposed work and might be slightly affected by the construction work, the magnitude of change would be Small during construction and the impact would be Slight. During Operation, the magnitude of change would be Negligible once the construction activities ceased and impact would be Insubstantial.

LR11 – Natural Seashore

- 8.58 A small part of the pumping station and rising mains connected to outfall would be located within this area, causing disturbance to the resources for less than 0.005ha. The magnitude of change is Small during construction, and hence the impact is Slight. During operation, the magnitude of change would be Negligible once the construction activities ceased and impact would be Insubstantial.

LR12 – Manmade Seashore

- 8.59 Existing rocky seashore and seaside vegetation from the proposed pump house to the proposed mechanical gate (approx. 0.19ha) will be affected by the proposed concrete pipe. Existing dense tree groups, mostly *Hibiscus tiliaceus* and *Macaranga tanarius* will be affected, inducing Large magnitude of change, and hence Moderate impact during construction. Trees will need to be either felled or transplanted. During operation, the permanent loss of vegetation will continue to induce Large magnitude of change and Moderate impact also.

LCA1 – Naturalistic Sea Bay

- 8.60 The construction of the proposed concrete pipe and pump house near the shore will affect the naturalistic and tranquil nature of Plover Cove. The magnitude of change would be intermediate during construction stage, inducing Moderate impact. As soon as the construction equipments are removed from the site and construction activities cease during operation, the character will restore.

The magnitude of change for LCA1 during operation phase would be small. During operation phase, the project would only induce Slight impact.

LCA2 – Suburban Road

- 8.61 The proposed construction will be highly visible from Ting Kok Road, affecting its suburban, semi-natural character. It will affect holiday cyclists, inducing Intermediate magnitude of change, and therefore Moderate impact. During operation, the placement of a relatively small pump house will not affect the character. The permanent loss of existing vegetation along the proposed concrete pipe will induce Small magnitude of change, and hence only Slightly affect the character, because the road will continue to have a view to the naturalistic sea of Plover Cove.

LCA3 – Marshes and Fish Ponds

- 8.62 The construction of the proposed box culvert will heavily affect the character as a bird sanctuary, inducing Large magnitude of change and hence Substantial impact. Upon completion of works (i.e. during operation phase), the proposed works would cause some permanent loss of the marshes along the edge. As the change would only be limited to the periphery of the marsh area, this may not heavily affect the character as long as construction ceases. Hence the magnitude of change would be Small, and the impact will only be Slight/Moderate.

LCA4 – Villages

- 8.63 The construction of the proposed box culvert will affect the character of village, inducing Intermediate magnitude of change. However, since the sensitivity is Low, the impact would be Slight. During operation, the proposed work will cause some permanent loss of the vegetation, which may slightly affect the character. The magnitude of change would be Small, and the impact will only be Insubstantial.

LCA5 – Natural Hillside

- 8.64 No work is carried out within this LCA, therefore the magnitude of change is Negligible and the impact is also Insubstantial.

Visual Impact Assessment (Before Mitigation)

- 8.65 Impact to the individual VSR is described below:

VSR1 – Sam Mun Tsai

- 8.66 There is only distant partial to glimpse view to the pump house and concrete pipe for this VSR. Since the construction work would be small in scale when viewing from a distance, the magnitude of change during construction would be Small, resulting in Slight impact. During operation, the concrete pipe and pump house is even less noticeable, therefore, the magnitude of change would be Negligible, and hence the impact would be Insubstantial.

VSR2 – Villages at Wai Ha

- 8.67 The proposed drain pipe and box culvert would be located in close vicinity to this VSR, inducing Large magnitude of change during construction. However, since the sensitivity is Low, resulting in Slight impact only. During operation, since the drain pipe is less noticeable and the box culvert is underground, inducing only Small magnitude of change and Slight impact also.

VSR3 – Villa Paloma

- 8.68 The residences have tall windows and balconies orientated towards the proposed pump house and concrete pipe along the shore. The construction will disrupt the tranquil, naturalistic view to the shore, imposing Large magnitude of change, and hence Substantial impact. The removal of existing

vegetation along the shore for the concrete pipe will also expose Ting Kok Road to the VSR. During operation, as the underground concrete pipe will cause planting of trees impossible, Ting Kok Road will continue be exposed to the VSR, imposing Intermediate magnitude of change, and hence Moderate impact.

VSR4 – Northwest Shore of Plover Cove

- 8.69 The VSR will have a close partial to full view of the pump house and concrete pipe during construction and operation, imposing Intermediate magnitude of change. However, since the sensitivity is Low, the overall impact would only be Slight.

VSR5 – Ting Kok Road near Tung Tsz Nursery

- 8.70 The VSR will have a clear view to the construction, which will affect the semi-countryside feeling of Ting Kok Road. The construction will also replace some existing vegetation and amenity planting between the road and the shoreline with construction activities, inducing Large magnitude of change, and therefore, Moderate impact. During operation, as the underground concrete pipe will cause planting of trees impossible, also inducing Large magnitude of change and Moderate visual impact. However, the removal of existing vegetation may also cause Ting Kok Road to have better view outlook to Plover Cove. To some people, this may somewhat be beneficial because there are actually few locations along this section of Ting Kok Road that one can view the sea of Plover Cove.

VSR6 – Northeast Shore of Plover Cove

- 8.71 There would be a distant partial to full view to the construction of concrete pipe and pump house for this VSR, imposing Intermediate magnitude of change. However, since the sensitivity is Low, the overall impact would be Slight only. During construction, the pump house and concrete pipe is less noticeable, resulting in Small magnitude of change and Slight impact.

VSR7 – Villages at San Tau Kok

- 8.72 This VSR have a close full view of the construction of the box culvert, which will be rather visually incompatible with the existing wetlands in the background. The magnitude of change would be Intermediate and the VSR will suffer from Moderate impact. During operation, although the proposed box culvert will be underground, some existing vegetation will permanently lost, inducing Small magnitude of change. Since the sensitivity is High, Moderate impact is resulted.

VSR8 – Ma Shi Chau & Yeung Chau

- 8.73 This VSR have a very distant glimpse to full view towards the pump house and concrete pipe. Like VSR 1, there would be Small magnitude of change and Slight impact during construction, and Negligible magnitude of change and Insubstantial impact during operation.

VSR9 – Tai Mei Tuk

- 8.74 This VSR have a very distant glimpse to full view towards the pump house and concrete pipe. Like VSR 1, there would be Small magnitude of change and Slight impact during construction, and Negligible magnitude of change and Insubstantial impact during operation.

VSR11 –Plover Cove

- 8.75 The proposed concrete pipe will be aligned perpendicular to typical views from the sea surface of Plover Cove. The VSR will have a clear panoramic view to the construction, which affect the tranquil, naturalistic view to the shoreline. The magnitude of change would be Intermediate and the VSR will suffer from Moderate impact. During operation, as construction activities cease, the magnitude of change would reduce to Small, and hence visual impact will be substantially reduced to Slight.

Table 8.2 Significance of Landscape Impacts Before Mitigation

Identity No.	LR/ LCA	Sensitivity to Change (Low, Medium, High)	Magnitude of Change BEFORE Mitigation (Negligible, Small, Intermediate, Large)		Impact Significance Threshold BEFORE Mitigation (Insubstantial, Slight, Moderate, Substantial)	
			Construction	Operation	Construction	Operation
LR1	Roadside Amenity Planting	Low	Small	Small	Slight	Slight
LR2	Nursery	Low	Large	Intermediate	Moderate	Slight
LR2A	Open Space Planting	Low	Small	Negligible	Slight	Insubstantial
LR3	Disturbed Vegetation and Farmland	Low	Intermediate	Small	Slight	Slight
LR4	Manmade Slope Vegetation	Low	Negligible	Negligible	Insubstantial	Insubstantial
LR5	Shrubland	Low	Negligible	Negligible	Insubstantial	Insubstantial
LR6	Secondary Woodland	High	Negligible	Negligible	Insubstantial	Insubstantial
LR6A	Disturbed Woodland	Medium	Intermediate	Intermediate	Moderate	Moderate
LR7	Fung Shui Woodland	High	Negligible	Negligible	Insubstantial	Insubstantial
LR8	Fish Pond	Low	Small	Negligible	Slight	Insubstantial
LR9	Marsh and Stream	High	Large	Intermediate	Substantial	Moderate
LR10	Mangrove	High	Small	Negligible	Slight	Insubstantial
LR11	Natural Seashore	High	Small	Negligible	Slight	Insubstantial
LR12	Manmade Seashore	Low	Large	Large	Moderate	Moderate
LCA1	Naturalistic Sea Bay	High	Intermediate	Small	Moderate	Slight
LCA2	Suburban Road	Medium	Intermediate	Intermediate	Moderate	Slight
LCA3	Marshes and Fish Ponds	High	Large	Small	Substantial	Slight
LCA4	Villages	Low	Intermediate	Small	Slight	Insubstantial
LCA5	Natural Hillside	High	Negligible	Negligible	Insubstantial	Insubstantial

