BHANJA CHEUNG & CO.

for

Excel Engineering & Technology
(International) Limited

in association with

Urbis Limited
Philip So & Associates Limited
Prudent Design Limited

Development of SkyCity Golf Course



Revised Project Profile
27 July 2005

Airport Management Services Limited

CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1. BASIC INFORMATION

1.1 Project Title

1.1.1 Interim Ancillary Recreation and Golf Facility Development, North Commercial District, Hong Kong International Airport (the "Project").

1.2 Purpose and Nature of the Project

Overview of the Project

1.2.1 The purpose of this Project is to construct and temporarily operate a 9-hole Golf Course, without the use of artificial chemicals, at the east side of the North Commercial District (NCD) on the Airport Island as an interim arrangement of the site prior to the area's future development as a business park. The proposed interim golf facility, known as "SkyCity Golf Course" is intended to serve airport passengers, overseas visitors and airport workers until at least August 2013.

1.2.2 In addition to the 9-hole Golf Course itself, associated infrastructure facilities such as an irrigation system, a sub-surface drainage system, artificial lake and stream system, a connection to the existing sewerage system, a maintenance area, a car park and a clubhouse will be constructed and temporarily operated at the site.

Viability in Terms of Location

1.2.3 The Golf Course will comprise areas of turfgrass, landscaped areas and also an artificial lake system, each of which has the potential to attract birds for foraging, nesting or drinking. Clearly, given the location of the Sky City Golf Course close to an international airport, aircraft safety in terms of the risk bird-strike is a concern. Hence, the viability of the Project itself at this location is a fundamental issue.

1.2.4 As described in Sections 3.11 and 5.10, the design of Sky City Golf Course has taken into consideration the issue of bird-strike and aircraft safety. The turfgrass, landscaped areas and artificial lake have been designed so as to be unattractive to birds – the turfgrass will not produce seeds and therefore will not provide foraging; the landscaped areas do not provide any perching or nesting areas by strict selection of tree and shrub species; and the lake is vertically sided thereby preventing wading and drinking. Furthermore, the Airport Authority and the Civil Aviation Department (the authority on aviation safety in Hong Kong) have both reviewed and confirmed the designs for Sky City Golf Course. Thus, there will be no increase in risk of bird-strike and therefore no reduction in aviation safety as a result of this Project.

1.2.5 Finally, it should be noted that there are numerous examples world-wide of golf courses located at or near to international airports, including Changi Airport in Singapore (with four 18-hole golf courses to the south), Schiphol Airport in the Netherlands (with an 18-hole golf course), Brisbane Airport in Australia (with an 18-hole golf course), Dallas/Fort Worth Airport, USA (with an 18-hole course), etc. It is therefore considered that the viability of locating a golf course at or near to an airport has been proved by reference to overseas experience.

Viability in Terms of "Chemical-free" Operation

1.2.6 Traditionally, golf courses have used artificial chemical fertilises and pesticides to maintain the turfgrass to high standards but often, as a result, have caused environmental pollution. Given the location of Sky City Golf Course within the areas frequented by Chinese White Dolphins and close to the ecologically sensitive Tung Chung Bay, the Project Proponent has committed to operating the golf course using "organic" principles, without the use of artificial chemical fertilisers or pesticides. The viability of such an approach, however, is fundamental to the operation of Sky City Golf Course.

1.2.7 In Hong Kong, there is one other golf facility that operates using "organic" principles – the Oriental Golf Club "Golf City" at Kai Tak successfully operates without the use of artificial chemical fertilises and pesticides, and on this basis was granted an Environmental Permit (No. EP-189/2004) on 21 April 2004 via direct application under Section 5(1)(b) of the EIAO.

1.2.8 Overseas, there are a numerous "organic" golf courses that have operated for a number of years, many having been certified as "organic" by the same international accreditation bodies that certify organic farms. Examples include Granite Ridge Lodge (Wisconsin, USA), Wawona Golf Course in Yosemite National Park (California, USA), Blackburn Meadows (British Columbia, Canada), Fiddler's Green (Nova Scotia, Canada), Clear Lake Golf Course in Riding Mountain National Park (Manitoba, Canada), Kabi Golf Course (Queensland, Australia), etc.

