6 ECOLOGY

6.1 INTRODUCTION

This chapter outlines the Ecological Monitoring and Audit regime for the San Tin Eastern Main Drainage Channel (73CD), including that for the Poldered Village Protection Schemes (35CD). The overall objectives of ecological monitoring and audit are as follows, based on Annex 16 of the Technical Memorandum on Environmental Impact Assessment Process:

- verify the accuracy of the predictions of the ecological assessment study;
- detect any unpredicted ecological impacts arising from the proposed development;
- monitor the effectiveness of the mitigation measures; and
- recommend action plans in response to unpredicted impacts and/or failed mitigation.

The following ecological monitoring and audit programme is proposed to meet these objectives in the most cost-effective manner. It focuses on the third and fourth objectives outlined above, monitoring the implementation of mitigation measures and identifying any required improvements or corrective measures.

No ecological monitoring is proposed to cover the construction phase of the project. Some construction phase impacts will be covered by other types of mitigation measures and monitoring (water, noise) and do not require ecological monitoring. Others (primarily habitat loss) will be mitigated by measures that will come into effect only during the operation (post-construction) phase of the project.

The operation-phase monitoring framework for the ecological impacts and mitigation measures, including the related project management regime and planting monitoring, is presented in this Section.

6.2 ECOLOGICAL MONITORING AND AUDIT REQUIREMENTS

6.2.1 *Operational Phase*

Task 1: Monitoring of Bird Use of San Tin Villages Flood Storage Pond

The objective of this task will be to monitor bird use of the flood storage pond at San Tin Villages, in order to ensure that it is providing ecological utility as predicted in the EIA Report (Paragraphs 3.6.4.6 to 3.6.4.8).

This will be accomplished by comparing bird use of the flood storage pond with bird use of three nearby fish ponds of comparable surface area. The fish ponds will provide a control, having a similar location but different construction (earthen rather than concrete bottoms, deeper water depths) and different management regimes. At least one active and one abandoned fish pond should be included in the sample. A point count approach shall be adopted, with the observer counting and identifying to species all birds using each pond (including adjacent bunds). Weather conditions and time of day during the survey shall be noted. Reporting will cover species and numbers of birds, notable behaviors, and analysis of trends over seasons and over years. Species richness, diversity and evenness shall be calculated and compared for the sites at each sampling session. Observations on management of the pond (maintenance of water level, frequency of dredging or vegetation clearance) will be recorded, and detailed information on performance of management tasks shall be sought from DSD and reported as part of the monitoring report. If bird use of the flood storage pond is concluded to be either unsatisfactory or declining over time, recommendations for altering the management measures as outlined in the EIA Report (Paragraph 3.6.4.7) shall be made to DSD.

This task will be carried out 4 times (sessions) per year, at 3-month intervals, for the first 3 years of pond operation. Bird counts will be carried out over 3 non-consecutive days (i.e. 3 replicates) during early morning for each quarterly sampling session. Point counts will cover 10-minute periods at each pond. All counts on a given day should be completed within 3 hours of sunrise. Where the duration of Task 1 overlaps with that of Tasks 2 and 4, monitoring for all three tasks should be conducted as close together in time as feasible at each monitoring session.

Task 2: Monitoring of Bird Use of Tidal Portion of Eastern Channel

The objective of this task will be to monitor whether the tidal portion of the Eastern MDC, lying downstream of the inflatable dam, is providing ecological utility as predicted in the EIA Report (Paragraph 3.6.4.10).

This will be accomplished by comparing bird use of the tidal area with bird use of a similar extent of the grasscrete channel upstream of the dam. A point count approach shall be adopted, with the observer counting and identifying to species all birds using each area. One counting point will be established in the intertidal zone, and one upstream. Weather conditions, tide level and time of day during the survey shall be noted. Reporting will cover species and numbers of birds, numbers and proportions of wetland dependent birds (cf. Final EIA Report, *Annex 3-E(2)*), noteworthy behaviours, and analysis of trends over seasons and over years. Species richness, diversity and evenness shall be calculated and compared for the two sites at each sampling session. Observations on operation and management of the dam and channel (including dam up or down, frequency of dredging or vegetation clearance) will be recorded, and detailed information on performance of management tasks shall be sought from DSD and reported as part of the monitoring report. If bird use of the tidal area is found to be significantly higher than bird use of the channel upstream of the dam, recommendations for altering the management regime of the dam and channel shall be made to DSD (refer to the EIA Report, Paragraphs 3.6.4.19 and 3.6.5.4).