Table 8.3 Significance of Visual Impacts Before Mitigation

Identity No.	VSR	Degree of Visibility of Source(s) of Visual Impact (glimpse, partial, full)		Minimum Distance Between VSR & Source(s) of Impact (m)		Receptor Sensitivity (Low, Medium, High)	Magnitude of Change in View BEFORE Mitigation (Negligible, Small, Intermediate, Large)		Impact Significance Threshold BEFORE Mitigation (Insubstantial, Slight, Moderate, Substantial)	
		Box Culvert	Pump House & Concrete Pipe	Box Culvert	Pump House & Concrete Pipe		Construction	Operation	Construction	Operation
VSR1	Sam Mun Tsai	No View	Partial to Glimpse	-	950m	Medium	Small	Negligible	Slight	Insubstantial
VSR2	Villages at Wai Ha	Full	No View	Close	-	Low	Large	Small	Slight	Slight
VSR3	Villa Paloma	No View	Partial to Full	-	Close	High	Large	Intermediate	Substantial	Moderate
VSR4	Northwest Shore of Plover Cove	No View	Partial to Full	-	Close	Low	Intermediate	Intermediate	Slight	Slight
VSR5	Ting Kok Road near Tung Tsz Nursery	Partial	Partial to Full	Close	Close	Medium	Large	Large	Moderate	Moderate
VSR6	Northeast Shore of Plover Cove	No View	Partial to Full	-	950m	Low	Intermediate	Small	Slight	Slight
VSR7	Villages at San Tau Kok	Full	No View	Close	-	High	Intermediate	Small	Moderate	Moderate
VSR8	Ma Shi Chau & Yeung Chau	No View	Glimpse to Full	-	2350m	Low	Small	Negligible	Slight	Insubstantial
VSR9	Tai Mei Tuk	No View	Glimpse	-	2250m	Medium	Small	Negligible	Slight	Insubstantial
VSR11	Plover Cove	No View	Full	-	Close	Medium	Intermediate	Small	Moderate	Slight

Recommended Landscape and Visual Mitigation Measures

- 8.76 Recommended mitigation measures, which are applicable to individual LR, LCA and VSR, are tabulated in **Table 8.4**, together with an indication of the responsible parties for funding, implementation, management and maintenance.
- 8.77 Mitigation measures during construction will be implemented from the commencement of the works and shall be applied for the whole duration of the construction period. Mitigation measures during operation will be included in the detailed design and shall be constructed or built up during the construction. All mitigation measures will be funded by DSD and implemented by the contractors. Management and maintenance for all mitigation measures will follow ETWB TCW No. 2/2004 Maintenance of Vegetation and Hard Landscape Features.
- 8.78 The total number of compensatory trees planted in the project area shall not be less than 1:1 ratios by new trees. Required numbers and locations of compensatory trees would be determined and agreed with Government during the tree felling application process under ETWCTC 3/2006.
- 8.79 Mitigation measures for the operation phase are shown on Conceptual Landscape Plan with Mitigation Measures (refer to **Figure 8.29**)

Residual Impacts

- 8.80 The potential residual landscape and visual impacts during construction and operation (for Day 1 operation and Year 10 operation) after mitigation are provided in **Table 8.5** to **Table 8.6**.
- 8.81 With mitigation measures, landscape and visual impact during construction and operation will be mostly Insubstantial to Slight, except for **LR9 – Marsh and Stream**, **LCA3 – Marshes and Fish Ponds**, and **VSR3 – Villa Paloma**, during construction. Even with mitigation measures, the loss of vegetation for the sensitive ecosystem in LR9 and the character as a bird sanctuary for LCA3 is still largely affected, and resulting in Moderate landscape impact during construction. The disruption of the tranquil, naturalistic view to the shore for VSR3 is unavoidable, resulting in Moderate visual impacts during construction. Once the construction activities cease and all mitigation measures are implemented, impacts of all LR, LCA and VSR would reduce to Insubstantial to Slight for Year 10 operation.
- 8.82 The residual impacts for LR and LCA during construction and operation are mapped in **Figure 8.30** to **Figure 8.33** for easy reference.

Photomontage of Residual Visual Impact

- 8.83 Photomontages of Residual Visual Impact for Day 1 and for Year 10 after mitigation are illustrated in **Figure 8.25 – Figure 8.28**, while a photomontage showing the compensatory plantings along Tung Tsz Road is illustrated in **Figure 8.34**. The locations of the view of the photomontages are mapped in **Figure 8.24**.

Conclusion

- 8.84 After mitigation, the proposed works would result in moderate residual landscape impacts would be expected at LR9 (i.e. Marsh and Stream) and LCA3 (i.e. Marshes and Fish Ponds), and moderate residual visual impact at VSR3 Villa Paloma during construction phase.
- 8.85 Upon completion of the proposed works and after mitigation, there will be only Insubstantial to Slight residual landscape and visual impacts.
- 8.86 With reference to criteria defined in Annex 10 of the EIAO TM, landscape and visual impacts in the construction and operational phases will be **acceptable after applying mitigation measures**.

Table 8.4 Recommended Landscape and Visual Mitigation Measures

ID No.	Landscape and Visual Mitigation Measure	Funding	Implementation	Management	Maintenance
	CONSTRUCTION				
CM-01	<u>Visual Screen</u> – Hoardings shall serve as visual screen for the construction in certain area. They shall be properly designed to be compatible to the surroundings.	DSD	Contractor	-	-
CM-02A	<u>Contaminant/ Sediment Control</u> – Suitable temporary barriers, covers and drainage provisions shall be provided around construction works to avoid discharge of contaminants (such as bleeding from in-situ concrete works) and sediments into sensitive water-based habitats including marshes, fish ponds and mangroves.	DSD	Contractor	-	-
CM-02B	<u>Pollution control</u> - The implementation of environmental pollution control measures, such as those for controlling water quality and ecological impacts as illustrated in Sections 5 and 7, to minimise any adverse impacts to the surrounding habitats.	DSD	Contractor	-	-
CM-03	<u>Liaison with Nursery</u> – The proposed box culvert passing through the existing nursery may affect its daily operation and substantially reduce its holding capacity for plants. DSD and the Contractor could continue to liaise with the nursery operator for mutual benefits as necessary.	DSD	Contractor	-	-
CM-04	<u>Existing Trees within Works Areas</u> – All existing trees within work sites shall be properly maintained and protected for their crowns, trunks and roots.	DSD	Contractor	-	-
CM-05	<u>Construction Light</u> – Security floodlight for construction areas shall be controlled at night to avoid excessive glare to the surrounding villages and to Plover Cove.	DSD	Contractor	-	-

ID No.	Landscape and Visual Mitigation Measure	Funding	Implementation	Management	Maintenance
	OPERATION				
OM-01	<u>Viewing Area Formation</u> – The proposed concrete pipe between the pump house and mechanical gate will affect the existing strip of vegetation, which visually separates the naturalistic shore of Plover Cove from Ting Kok Road. Unlike the proposed box culvert, the concrete pipe will not support any tree planting above due to both technical and maintenance reasons. While it is apparent that the impact cannot be reversed, there is room for enhancing the overall landscape design of the strip to form a roadside landscaped viewing area overlooking Plover Cove. Although Ting Kok Road has been constructed along the shore, it is actually only few sections of the road that have an open view to Plover Cove. The area shall be planted with shrubs and grasses and a few benches.	DSD	Contractor	HyD	HyD / LCSD / ArchSD
OM-02A	<u>Architectural Design for Pump House</u> – The appearance of proposed pump house shall be properly designed, including a careful selection of material colour and texture, so that it fit into the existing suburban, natural to semi-natural surroundings. The aesthetic design of the pumping station will be circulated to ASD for comment in accordance with ETWB TCW 8/2005.	DSD	Contractor	DSD	DSD
OM-02B	<u>Landscape Design for Pump House</u> – Sufficient planting shall be provided around the boundary fence of the pump house for screening.	DSD	Contractor	DSD	DSD
OM-03A	<u>Enhancement Planting along Tung Tsz Road</u> – An existing strip of disturbed woodland with some large trees and the marsh edge area with mostly grasses and small trees will be affected by the proposed box culvert. After the construction, the area shall be planted with shrubs / trees of suitable species, such as <i>Ficus</i> spp., <i>Schefflera octophylla</i> , <i>Hibiscus tiliaceus</i> , which help to protect the stream and the marshes.	DSD	Contractor	LCSD	LCSD
OM-03B	<u>Soil Depth for Enhancement Planting</u> – The box culvert shall be designed with sufficient loading capacity and with at least 1.0m soil depth for shrub / tree planting above.	DSD	Contractor	LCSD	LCSD

ID No.	Landscape and Visual Mitigation Measure	Funding	Implementation	Management	Maintenance
OM-04A	<u>Transplanting of Trees to Adjacent Locations</u> – Existing trees to be affected shall be directly transplanted to other locations in vicinity, where no construction will take place.	DSD	Contractor	LCSD	LCSD
OM-04B	<u>Preparation for Transplanting</u> – The construction program should also allow sufficient time for root pruning and rootball preparation prior to transplanting.	DSD	Contractor	LCSD	LCSD
OM-05	<u>Reinstatement of affected area</u> – The works area should be properly reinstated to the satisfaction of relevant government departments.	DSD	Contractor	AFCD / HAD	AFCD / HAD