1.2.9 As described above, there are both local and overseas examples of the successful operation of golf courses using "organic" principles. Experience from some of the overseas golf courses listed above suggests that "organic" golf courses can be more labour-intensive, e.g. in controlling weeds. Nevertheless it has been successfully demonstrated that "chemical-free" golf courses are viable.

1.3 Name of Project Proponent

1.3.1 The project proponent is Airport Management Services Limited.

1.4 Location and Scale of Project and History of Site

Location and Scale of Project

1.4.1 The location of the Project is at the Airport Island, North of Lantau Island, as shown in Figure 1.1, about 500m east of the existing Passenger Terminal on the cleared site of one of the former temporary "villages" set up during airport construction in the 1990s. The site is fully contained on the Airport Island and will be developed entirely on existing land.

1.4.2 The preliminary layout of the Project is shown in Figure 1.2 and a typical cross-section is shown in Figure 1.3. The Project is small scale, with a total area of 11.56ha. Upon completion of construction, the Project will comprise :

- An executive 9-hole Golf Course (comprising greens, tees, fairways, rough, bunkers, lakes and streams).
- A clubhouse (comprising reception, snack bar/restaurant, changing rooms/restrooms and pro shop). The maximum Gross Floor Area (GFA) of the clubhouse will be 1,200m^2, and the maximum building height will be 6m.
- Refreshment counters.
- Maintenance building and yard. The maintenance building maximum GFA will be 1,500m^2, and the maximum building height will be 6m.
- Car parking – a maximum of 80 spaces.
- Two loading/unloading Bays and two boarding/alighting Lay-bys.

1.4.3 The Golf Course is designed to operate from 6am to 11pm, or later, as night-golf is possible with a proposed floodlighting system. The course can accommodate around 44 golfers at any one time, or up to 464 golfers in a day (depending on opening hours) and will require about 50 full-time staff to provide an executive level of service.

History of the Site

1.4.4 The development of the Hong Kong International Airport was the major component of the Airport Core Programme. Under the Environmental Impact Assessment Ordinance (EIAO) enacted in April 1998, the construction and operation of the airport was an exempted project.

1.4.5 A New Airport Master Plan (NAMP) prepared in 1991 provided a comprehensive and environmentally acceptable scheme for the development of the Airport. The outcome of the NAMP was a range of proposed construction practices, preliminary infrastructure designs and operational forecasts, from which detailed designs were developed. The New Airport Master Plan – Environmental Impact Assessment (NAMP-EIA) then addressed all anticipated environmental impacts likely to arise from the airport development and proposed a range of environmental mitigation measures and environmental monitoring and audit requirements for the design, construction and operation phases.

1.5 Number and Type of Designated Project to be Covered by the Project Profile

1.5.1 Development of an outdoor golf course is a Designated Project (Item O.1) under the "Tourist and Recreational Developments" category of Part 1, Schedule 2 of the EIAO. There is only one Designated Project covered by this Project Profile, namely the construction and operation of SkyCity Golf Course.

1.5.2 When the Golf Course land use is replaced by the later expansion of SkyCity, the temporary Golf Course will be decommissioned. Decommissioning of the Project is not included as part of this Project Profile, but is discussed in Appendix A, which concludes that no adverse environmental impacts are expected from decommissioning. The preparation of this Project Profile has been guided by the contents and checklist provided in the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM) Chapter 2 and Annex 1 – Project Profile for Designated Project.

1.6 Name and Telephone Number of Contact Person

Company	Airport Management Services Limited	(Project Proponent)
Contact	Mr Ricky Li	(Assistant Managing Director)
Address	36/F Enterprise Square Two 3 Sheung Yuet Road Kowloon Bay Hong Kong	
Telephone	2755 1555	
Facsimile	2795 3722	
Email	ricky@kingpower.com	

1.7 Summary of Environmental Assessments

1.7.1 The assessments carried out in this Project Profile demonstrate that the environmental impact of this Project will not be adverse. Furthermore, the mitigation measures proposed in this Project Profile meet the requirements of the EIAO-TM.