This task will be carried out 4 times (sessions) per year, at 3-month intervals, for a period of 3 years starting from completion of construction. Bird counts will be carried out over 3 non-consecutive days (i.e. 3 replicates) during early morning for each quarterly sampling session. Point counts will cover 10-minute periods at each pond. All counts on a given day should be completed within 3 hours of sunrise. Where the duration of Task 2 overlaps with that of Task 4, monitoring for the two tasks should be conducted as close together in time as feasible at each monitoring session.

Task 3: Monitoring of Fish and Invertebrates in Constructed Wetland Area East of Eastern Channel

The objective of this task will be to monitor colonization, survival and abundance of fish, benthic invertebrates and chironomid flies in the constructed wetland area, as an indicator of the ecological health and self-sustainability of this wetland and to ensure that it is supporting prey species for birds (see the EIA Report, Paragraphs 3.6.4.11 to 3.6.4.12).

Fish: Three sampling locations shall be selected for fish, each in a pond or other perennial waterbody: one near the northern end of the constructed wetland, one near the middle, and one near its southern end. Fine-mesh cast nets will be used to sample fish inhabiting these waterbodies. A minimum of 3 casts will be made at each site. Captured fish will be identified to species and measured for standard length. The weight of the total catch for each cast will be recorded.

Benthic invertebrates: Sampling locations for benthic invertebrates shall be the same as those for fish. Three grab samples will be taken at each site using a 0.1 m^2 van Veen grab. Samples will be sieved using a 0.5 mm sieve, and collected organisms will be preserved for identification to the lowest possible taxon.

Chironomid flies: Three sampling locations for chironomid flies will be selected within the constructed wetland area. These should be located in areas dominated by grassy or reedy vegetation rather than open water, and should be separated as widely as possible from each other. The dominant vegetation of the sampling site should be recorded. Chironomids should be sampled using a sweep net of 1.5 mm mesh size. Fifteen sweeps should be made at each site. Results should be reported as total individuals per 15 sweeps.

The exact monitoring locations for fish, benthic invertebrates and chironomid flies can be set only after the detailed design of the constructed wetland has been completed.

To assist the interpretation of the Task 3 monitoring results, once monitoring locations for fish and benthic invertebrates are fixed, the same locations should be used for water quality monitoring in the constructed wetland. Parameters including dissolved oxygen (mg L^{-1} and % saturation), temperature (°C), pH, turbidity (NTU), water depth (m), suspended solids (mg L^{-1}) and ammoniacal nitrogen (mg L^{-1}) will be measured. A baseline water quality monitoring will be conducted right after the completion of the wetland construction, during mid ebb tide, for 4 days per week for 4 consecutive weeks, applicable with a period of six weeks. Afterwards the water quality monitoring will be carried out at the same time as the monitoring for fish, benthic invertebrates and chironomid flies (i.e. 2 times per year at 6-month intervals, for a period of 3 years following completion of wetland construction).

Reporting shall note any change in species representation, abundance, diversity or other factors that may reflect changes in the ecological function of the wetland. Seasonal variation shall be duly taken into account. Other factors, such as changes in extent or nature of vegetation or changes in water levels, that may affect the results of monitoring shall be noted.

Based on the results of monitoring, recommendations shall be made on revising the management measures for the area such as stocking of fish (see the EIA Report, *Annex 3-J*, for proposed management measures).

This task will be carried out 2 times per year at 6-month intervals, for a period of 3 years following completion of wetland construction. The first monitoring is recommended to take place 6 months after completion of wetland construction. Monitoring will be scheduled to coincide with water quality monitoring of the constructed wetland.

Task 4: Monitoring of Bird Use of Constructed Wetland Area and Eastern Channel

This task will have the objective of ensuring that the constructed wetland area is providing ecological utility to birds, as proposed (EIA Report, Paragraph 3.6.4.12). A secondary objective will be to compare bird use of the constructed wetland area to that of the adjacent Eastern MDC.

This will be accomplished by walking a set transect along the full length of the eastern embankment of the Eastern MDC, and recording birds observed on either side of the transect (east side = constructed wetland; west side = Eastern MDC). The observer shall count and identify all birds seen and heard to species, and make note of any noteworthy behaviors (feeding, breeding behaviors, etc.). Weather conditions, tide level and time of day during the survey shall be noted. Reporting will provide species lists and calculation of species richness, diversity and evenness for each side of the transect. Numbers and proportions of wetland dependent birds (cf. EIA Report, *Annex 3-E(2)*) will also be reported. Reporting shall analyze trends over seasons and over years. The species list for the San Tin area contained in *Annex 3-E(1)* of the EIA Report shall be used as a reference for historical records of birds in the area.