Table 8.5 Landscape Impacts After Mitigation

Identity No.	LR / LCA	Recommended Mitigation Measure		Residual Impact Significance Threshold AFTER Mitigation (Insubstantial, Slight, Moderate, Substantial)		
		Construction	Operation	Construction	Operation	
					Day 1	Year 10
LR1	Roadside Amenity Planting	CM-04	OM-02A, -02B, -04A, -04B	Slight	Slight	Insubstantial
LR2	Nursery	CM-03, -04	-	Slight	Slight	Insubstantial
LR2A	Open Space Planting	CM-04	-	Slight	Insubstantial	Insubstantial
LR3	Disturbed Vegetation and Farmland	CM-04	OM-03A, -03B, -04A, -04B	Slight	Slight	Insubstantial
LR4	Manmade Slope Vegetation	-	-	Insubstantial	Insubstantial	Insubstantial
LR5	Shrubland	-	-	Insubstantial	Insubstantial	Insubstantial
LR6	Secondary Woodland	-	-	Insubstantial	Insubstantial	Insubstantial
LR6A	Disturbed Woodland	CM-04	OM-03A, -03B, -04A, -04B	Slight	Slight	Insubstantial
LR7	Fung Shui Woodland	-	-	Insubstantial	Insubstantial	Insubstantial
LR8	Fish Pond	CM-02A, -02B, -04	-	Slight	Insubstantial	Insubstantial
LR9	Marsh and Stream	CM-02A, -02B, -04	OM-03A, -03B, -04A, -04B, -05	Moderate	Slight	Slight
LR10	Mangrove	CM-02A, -02B, -04	-	Slight	Insubstantial	Insubstantial
LR11	Natural Seashore	CM-02A, -02B, -04	-	Slight	Insubstantial	Insubstantial
LR12	Manmade Seashore	CM-02A, -02B, -04	OM-01, -04A, -04B	Slight	Slight	Slight
LCA1	Naturalistic Sea Bay	CM-01, -02A, -02B, -04, -05	OM-01, 02A, -02B, 04A, -04B	Slight	Slight	Insubstantial
LCA2	Suburban Road	CM-01, -04, -05	OM-01, 02A, -02B, 04A, -04B	Slight	Slight	Insubstantial
LCA3	Marshes and Fish Ponds	CM-01, -02A, -02B, -04, -05	OM-03A, -03B, -05	Moderate	Slight	Slight
LCA4	Villages	CM-04, -05	OM-03A, -03B, -04A, -04B, -05	Slight	Insubstantial	Insubstantial
LCA5	Natural Hillside	-	-	Insubstantial	Insubstantial	Insubstantial

Table 8.6 Visual Impacts After Mitigation

Identity No.	VSR	Recommended Mitigation Measure		Residual Impact Significance Threshold AFTER Mitigation (Insubstantial, Slight, Moderate, Substantial)		
		Construction	Operation	Construction	Operation	
					Day 1	Year 10
VSR1	Sam Mun Tsai	-	-	Slight	Insubstantial	Insubstantial
VSR2	Villages at Wai Ha	-	OM-05	Slight	Slight	Insubstantial
VSR3	Villa Paloma	CM-01, -02A, -02B, -04, -05	OM-01, -02A, -02B, -04A, -04B	Moderate	Slight	Slight
VSR4	Northwest Shore of Plover Cove	CM-04	OM-01, -02A, -02B, -04A, -04B	Slight	Slight	Insubstantial
VSR5	Ting Kok Road near Tung Tsz Nursery	CM-04, -05	OM-01, -02A, -02B, 04A, -04B	Slight	Slight	Insubstantial
VSR6	Northeast Shore of Plover Cove	CM-04	OM-02A, -02B	Slight	Slight	Insubstantial
VSR7	Villages at San Tau Kok	CM-01, -04,-05	OM-03A, -03B, -04A, -04B	Slight	Slight	Insubstantial
VSR8	Ma Shi Chau & Yeung Chau	-	-	Slight	Insubstantial	Insubstantial
VSR9	Tai Mei Tuk	-	-	Slight	Insubstantial	Insubstantial
VSR11	Plover Cove	CM-02A, -02B, -04, -05	-	Slight	Slight	Insubstantial

9. FISHERIES IMPACT

Introduction

9.1 This section of the *EIA Report* presents the findings of the assessment of potential impacts on fisheries arising from the proposed Project. This fisheries assessment is based on a desk-top review of the latest relevant literature. It includes a description of baseline conditions, evaluation of potential impacts and recommends mitigation measures, where appropriate. The objectives of the fisheries impact assessment are as follows:

- to establish the importance of the fisheries habitats which may be affected by construction and operation of the Project
- to identify fisheries sensitive receivers;
- to assess the scale of possible impacts on fisheries resources from the proposed works;
- to identify any necessary mitigation measures and evaluate residual impacts; and
- to assess the need for a fisheries monitoring and audit programme.

Environmental Legislation, Standards and Guidelines

9.2 Evaluation of fisheries impacts in Hong Kong is conducted according to criteria set out in the *EIAO TM*. These criteria provide for the complete and objective identification, prediction and evaluation of potential fisheries impacts. In this regard, *Annex 9* of the Technical Memorandum sets out criteria for evaluating fisheries impact while *Annex 17* denotes the guidelines for fisheries impact assessment.

9.3 Other legislation which applies to fisheries and is relevant to fisheries assessment includes the:

- Fisheries Protection Ordinance (Cap. 171) – It promotes the conservation of fish and other forms of aquatic life within the waters of Hong Kong and regulates fishing practices to prevent activities detrimental to the fishing industry;
- Marine Fish Culture Ordinance (Cap. 353) – It designates, regulates and protects fish culture zones (FCZs) from injury to fish and pollution of waters
- Water Pollution Ordinance (Cap. 358) – It sets limits to water quality parameters in various Water Control Zones.

Assessment Methodology

9.4 Baseline information on fisheries in the Assessment Area, were elucidated via a desk-top review of the literature. This review included relevant fisheries baseline data presented in AFCD's Port Survey 2001/2002 and incorporated the most recent information available in other reports and publications. Potential impacts on the Fish Culture Zone at Yim Tin Tsai and Yim Tin Tsai (East) are also discussed. The impact assessment followed the criteria and guidelines for evaluating and assessing fisheries impacts as stated in *Annexes 9* and *17* of the *EIAO TM* respectively.

Description of the Environment

9.5 In Hong Kong, marine-based commercial fishing operations are classified as capture or culture fisheries. According to AFCD updated information in homepage, in year 2004, it produced an estimated 167,500 tonnes of fisheries produce valued at \$1,600 million with about 90% of the total catch coming from waters outside Hong Kong. The industry now consists of some 4,630 fishing vessels and some 9 500 fishermen working abroad. Main fishing methods include trawling, long-lining, gill-netting and purse-seining with the majority of the total catch obtained through trawling

- 9.6 Culture fisheries activities, on the other hand, include 26 fish culture zones (FCZs) located in various sheltered embayments across the HKSAR and occupy about 209 ha of sea area. Typically, fish farms are relatively small scale, family-run operations consisting of one or two rafts with an average size of about 260m². In 2002, there were 1,125 licensed operators at these Fish Culture Zones. With effect from June 2002, amendments to the Marine Fish Culture Ordinance allowed licenses to be transferred. The annual production in 2004 by the marine fish culture industry was about 1,540 tonnes of fish valued at HK\$79 million and catering for about 9.1% of local demand for live marine fish (AFCD 2006).
- 9.7 With regard to the capture fisheries operations and resources, the Assessment Area comprises Tolo Harbour fishing grounds adjacent to Shuen Wan (Plover Cove).
- 9.8 Marine culture fisheries are also present at two locations in the vicinity of the project works. These are Yim Tin Tsai FCZ located in the open waters of northern Tolo Harbour approximately 3 km east of the mouth of the Tai Po River, and Yim Tin Tsai (East) FCZ, located in Plover Cove approximately 3km south of Shuen Wan. Both Yim Tin Tsai and Yim Tsin Tsai (East) FCZs are fisheries sensitive receivers.

Capture Fisheries

- 9.9 According to the most recently published data (AFCD 2003), annual catches of adult fish within the Assessment Area typically range 200 – 400 kg /ha for most waters neighbouring Yuen Chau Tsai (Tai Po) and in Plover Cove, and as high as 400 – 600 kg/ha in waters off Kwun Hang. In comparison to other fishing grounds across Hong Kong, these fishing grounds are therefore considered to support moderate to high adult fish production.
- 9.10 In addition to this adult fish production, the waters across Tolo Harbour are extensively used for fry production to supply grow-out stock for mariculturists (although most fry for used in the local mariculture industry are imported from overseas). Latest figures indicate that the fry occur in these waters at a density of 100 – 500 tails/ha (AFCD 2003). According to ERM (1998), the outer Tolo Harbour including waters off Kwun Hang forms part of an important nursery area in northeastern Hong Kong waters for high commercial value *Chrysophrys major*, Golden-lined sea bream *Rhabdosargus sarba*, sea breams (*Sparus* spp.), Southern velvet shrimp (*Metapenaeopsis palmenis*) and snapper (*Lutjanus*) fry.
- 9.11 The scale of fishing operations in terms of number of fishing vessels operating in the Tolo Harbour is moderate to high as compared with other fishing grounds of Hong Kong. Tolo Harbour support a range of fishing vessel operations dominated by P4 sampans but also including shrimp trawling and stern trawling. Of particular note, these waters are among the most frequently used by pair trawlers and purse seiners in Hong Kong. Within the waters of the Assessment Area, AFCD (2003) data indicate fishing operations are more concentrated off the Kwun Hang coast (Ma On Shan) (400 – 700 vessels) compared to waters off Yeun Chau Tsai (Tai Po) and Shuen Wan (Plover Cove) (100 – 400 vessels). The higher fishing effort off Kwun Hang may account for the higher adult fish production in these waters (refer to section 8.8).
- 9.12 Compared to production levels from other inshore fishing grounds, figures indicate Tolo Harbour waters typically provide among the highest yields (>60kg/ha) of sardine (Clupeidae) in Hong Kong (AFCD 2006). In comparison with other fishing grounds, Tolo Harbour also support a high production (40 – 60 kg/ha) of rabbit fish (Siganidae) and anchovy (Engraulidae) and, in general, moderate production levels (20-40 kg/ha) of scad (Carangidae), seabream (Sparidae), squid and crab. Among the other most common components of the catch by Hong Kong fisheries, Tolo Harbour waters typically yield very low production (<5 kg/ha) of croaker (Sciaenidae), threadfin bream (Nemiperidae) and shrimp (AFCD 2003). Of the fishes with the higher yields caught in the Assessment Area, sardine, rabbit fish, anchovy and scad are fast-growing fishes of relatively low commercial value that appear to thrive in the sheltered nutrient-enriched waters of Tolo Harbour (Leung 1997). Traditionally, these so-called 'trash' fishes have often been used as fish feed by mariculturists.

- 9.13 Based on annual adult fish and fry production figures, the dollar worth of catches in Plover Cove and off the Kwun Hang coast was regarded as moderate – high (HK\$5,000 – 10,000/ha/yr) as compared with other fishing grounds in Hong Kong. Waters off Yuen Chau Tsai (Tai Po) were of less importance being regarded as of relatively moderate commercial value (HK\$2000 – 5000/ha) to the fisheries industry.

Culture Fisheries

- 9.14 As at 31st December 2005, the Yim Tin Tsai FCZ consisted of 297 licensed rafts with a total licensed area of 26,467 m² (total gazetted area = 136,300m²). A total of 133 licenses have been issued to operators at this FCZ.
- 9.15 Similarly, the Yim Tin Tsai (East) FCZ consists of 289 licensed rafts with a total licensed area of 20,556 m² (total gazetted area = 149,500m²). Operations are conducted under 81 licences at this FCZ.
- 9.16 Although no figures are available on the individual production of these FCZs, it is known that Hong Kong production in 2004 totalled 1,540 tonnes. The fish species commonly cultured in FCZs are Common species under culture include green grouper, brown-spotted grouper, giant grouper, Russell's snapper, mangrove snapper, red snapper, cobia and pampano. Fry are mostly imported from the Mainland, Taiwan, Thailand, Philippines or Indonesia.

Fisheries Importance

- 9.17 Based on the information presented above, the fisheries within the Assessment Area are considered to be of relatively moderate – high value and importance to the Hong Kong fishery. Furthermore, under the Fisheries Protection Ordinance, Tolo Harbour including the assessment area waters has been proposed to become a Fisheries Protection Area primarily for the purpose of introducing specific controls on fishing activities.
- 9.18 Moderate to high catches from Tolo Harbour waters as compared with other Hong Kong fishing grounds are dominated by fish species of low commercial value often sold as fish feed in mariculture. These waters attract a relatively moderate to high level of capture fishing operations and are the location for two fish culture zones. In addition, the Assessment Area off Kwun Hang comprises area previously identified as important nursery habitat for commercially important species.

Environmental Impact Identification, Prediction and Evaluation

Construction Phase

- 9.19 Temporary elevation in suspended sediment (SS) during drainage improvement works is identified as the potential impact on water quality for primary consideration because at high levels sediment may cause injury to fisheries resources. For instance, high SS levels may clog gill structures and hinder transfer of oxygen. Eggs and early life stages (fry) are more susceptible to smothering of respiratory surfaces due to high sediment levels. Susceptibility generally decreases with age, so that adult fishes are the least sensitive to effects from sediments.
- 9.20 As discussed in Sections 5.20 – 5.21, the proposed construction method for excavation works in rivers would be to enclose part of the river channel using bunds. Excavation would be conducted on a dry section of the river bed. Consequently, downstream impacts of sediment would not occur as no water would flow from the dry river section undergoing excavation.
- 9.21 Furthermore, good site practices would be implemented to control construction site runoff and drainage from the works areas, and to prevent runoff and drainage water with high levels of suspended solids from entering the river channels and hence Tolo Harbour.
- 9.22 There would be no unacceptable adverse indirect impacts on fishing areas or fish culture zones due to release of sediments during the construction phase of the Project.

Operation Phase

- 9.23 No unacceptable impacts on fisheries resources are anticipated during the operation phase of the Project.

Cumulative Assessment

- 9.24 No concurrent project in the Assessment Area was identified that would give rise to cumulative impacts on fisheries. Hence, no impacts to fisheries beyond those identified and evaluated in the assessment for this Project were expected.

Mitigation of Adverse Environmental Impacts

- 9.25 According to the *EIAO TM*, the order of priority for mitigating impacts should be avoidance, minimisation and compensation.
- 9.26 Since no unacceptable adverse impacts on fisheries are predicted, no need for fisheries-specific mitigation measures was identified. The mitigation measures recommended in Sections 5 this *EIA Report*, for controlling water quality would serve to protect fisheries from indirect impacts and ensure no unacceptable impact on fisheries resources and operations.

Evaluation of Residual Impacts

- 9.27 Based on the above assessment, it is anticipated that there would be no residual impact on fisheries due to the project.

Environmental Monitoring and Audit

- 9.28 Recommendation for regular site audits be undertaken to inspect the construction activities at all works areas to ensure the recommended mitigation measures are properly implemented (refer to Section 5) would also serve to protect fisheries resources. Environmental monitoring and audit to assess the effects of the Project on commercial fisheries resources is deemed unnecessary.

Conclusions

- 9.29 A literature review has been conducted to incorporate the latest relevant information for determining impacts on fisheries arising from the Project.
- 9.30 The size of catches in the Tolo Harbour assessment area were ranked as moderate – high compared to other fishing grounds in Hong Kong though the fish species captured were considered to be of low commercial value. Waters off the Kwun Hang coast forms part of an important nursery area in northeastern Hong Kong waters for some high commercial value fishes. Fishing grounds in Tolo Harbour off Shuen Wan and Kwun Hang were considered to be of high commercial importance. Fishing grounds off Yuen Chau Tsai (Tai Po) were considered to be of moderate commercial importance. Sensitive fisheries receivers were identified as the Fish Culture Zones at Yim Tim Tsai and Yim Tin Tsai (East).
- 9.31 No direct loss of fishing ground would arise from the project. Owing to containment of construction and maintenance works to dry sections the rivers through the use of bunds, it is anticipated that there would be no unacceptable downstream impact on fisheries resources or operations.
- 9.32 There would be no unacceptable adverse impacts on fishing areas and the two fish culture zones resulting from the project. Also, provided that recommendations to protect water quality (Section 5) are fully implemented, specific mitigation measures to protect fisheries resources are not necessary. Similarly, audit activities on work sites to ensure prevention of water quality impact would also serve to protect fisheries resources. Therefore EM&A programme for fisheries is not recommended.

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10. ENVIRONMENTAL MONITORING AND AUDIT

Introduction

10.1 This section further elaborates the requirements of environmental monitoring and audit (EM&A) for the construction and operation phases of the Project, based on the assessment results of the various environmental issues. The objectives of carrying out EM&A for the Project include the following:

- provide a database against which any short or long term environmental impacts of the Project can be determined;
- provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- monitor the performance of the Project and the effectiveness of mitigation measures;
- verify the environmental impacts predicted in the EIA Study;
- determine project compliance with regulatory requirements, standards and government policies;
- take remedial action if unexpected problems or unacceptable impacts arise; and
- provide data to enable an environmental audit.

10.2 The following section summarises the recommended EM&A requirements for the Project. Details of the specific requirements are provided in a stand-alone EM&A Manual.

Construction Noise Impact

10.3 Construction noise impacts from the Project were predicted at the identified NSRs. Practicable mitigation measures were recommended to alleviate the potential impacts to meet the EIAO-TM criteria. Noise monitoring during construction phase should be carried out to ensure such mitigation measures would be implemented properly. Details of the recommended monitoring and audit programme for construction noise are presented in the stand-alone EM&A Manual.

Construction Air Quality Impact

10.4 Mitigation measures have been proposed and presented in Section 4 to minimize construction dust impact. Regular site audits on a weekly basis are recommended to ensure that the dust control measures are properly implemented.