Observations on management of the constructed wetland area (e.g. water depths, apparent water quality, plant life) and of the Eastern MDC (e.g. dam up or down, clearance of vegetation in the grasscrete areas) will be recorded, and recommendations on changes in the management measures for both areas will be made to DSD as appropriate, with a view to maximizing the utility to birds of these areas.

This task will be carried out 4 times (sessions) per year, at 3-month intervals, for a period of 3 years starting from completion of the constructed wetland area. Each session will consist of 3 replicates of the transect on non-consecutive mornings. Replicates should be completed within 3 hours of sunrise. Where the duration of Task 4 overlaps with that of Task 2, monitoring for the two tasks should be conducted as close together in time as feasible at each monitoring session.

Task 5: Monitoring of Maintenance Regime of Eastern Channel

The objective of this task will be to monitor sediment accumulation and need for maintenance dredging in the Eastern MDC, in order to strike a reasonable balance between retention of flood capacity on the one hand and provision of useful habitat on the other.

This will be accomplished by DSD, which will monitor its own maintenance operations in the channel, including frequency of dredging and clearance of vegetation. Tasks should include measuring and recording the rate of sedimentation prior to each dredging exercise, judging the impact of such rates on the channel's flood capacity based on the Operations & Maintenance (O&M) Manual developed by the designer of the project, critically reassessing whether the frequency of dredging and vegetation clearance is justified, and reducing it if feasible. In conducting this review, DSD should liaise with the appointed ecologist that undertakes the ecological monitoring work and give due consideration to the ecological justifications for minimizing dredging, as noted in the EIA Report (Paragraph 3.6.5.1). The review should take place once annually for the first 2 years of channel operation, and thereafter at appropriate intervals throughout the operational lifetime of the channel based on DSD experience during the first 2 years.

Task 6: Monitoring of Planting for Eastern MDC

The ecological mitigation proposals also have the benefit of mitigating landscape and visual impact. It is recommended that monitoring of the planting work be undertaken, including planting to eastern embankment, constructed wetland (and associated planting) and western embankment as presented in the EIA Report (*EIA Section 9.9.1.1-3* as well as *Section 3.6.4*).

The monitoring should take place once annually for the first 3 years of channel operation, and subsequent monitoring requirement to be reviewed at the end of the 3 year monitoring period.

6.3 STAFFING

Tasks 1, 2, 3 and 4 shall be carried out by a qualified ecologist appointed by TDD, with a degree in biological or ecological science and 3 years of local experience in ecological monitoring. For Tasks 1, 2 and 4, the appointed ecologist must be able to identify the bird species occurring in the San Tin area. For Task 3, the appointed ecologist must be able to identify freshwater and brackish-water fish and aquatic invertebrate species of Hong Kong.

Task 5 shall be carried out by DSD staff.

Task 6 shall be carried out by TDD or appointed consultant who is the appointed ecologist or a registered landscape architect.

6.4 REPORTING

An Operations Monitoring Report on the results of monitoring Tasks 1, 2, 3 and 4 shall be submitted twice per year. Each report shall cover results of the previous 6 months of monitoring, and shall also discuss any long-term trends or interim conclusions reached based on the monitoring results to date. Each report will devote a chapter to discussing the ecological effects of DSD's operation and maintenance of the flood storage pond and the Eastern MDC, and of the management of the constructed wetland. Prior to submission of each report, the ecologist will liaise with DSD to review current management procedures of the flood storage pond and Eastern MDC (findings of Task 5) and with other relevant Government authorities to review management of the constructed wetland. Similarly the ecologist will liaise with TDD/appointed consultant to review the monitoring of planting and address in the report. The ecologist will, in cooperation with these authorities, investigate ways to improve the management of these areas where necessary to ensure that the ecological value predicted in the EIA report is realized. Results of liaison, and recommendations on alteration of management procedures where appropriate, will be reported in each Operations Monitoring Report. Each Operations Monitoring Report will be submitted to DSD, TDD, AFD and EPD for review and comment.

The final Operations Monitoring report shall be submitted upon the conclusion of the 3-year monitoring programme for Tasks 1, 2, 3 and 4. This report shall summarize the overall findings of the programme. It shall also outline and justify any need for further ecological monitoring, and any need for continued periodic review of management of the flood storage pond, Eastern MDC and constructed wetland, and will identify the parties to be responsible for such monitoring and review. The final report shall be submitted to DSD, TDD, EPD and AFD for review and consideration.