Water Quality Impact

10.5 The water quality assessment concluded that the identified water quality impacts could be minimized by implementing the recommended working method controls and mitigation measures for drainage improvement works in Shuen Wan, such as control measures on site runoff and drainage from the works areas and proper site management and good housekeeping practices. No unacceptable residual water quality impact was expected. Any effluent discharges from the site would be required to comply with the terms and conditions of a discharge licence, issued by EPD, under the WPCO. The monitoring of downstream water quality within the Wai Ha River during the construction activities was therefore not considered warranted for the Project. However, it was recommended

that regular site inspections be undertaken to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

Waste Management Implications

- 10.6 Waste management would be the contractor's responsibility to ensure that all wastes produced during the construction of the drainage improvement works in Shuen Wan are handled, stored and disposed of in accordance with the recommended good waste management practices and EPD's regulations and requirements. The mitigation measures recommended in Section 6 should form the basis of the site Waste Management Plan to be developed by the Contractor at the construction stage.
- 10.7 It was recommended that the waste arisings generated during the construction activities be audited periodically to determine if wastes are being managed in accordance with approved procedures and the site Waste Management Plan. The audits should look at all aspects of waste management including waste generation, storage, transport and disposal. An appropriate audit programme would be to undertake a first audit near the commencement of the construction works, and then to audit on a quarterly basis thereafter. In addition, the routine site inspections should check the implementation of the recommended good site practices and other waste management mitigation measures.

Ecological Impact

- 10.8 Monitoring requirements for ecology are outlined in Section 7.128-7.130 of the Report. In summary, monitoring would include:
- The implementation of all mitigation measures described in the Report should be subject to regular audit.
 - Following transplantation, the health and condition of individuals of the species of conservation interest affected by the proposed works should be monitored by a qualified botanist/ecologist. The Contractor would be responsible for the maintenance of the compensatory habitats during the establishment period which should normally last for 12 months. AFCD has agreed that they could take up the subsequent maintenance of the compensatory habitat after the establishment period/completion of the project, and details of the subsequent maintenance would be agreed between AFCD and the project proponent at the design stage of the project.
 - A specific monitoring of the compensatory marsh habitat is recommended. The programme should provide data on the establishment of marsh communities, and allow an assessment of the relative success of mitigation measures to be made. Baseline data should be collected before the commencement of construction phase, with monitoring conducted during the construction phase and after the completion of works. Monitoring should be conducted by qualified ecologist(s) with relevant experience.

Landscape and Visual Impact

Construction Phase

Baseline Review

- 10.9 A baseline review shall be undertaken at the commencement of the construction contracts. The purpose of the review is:

- to check the status of the landscape resources within, and immediately adjacent to, the construction works areas
- to determine whether any change has occurred to the status of the landscape
- to determine whether such change warrants a change in the design of the landscape and visual mitigation measures
- to recommend any necessary changes to the design of the landscape and visual mitigation measures

Landscape and Visual Monitoring

- 10.10 The design, implementation and maintenance of landscape and visual mitigation measures shall be audited bi-weekly to ensure that they are fully realised and that any potential conflicts between the proposed landscape measures and any other project works and operational requirements are resolved at the earliest possible date and without compromise to the intention of the mitigation measures.

Design of Landscape and Visual Mitigation Measures

- 10.11 The detailed design of the landscape and visual mitigation measures shall be undertaken so as to ensure compliance with the measures described in Section 8, and to ensure compliance with the intended aims of the measures, taking into account any changes to the mitigation measures that may have been recommended as a result of the Baseline Review or ongoing monitoring of the design, construction and establishment works.

Operational Phase

Landscape and Visual Monitoring

- 10.12 All landscape and visual mitigation measures shall be audited monthly during the first year of the operational phase to check that intended mitigation effects are realised.

Fisheries Impact

- 10.13 Recommendation for regular site audits shall be undertaken to inspect the construction activities at all works areas to ensure the recommended mitigation measures are properly implemented (refer to Section 5.27-5.31). It would also serve to protect fisheries resources. Environmental monitoring and audit to assess the effects of the Project on commercial fisheries resources is not deemed necessary.

11. OVERALL CONCLUSION AND SUMMARY OF ENVIRONMENTAL OUTCOMES

- 11.1 This EIA Report has provided an assessment of the potential environmental impacts associated with the construction and operation phases of the Shuen Wan drainage improvement works under the Drainage Improvement in Sha Tin and Tai Po Project.
- 11.2 The environmental issues below have been assessed in this EIA report, in accordance with the EIA Study Brief (No. ESB-077/2001) registered under the EIAO for the Project:
- (i) Construction noise impact.
 - (ii) Construction air quality impact.
 - (iii) Water quality impact.
 - (iv) Waste management impact.
 - (v) Ecological impact.
 - (vi) Landscape and visual impact.
 - (vii) Fisheries impact
- 11.3 The findings of the EIA have provided information on the nature and extent of environmental impacts arising from the construction and operation of the proposed Project. A summary of assessment findings of these individual issues is provided at the end of each section. The EIA has, where appropriate, identified practicable mitigation measures for incorporation into the design and construction method of the Project, to comply with environmental legislation and standards. The Implementation Schedules of the recommended mitigation measures are presented in Section 13.
- 11.4 Overall, the EIA Report for the Project has predicted that the Project would comply with environmental legislation after the implementation of the proposed construction and operation phase mitigation measures, and any residual impacts from the Project minimised. This EIA has also demonstrated the protection of the population and environmentally sensitive resources. Table 11.1 summarises the environmental outcomes/benefits from the implementation of the Project as well as the associated mitigation measures proposed. An environmental monitoring and audit programme have been recommended before and during construction, where necessary, as a check on the implementation and effectiveness of the recommended mitigation measures.

Table 11.1 Summary of Key Environmental Outcomes / Benefits

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
The Project	The project aims to relieve the potential flooding problem in the Shuen Wan area. The scope of works proposed under this Project comprises: <ul style="list-style-type: none"> - Construction of a twin-cell box culvert along Tung Tsz Road - Construction of a floodwater pumping station at Shuen Wan - Replacement of mechanical gate at Wai Ha River - Construction of about 280m of relief drain in Wai Ha Village - Construction of about 260m drainage pipe along Ting Kok Road
Population & environmentally sensitive areas protected	The proposed Project would relieve the risk of flooding in the Tung Tsz and Wai Ha areas. Population and environmentally sensitive areas protected would include villages located north of Tung Tsz Road and road users of Tung Tsz Road. Additionally, it would protect extra areas in Wong Yue Tan and Ha Tei Ha from flooding. The estimated population protected under this Project would be about 2,500. In this way, disruption to everyday life during the wet seasons in the flood-prone areas in Shuen Wan would be reduced. Potential economic loss due to flooding would also be minimised.

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	<p>Most of the works within natural areas would be avoided as far as possible. With respect to the works at Wai Ha River, consideration was given to the protection of the natural stream section. Works at the natural stream section would be avoided as far as possible. According to the present design, the proposed works would only be conducted at the artificially modified sections of Wai Ha River. In so doing, the natural stream section of Wai Ha River would be protected.</p> <p>As the majority part of the Shuen Wan Conservation Area (CA)/marsh area would be protected by designing the box culvert to align immediately next to Tung Tsz Road, the affected area would only be limited to the periphery of the CA/marsh area, which would be of lower conservation value as it is already subject to disturbance from the existing busy vehicular and pedestrian traffic along Tung Tsz Road.</p> <p>Potential consequence of not implementing this project would be that flooding would persist in the flood-prone areas in the Shuen Wan area identified in the DMP study and development in the study area would be hindered. The risk of potential damage to property and nuisance to the public resulting from flooding would remain high. Moreover, flooding of the area may disrupt the traffic along Tung Tsz Road, which is the only access to the villages in the Tung Tsz and Wai Ha areas. With this Project in place, these consequences as well as the environmental problems above could be avoided.</p>
<p>Drainage options, alignment, construction methods and environmentally friendly design considered</p>	<p>Six drainage improvement options had been considered to improve the level of flood protection for urban drains. Based on consideration of social, ecological and environmental factors, the construction of box culvert along Tung Tsz Road was identified as the preferred option.</p> <p>The preferred option has the following benefits:</p> <ul style="list-style-type: none"> - The proposed drainage improvement works would provide a longer term solution for flooding. - The proposed box culvert would be underground incurring limited visual impact to the sensitive receivers in the vicinity as compared to the floodwall option. - This option is supported by the local villagers and representatives. <p>Environmentally friendly considerations given to the construction method proposed for this project would include the following:</p> <ul style="list-style-type: none"> - Sheet piling would be adopted to limit the size of works area, and as a result of this, the encroachment to the marsh area and the designated Conservation Area could be minimised. The installed sheet piling around excavated trench could also prevent spillage of muddy water from works site during heavy rainstorms. - Percussive piling would not be used, such that noise disturbance to the residents as well as to the wildlife would be minimised during construction phase of the Project. - Quieter alternative construction method - Low Impact Method has been proposed to minimize the construction noise disturbance to nearby residents as far as possible. - Potential impact on water quality particularly in the nearby

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	<p>Conservation Area would be minimised through the use of working method controls. Excavation works within the upstream end of the existing river channel of Wai Ha River for the construction of the proposed box culvert would be carried out in dry condition by the use of containment measures within the channel, and be restricted to the dry season as far as possible.</p> <ul style="list-style-type: none"> - The alignment of the box culvert would be shifted away from the Conservation Area as much as possible to minimize encroachment. - Architectural design of the pumping station could blend in with the surrounding environment to minimize the long-term visual impacts due to the Project.
<p>Key environmental problems avoided / minimised and environmental benefits</p>	<p>The proposed drainage improvement works have been designed to avoid or minimise direct impacts to areas of recognised conservation importance, including the Conservation Area (CA), Coastal Protection Area (CPA) and Site of Special Scientific Interest (SSSI), in the Assessment Area.</p> <p>The proposed box culvert constructed partially underneath Tung Tsz Road has been designed to reduce the footprint of the proposed works, thereby minimising direct impacts to marsh habitat and the CA.</p> <p>Direct impact to natural stream section would be minimised as most part of the box culvert construction works would be conducted in the existing artificially modified channel.</p>
<p>Noise</p>	<p>Unmitigated construction noise levels at the representative NSRs were predicted to be in the range of 59-105dB(A), exceeding the EIAO-TM daytime construction noise limit of 75dB(A). NSRs as shown in Figure 3.1 would be affected.</p> <p>Mitigation measures such as good site practices, quieter PME, temporary barriers, the use of quieter alternative construction method (the Low Impact Method) and the use of noise enclosure were recommended to minimize the potential noise impacts. With these mitigation measures in place, there would not be any residual impact at all NSRs (Table 3.8 refers). Noise disturbance to the nearby villagers and wildlife could thus be minimized.</p> <p>To check on the proper implementation and the effectiveness of the suggested mitigation measures, construction noise monitoring and audit programme was recommended. This could further protect the nearby residences and wildlife from the potential sources of noise impacts.</p>
<p>Air quality</p>	<p>Potential air quality impacts arising from the Project would include dust nuisance from land excavation works and gaseous emissions from the construction plant and vehicles.</p> <p>To minimize these impacts, mitigation measures as stipulated in the <i>Air Pollution Control (Construction Dust) Regulation</i> and general good site practices are recommended. It is anticipated that with the proper implementation of the mitigation measures, there would not be any adverse residual air quality impact and thus all NSRs as</p>

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	<p>shown in Figure 4.1 would be protected to comply with the dust criteria during construction stage. It is also anticipated that there would be no adverse impact during the operation stage of the Project.</p> <p>EM&A requirements have also been recommended to check on the dust control measures and other mitigation measures are implemented effectively. In this way, adverse residual impact would not be anticipated.</p>
Water quality	<p>The key water quality impact arising from the Project would be due to the excavation works within the CA, Wai Ha River at the junction of the box culvert and the existing stream course at the upstream end. To minimize this impact, sheet-piles would be installed around the works trench near the CA to serve as hoardings to isolate the works site. The excavation works within the river channel would be carried out only from October to April in dry condition, which could provide a dry zone for excavation works within the river channel and would prevent the transportation of suspended sediment downstream. With the proper implementation of the working method controls, it is predicted that the identified WSRs would not be adversely affected by the excavation works.</p> <p>Other potential sources of impacts would include construction site runoff and drainage, debris, refuse and liquid spillages from general construction activities and sewage effluents from the construction workforce. Proper site management, good housekeeping practices and appropriate treatment of sewage effluent would be recommended as mitigation measures to prevent water quality deterioration.</p> <p>Regular site audits were recommended to inspect the construction activities at all works areas to check on the recommended mitigation measures are properly implemented.</p> <p>As such, with the implementation of the recommended mitigation measures and site audits, the identified WSR within Tolo Harbour, including the fish ponds at Shuen Wan, Wai Ha River and Shuen Wan CA could be protected. No adverse residual impact on water quality would be anticipated.</p>
Waste management implications	<p>The wastes which would be generated from the Project include construction and demolition (C&D) materials, chemical waste and general refuse.</p> <p>Excavated material would be generated from excavation works for construction of box culvert, pumping station, relief drain and drainage pipe. Total volume of C&D material from the Project estimated to be approx. 86,580 m³.</p> <p>C&D material of suitable characteristics should be reused on-site as far as practicable (approx. 21,700m³). Surplus C&D material (approx. 64,880 m³) would be delivered to and reused in public filling area.</p> <p>Good site practices and waste reduction measures should be implemented to mitigate the potential impacts arising from the</p>

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	<p>waste generated. For example, appropriate waste handling, transportation and disposal methods for all waste generated during the construction works should be implemented to such that construction wastes do not enter the Wai Ha River channel and coastal waters of Inner Tolo Harbour, and to minimize potential impacts where works areas are located close to ecological sensitive receivers.</p> <p>Provided that these identified waste arisings are to be handled, transported and disposed of using the recommended methods and that good site practices are followed strictly, adverse environmental impacts are not anticipated during the construction works.</p>
Ecology	<p>The alignment of the twin-cell box culvert has been carefully designed such that impacts on key ecological resources are avoided. The main impacts on habitats resulting from the proposed works would be minimised to approximately 0.3ha of moderate-high ecological value marsh habitat, 0.08ha of moderate value secondary woodland and 30m natural stream section of low to moderate value.</p> <p>To compensate for the loss of a small area of marsh habitat resulting from the construction of the box-culvert along Tung Tsz Road, a low ecological value recreational fishpond, approximately 0.8ha, adjacent to the marsh would be enhanced to create a suitable foraging habitat for avifauna.</p> <p>Direct impacts to small areas of secondary woodland habitat would be compensated for through planting of trees and other vegetation alongside Wai Ha River and Tung Tsz Road. Construction works would be limited to one side of river bank and the affected stream section would be reinstated to enhance the re-establishment of aquatic and riparian communities.</p> <p>Indirect impacts would include increased sedimentation in aquatic habitats during the construction phase, and disturbance to wildlife caused by increased human activity and noisy construction phase activities.</p> <p>With the effective implementation of recommended mitigation measures, the residual ecological impact resulting from the proposed drainage improvement works would be very minor and environmentally acceptable.</p> <p>With the implementation of recommended measures, operation phase impacts resulting from regular maintenance such as desilting are considered to be minor and acceptable.</p>
Landscape and Visual	<p>Landscape and visual impacts arising from the Project have been predicted and mitigation measures are recommended. During the construction phase, measures such as visual screen, contaminant / sediment control and pollution control were suggested. These measures would be implemented from the commencement of the works and applied for the whole duration of the construction period.</p> <p>During operation phase, the landscape and visual impacts would be mitigated by incorporating architectural design and landscape design of pump house, enhancement planting along Tung Tsz Road, viewing area formation, etc. these measures would be included in the detailed design and should be constructed during</p>

Area/Issue	Environmental Outcomes / Benefits and Mitigation Measures
	<p>the construction.</p> <p>According to the criteria defined in Annex 10 of the EIAO TM, upon carrying out the above mitigation measures, the landscape and visual impacts of this Project in the construction and operational phases would be considered to be low and acceptable.</p>
Fisheries	<p>Impacts to fisheries resulting from the proposed works are expected to be negligible. No direct loss of fisheries resources in the fishing areas and the two fish culture zones would result from the proposed works, and potential indirect impacts would largely be limited to minor increases in sedimentation during the construction phase. Measures would be taken during the construction phase (e.g., conducting excavation works in dry condition) that would effectively control any indirect impact to fisheries resources through water quality deterioration. Provided that recommendations to protect water quality (Section 5) are fully implemented, specific mitigation measures to protect fisheries resources are not necessary.</p>

12. IMPLEMENTATION SCHEDULE AND RECOMMENDED MITIGATION MEASURES

12.1 This chapter presents the implementation schedule of the proposed mitigation measures for the Project. **Tables 12.1** summarises the details. For each recommended mitigation measure, both the location and timing for the measure have been clearly identified. As well, the parties responsible for implementing the measure and for maintenance (where applicable) have also been clearly identified.

Table 12.1 Project Implementation Schedule

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
A Noise Impact							
S 3.30	2.18	Good Site Practice: <ul style="list-style-type: none"> ▪ Only well-maintained plant shall be operated on-site and plant shall be serviced regularly during the construction program ▪ Silencers or mufflers on construction equipment shall be utilized and shall be properly maintained during the construction program ▪ Mobile plant, if any, shall be sited as far from NSRs as possible ▪ Machines and plant (such as trucks) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum ▪ Plant known to emit noise strongly in one direction shall, wherever possible, be orientated so that the noise is directed away from the nearby NSRs ▪ Material stockpiles and other structures shall be effectively utilized, wherever practicable, in 	To minimize construction noise impacts	Contractor	Works areas	Construction phase	EIAO-TM NCO

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		screening noise from on-site construction activities.					
S 3.31 - 3.32	2.19	Use of quieter PME	To minimize construction noise impacts	Contractor	Works areas	Construction phase	EIAO-TM NCO
S 3.33 - 3.34 - 3.36 - 3.38	2.20-2.21 - 2.23-2.24	Use of temporary noise barrier	To minimize construction noise impacts	Contractor	Works areas as shown in Figure 3.5	Construction phase	EIAO-TM NCO
S 3.35 and Table 3.6	2.22	Use of alternative quieter construction method (the Low Impact Method)	To minimize construction noise impacts	Contractor	Part of the works area for pipe laying in Wai Ha (refer to Figure 3.5)	Construction phase	EIAO-TM NCO
3.36 - 3.38	2.23-2.24	Use of noise enclosure	To minimize construction noise impacts	Contractor	Part of the works area for pipe laying in Wai Ha (refer to Figure 3.5)	Construction phase	EIAO-TM NCO
B Air Quality Impact							
S4.16	3.5	Implementation of mitigation measures stipulated in the Air Pollution Control (Construction Dust) Regulation and good site practices including but not limited to the following: <ul style="list-style-type: none"> ▪ Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved road, with complete coverage, particularly during dry weather; ▪ Use of frequent watering for 	To minimize construction dust impacts	Contractor	Construction Sites	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>particularly dusty static construction areas and areas close to ASRs;</p> <ul style="list-style-type: none"> ▪ Tarpaulin covering of all dusty vehicle loads transported to, from and between site location; ▪ Establishment and use of vehicle wheel and body washing facilities at the exit points of the site; ▪ Routing of vehicles and positioning of construction plant should be at the maximum possible distance from ASRs. ▪ Stockpiled excavated materials should be covered with tarpaulin, and should be removed off-site within 24 hours to avoid any odour nuisance arising. 					
C Water Quality Impact							
S5.29	4.5	<p>Construction Site Run-off and Drainage:</p> <ul style="list-style-type: none"> ▪ Before commencing any site formation work, all sewer and drainage connections shall be sealed to prevent debris, soil, sand etc. from entering public sewers/drains. 	To minimize water quality impacts	Contractor	Works sites	Construction phase	ProPECC PN 1/94 Construction Site Drainage

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<ul style="list-style-type: none"> ▪ Temporary ditches shall be provided to facilitate run-off discharge into appropriate watercourses, via a silt retention pond. No site run-off shall enter the fishponds at Shuen Wan. ▪ Sand/silt removal facilities such as sand traps, silt traps and sediment basins shall be provided to remove sand/silt particles from runoff to meet the requirements of the Technical Memorandum standard under the Water Pollution Control Ordinance. The design of silt removal facilities shall be based on the guidelines provided in ProPECC PN 1/94. All drainage facilities and erosion and sediment control structures shall be inspected monthly and maintained to ensure proper and efficient operation at all times and particularly during rainstorms. ▪ Water pumped out from excavated pits shall be discharged into silt removal facilities. ▪ During rainstorms, exposed slope/soil surfaces shall be covered by a tarpaulin or other means, as far as practicable. Other measures that need to be 					

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>implemented before, during, and after rainstorms as summarized in ProPECC PN 1/94 shall be followed.</p> <ul style="list-style-type: none"> ▪ Exposed soil areas shall be minimized to reduce potential for increased siltation and contamination of runoff. ▪ Earthwork final surfaces shall be well compacted and subsequent permanent work or surface protection shall be immediately performed to reduce the potential of soil erosion. ▪ Open stockpiles of construction materials or construction wastes on-site of more than 50 m³ shall be covered with tarpaulin or similar fabric during rainstorms. 					
S5.30	4.7	<p>Further precautionary measures during rainy season:</p> <ul style="list-style-type: none"> ▪ For the construction of the box culvert next to the existing channel of the Wai Ha River, sand bags should be deployed around the boundary of the works trench to 	To minimize water quality impacts to the designated Conservation Area	Contractor	Works areas near the Conservation Area	Rainy seasons during construction phase	EIAO-TM Water Pollution Control Ordinance (WPCO)

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>prevent muddy water ingress into the adjacent CA or Wai Ha River. Sand bags should also be used to surround the excavated trench. Generally, the sand bags will be placed up to a height of 300mm to provide adequate allowance for the built-up water level during rainstorm event. With sand bags in place, surface runoff will be intercepted and flow to Wai Ha River or collected by the existing drainage system as usual.</p> <ul style="list-style-type: none"> ▪ Sheet-piles, which would be installed around the works trench near the Conservation Area, would be extended above ground level for about 2m to serve as hoardings to isolate the works site. ▪ Tarpulin sheets would be used to cover the excavation areas during heavy rainstorms. This would prevent the ingress of rainwater into the trench minimising the risk of muddy water getting into Wai Ha River and the adjacent Conservation Area. ▪ Any concrete washing water would be contained inside the works site surrounded by the extended sheet piles. A pump sump at the bottom 					

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>of the trench would be provided to pump any excess water during concrete washing.</p> <ul style="list-style-type: none"> ▪ Stockpiling the excavated materials adjacent to the Conservation Area would not be allowed. The excavated materials would be either removed off site immediately after excavation, or stockpile at location(s) away from the Conservation Area. The stockpile locations shall be approved by the site engineer. 					
S5.31-S5.32	4.8-4.9	<p>General Construction Activities:</p> <ul style="list-style-type: none"> ▪ Debris and refuse generated on-site should be collected, handled and disposed of properly to avoid entering the Wa Ha River and fish ponds at Shuen Wan. Stockpiles of cement and other construction materials should be kept covered when not being used. ▪ Oils and fuels should only be used and stored in designated areas which have pollution prevention facilities. To prevent spillage of fuels and solvents to nearby water bodies, all fuel tanks and storage areas should be provided with 	To minimize water quality impacts	Contractor	Works sites	Construction phase	EIAO-TM WPCO

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank. The bund should be drained of rainwater after a rain event.					
S5.33	4.10	<p>Sewage from Construction Workforce:</p> <ul style="list-style-type: none"> Temporary sanitary facilities, such as portable chemical toilets, should be employed on-site. A licensed contractor would be responsible for appropriate disposal and maintenance of these facilities. 	To minimize water quality impacts	Contractor	Works sites	Construction phase	EIAO-TM WPCO
S5.34	4.11	<p>River Channel Excavation Works:</p> <ul style="list-style-type: none"> The excavation works within the upstream end of the existing river channel of the Wai Ha River for the construction of the proposed box culvert shall be carried out in dry condition. Containment measures such as bunds and barriers shall be used within the affected length of the river channel and the excavation works restricted to within an enclosed dry section of the channel. The excavation works within Wai Ha 	To minimize water quality impacts	Contractor	Works sites	Construction phase	EIAO-TM WPCO

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		River shall be restricted to the period from October to April.					
D Waste Management Implications							
S6.20 – 6.22	5.5	<p>Good site practices:</p> <ul style="list-style-type: none"> ▪ Nomination of approved personnel, such as a site manager, to be responsible for good site practices and making arrangements for collection of all wastes generated at the site and effective disposal to an appropriate facility. ▪ Training of site personnel in proper waste management and chemical waste handling procedures. ▪ Provision of sufficient waste disposal points and regular collection for disposal. ▪ Appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers. ▪ Separation of chemical wastes for special handling and appropriate treatment at the Chemical Waste Treatment Facility. ▪ Regular cleaning and maintenance 	To reduce waste management impacts	Contractor	Works sites	Construction phase	ETWB TCW No.19/2005 ETWB TCW No.31/2004

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>programme for drainage systems, sumps and oil interceptors.</p> <ul style="list-style-type: none"> ▪ A Waste Management Plan should be prepared and submitted to the Engineer for approval. One may make reference to ETWB TCW No. 15/2003 for details. ▪ A recording system for the amount of wastes generated, recycled and disposed (including the disposal sites) should be proposed. 					
S6.23-6.24	5.7	<p>Waste reduction measures:</p> <ul style="list-style-type: none"> ▪ Segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal. ▪ To encourage collection of aluminium cans by individual collectors, separate labelled bins shall be provided to segregate this waste from other general refuse generated by the work force. ▪ Any unused chemicals or those with remaining functional capacity shall be recycled. ▪ Maximising the use of reusable 	To achieve waste reduction	Contractor	Works sites	Construction phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>steel formwork to reduce the amount of C&D material.</p> <ul style="list-style-type: none"> ▪ Proper storage and site practices to minimise the potential for damage or contamination of construction materials. ▪ Plan and stock construction materials carefully to minimise amount of waste generated and avoid unnecessary generation of waste. 					
S6.25-6.26	5.9	<p>Construction & Demolition (C&D) Material:</p> <ul style="list-style-type: none"> ▪ Excavated material with suitable characteristics/size should be reused on-site as fill material as far as practicable, such as for backfilling of the box culvert and drainage pipe works. ▪ Suitable areas should be designated within the works site boundaries for temporary stockpiling of C&D material. ▪ Within stockpile areas, the following measures should be taken to control potential environmental impacts or nuisance: 	<p>To minimize off-site disposal of C&D material</p> <p>To minimize environmental impacts during the handling of C&D material</p>	Contractor	Works sites	Construction phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<ul style="list-style-type: none"> - covering material during heavy rainfall; - locating stockpiles to minimise potential visual impacts; and - minimizing land intake of stockpile areas as far as possible. <p>▪ When disposing C&D material at a public filling area, the material shall only consist of soil, rock, concrete, brick, cement plaster/mortar, inert building debris, aggregates and asphalt. The material shall be free from marine mud, household refuse, plastic, metals, industrial and chemical waste, animal and vegetable matter, and other material considered to be unsuitable by the Filling Supervisor.</p>					
S6.27	5.10	<p>Chemical waste:</p> <p>▪ Contractor should register with the EPD as a Chemical Waste Producer and to follow the guidelines stated in the Code of Practice on the Packaging, Labelling and Storage of Chemical</p>	To minimize environmental impacts during the handling, transportation and disposal of chemical waste	Contractor	Works sites	Construction phase	EIAO-TM Waste Disposal (Chemical Waste) (General) Regulation

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>Wastes.</p> <ul style="list-style-type: none"> ▪ Good quality containers compatible with the chemical wastes should be used, and incompatible chemicals should be stored separately. ▪ Appropriate labels should be securely attached on each chemical waste container indicating the corresponding chemical characteristics of the chemical waste, such as explosives, flammable, oxidizing, irritant, toxic, harmful, corrosive, etc. ▪ The Contractor should use a licensed collector to transport and dispose of the chemical wastes generated at the Chemical Waste Treatment Centre at Tsing Yi, or other licenced facility, in accordance with the Waste Disposal (Chemical Waste) (General) Regulation. 					
S6.28	5.11	<p>General refuse:</p> <ul style="list-style-type: none"> ▪ It should be stored in enclosed bins or compaction units separate from C&D material. 	To minimize environmental impacts during the handling and transportation of general refuse	Contractor	Works sites	Construction phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<ul style="list-style-type: none"> ▪ A reputable waste collector should be employed by the contractor to remove general refuse from the site, separately from C&D material. ▪ An enclosed and covered area is preferred to reduce the occurrence of 'wind blown' light material. 					
E Ecological Impact							
S. 7.95	6.6	<ul style="list-style-type: none"> ▪ Sheet-pilings, which will be installed around the trench of excavation, should be extended above ground level for ~2m to act as hoarding to isolate the works site. ▪ The trenching works for the construction of the proposed box culvert should be carried out in phases, with a trench length of not more than 120m in each phase. The trench should be backfilled and compacted with suitable materials upon completion of each phase of the construction works. 	To minimize the impacts on the stream and natural river bank	Contractor	Whole site	Construction Phase	EIAO-TM
S7.117	6.6	<ul style="list-style-type: none"> ▪ The construction of intercept point of twin cell box culvert at the upstream of Wai Ha River should be confined to only one side of the river bank. 	To minimize the impacts on the stream and natural river bank	Contractor	Whole site	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<ul style="list-style-type: none"> ▪ To restore and enhance the ecological value of the stream, the affected river bank should be reinstated to its original condition or lined with rock-filled gabion. ▪ Planting pits should be provided in the gabion bank to allow the re-establishment of riparian vegetation. ▪ The existing natural riverbed and substrates should be retained and the natural pool-riffle sequence should be re-created in the new channel bed. 					
S 7.118	6.7	<ul style="list-style-type: none"> ▪ All works carried out within the river channel of Wai Ha River should be carried out from October to April, with construction carried out by land-based plant. ▪ Works within river/stream channels should be restricted to an enclosed dry section of the river, with containment measures such as bunds and barriers used within the river to minimize the impacts upon the downstream water body. ▪ Site runoff should be directed towards regularly cleaned and 	To minimise sedimentation/ water quality impacts	Contractor	Whole Site	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>maintained silt traps and oil/grease separators to minimize the risk of sedimentation and pollution of river water.</p> <ul style="list-style-type: none"> ▪ The silt and oil/grease separators should be appropriately designed for the local drainage and ground conditions. ▪ To minimize leakage and loss of sediments during excavation in narrow channels, tightly sealed closed grab excavators should be deployed where material to be handled is wet. 					
S 7.119	6.8	<ul style="list-style-type: none"> ▪ The construction of the proposed box-culvert would have the potential to directly impact a few individual of a plant species of conservation interest (Hong Kong Pavetta, <i>Pavetta hongkongensis</i>). The affected individuals should be transplanted to a suitable nearby habitats prior to the construction phase. ▪ A detailed vegetation survey of the affected species of conservation interest should be conducted by a suitably qualified botanist/ecologist to identify the affected individuals in order to provide details for transplantation scheme. 	To protect plant species of conservation interest	Contractor/qualified botanist/horticulturalist	Whole site	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<ul style="list-style-type: none"> Transplantation should be supervised by a suitably qualified botanist/horticulturalist. A detailed transplantation methodology should be formulated during the detailed design stage of this Project. 					
S 7.120	6.9	<ul style="list-style-type: none"> Noise mitigation measures such as the use of quieter construction plant and temporary noise barriers should be implemented to minimize disturbance to habitats adjacent to the works areas. Temporary noise barriers should be used during the construction of the box-culvert along Tung Tsz Road, the floodwater pumping station, the mechanical gate, and drainage pipe to minimize potential construction phase disturbance to ardeids and avifauna foraging in marsh habitat. Noise generating construction works near the Shuen Wan Egretty SSSI should be avoided as far as practicable during the breeding season (March to June) of the ardeids. Works near the SSSI (i.e. installation of mechanical gate) 	To minimise disturbance impacts.	Contractor	Whole site	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		<p>should be restricted to be executed outside the breeding season by provision of special conditions in the contract document.</p> <ul style="list-style-type: none"> ▪ Hoardings with minimum height of 2m should be set up along the south side of the proposed box culvert works area adjacent to the marsh, extending at least 20m at both ends, throughout the construction period. 					
S 7.121	6.10	<ul style="list-style-type: none"> ▪ Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural or moderate-high ecological value habitats. 	To minimise disturbance to habitats.	Contractor	Whole site	Construction Phase	EIAO-TM
S 7.121	6.10	<ul style="list-style-type: none"> ▪ Construction activities should be restricted to work areas that would be clearly demarcated. The work areas should be reinstated after completion of the works. 	To minimise disturbance to natural habitats outside works area.	Contractor	Whole site	Construction Phase	EIAO-TM
S 7.121	6.10	<ul style="list-style-type: none"> ▪ Waste skips should be provided to collect general refuse and construction wastes. The wastes would be disposed of timely and properly off-site. 	To minimise disturbance to habitats.	Contractor	Whole site	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
S 7.121	6.10	<ul style="list-style-type: none"> General drainage arrangements should include sediment and oil traps to collect and control construction site run-off. 	To minimise sedimentation/water quality impacts	Contractor	Whole site	Construction Phase	EIAO-TM
S 7.121	6.10	<ul style="list-style-type: none"> Open burning on works sites is illegal, and should be strictly prohibited. 	To prevent accidental hill-fires.	Contractor	Whole site	Construction Phase	EIAO-TM
S 7.122	6.11	<ul style="list-style-type: none"> De-silting should be limited to the dry season. 	To minimise sedimentation/water quality impacts	Maintenance parties of the channel	Whole site	Operation Phase	EIAO-TM
S 7.122	6.11	<ul style="list-style-type: none"> Waste material produced during de-silting should be disposed of in a timely and appropriate manner. 	To minimise sedimentation/water quality impacts	Maintenance parties of the channel	Whole site	Operation Phase	EIAO-TM
S 7.123	6.12	<ul style="list-style-type: none"> Planting of trees should be provided within the project area to compensate for the unavoidable loss of approximately 0.08ha secondary woodland habitat due to the Project. Planting of trees and other vegetation within project area along the banks of Wai Ha River and Tung Tsz Road should be carried out to provide compensation for unavoidable tree-felling and loss of riparian vegetation resulting from the Project. The compensatory planting should make use of native plant species with flowers/fruits attractive to 	To compensate the loss of vegetation	Contractor	Whole site	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		wildlife.					
S 7.124	6.13	<ul style="list-style-type: none"> ▪ Compensation would be required for the loss of a small area of marsh habitat (about 0.30ha) within the CA resulting from the construction of the box-culvert. ▪ An existing low ecological value recreational fishpond on government land adjacent to the marsh would be used as a proposed area (about 0.8ha) for the compensation for the marsh as well as secondary woodland habitats loss (0.08ha). ▪ The pond should be enhanced by removing boardwalks around the existing pond, and restoring vegetation along the pond bunds, and it would be re-profiled to provide areas of shallow water (approximately 15-50cm deep), creating a suitable foraging habitat for avifauna, particularly ardeids and other waders. ▪ Screen planting of shrubs and trees along the south-eastern bund of the pond should be implemented to minimise 	To compensate the loss of marsh habitat and enhance the quality compensatory habitat	Contractor / qualified ecologist	The recreational fish pond located to the southwest of the existing Tung Tsz Nursery	Construction Phase	EIAO-TM

EIA Ref.	EM&A Ref.	Recommended Mitigation Measures	Objectives of the Recommended Measure & Main Concern to Address	Who to implement the measure?	Location of the measure	When to implement the measure?	What requirements or standards for the measure to achieve?
		disturbance to avifauna and other wildlife from the adjacent recreational fishpond. The enhanced pond is expected to provide a moderate-high ecological value wetland habitat.					
F Landscape and Visual							
Table 8.4	7.6	Visual screen, contaminant/sediment control, pollution control, liaison with nursery, protection of existing trees with works area and construction light are used or practiced to mitigate the impacts during construction phase.	To mitigate the landscape and visual impacts during construction phase.	Contractor	Whole site	Construction Phase	EIAO-TM
Table 8.4	7.7	Viewing area formation, architectural design for pump house, landscape design for pump house, enhancement planting along Tung Tsz Road, sufficient soil depth for enhancement planting, transplanting of trees to adjacent locations, preparation for transplanting and reinstatement of affected area are practiced to mitigate the impacts during operational phase.	To mitigate the landscape and visual impacts during the operational phase.	Contractor	Whole site	Detail Design / Operational Phase	EIAO-TM