1.7.2 Based on the above, the Project Proponent considers that the environmental impact of the Project falls well within the guidelines and criteria laid down in the EIAO-TM, and the effectiveness of the proposed mitigation measures has been demonstrated in practice.

1.8 Summary of Key Environmental Protection Features of SkyCity Golf Course

1.8.1 This sub-section provides an overview of the design environmental protection features of SkyCity Golf Course that have been included to minimise and manage environmental impacts arising from construction and operation of the Project.

The Golf Course and Supporting Facilities

1.8.2 The Project site is located within a catchment area of some 38ha that is drained via Outfall No. 8 into the surrounding marine waters. Of the total 11.56ha Project area, the landscaped Golf Course occupies 10.5ha, comprising fairways, tees and greens (2.8ha), sand bunkers (1.3ha), off-course rough (5.1ha) and an artificial lake and stream system (1.3ha). The remainder of the site is occupied by the clubhouse, car park, maintenance sheds, etc.

1.8.3 Water from the lakes will be used to irrigate the landscaped areas, supplemented by bore water. The topography of the Golf Course, the subsurface drainage design and the surrounding 1.5m high landscaped bund will ensure that rainfall and irrigation water are channelled into the lakes and do not flow off-site in an uncontrolled manner.

Environmental Issues

1.8.4 There are two main potential environmental issues, both relating to water quality, and consequential impacts on the surrounding marine environment, in particular Chinese White Dolphins. The first issue relates to silt-laden run-off potentially discharging from the site during the early construction phase and the second issue relates to discharge from the Golf Course and its potential to impact surrounding marine waters during the operation phase.

1.8.5 In terms of the first, this can be satisfactorily addressed through good site practice that will be adopted by the Contractor, such as *ProPECC PN 1/94*. In terms of the second, a number of key environmental protection features prevent discharge from causing adverse impacts to the marine environment through minimising the volume of run-off, preventing the use of artificial chemical fertilisers and pesticides, and limiting the amounts of organic nutrients through a comprehensive Turfgrass Management Plan (TMP). Thus, the controlled release of water from the Golf Course will not be contaminated by any artificial chemicals and will not result in a significant increase in nutrient loading. It will effectively be only "clean" water that is discharged and, as such, this will not have any adverse environmental impact.

1.8.6 Because of its location on newly formed land and its distance from sensitive receivers, the environmental impacts anticipated from the Project in terms of air, noise, terrestrial ecology, waste, landscape and visual and cultural heritage will not be significant. The validity of these conclusions is demonstrated in the main text and appendices of this Project Profile.

Environmental Design Features

1.8.7 Three key benefits are provided from the environmental design features discussed below :

- **NO Artificial Chemical Fertilisers.** Artificial chemical fertilisers will not be used at any time. Instead, by using only organic nutrients, there is absolutely no possibility for artificial chemical fertilisers, such as inorganic nitrogen, to enter the environment.
- **NO Artificial Chemical Pesticides.** Artificial chemical pesticides will not be used at any time. Instead, an Integrated Pest Management (IPM) approach will be adopted in which biological pest control will be used – this relies on naturally occurring organisms that are non-toxic to non-target species and are environmentally safe to use. As such, there is absolutely no possibility for artificial chemical pesticides to enter the environment.
- **NO Discharge of Contaminated Water.** Environmental Monitoring and Audit (EM&A) of lake water will demonstrate that water is of an acceptable quality and will not cause any environmental impact when released. However, should monitoring show that lake water quality is unacceptable then control valves will be closed, thereby preventing water from being discharged until such time as the quality improves.

<u>Use of Organic Nutrients</u>

1.8.8 During establishment and maintenance of the Golf Course, **artificial chemical fertilisers will not be used**. By using organic nutrients instead, no artificial chemicals, such as

inorganic nitrogen, will be washed off the Golf Course – Total Inorganic Nitrogen (TIN), which is of concern in the waters surrounding the Airport Island, is not present in organic nutrients. By carefully controlling the quantities of organic nutrients applied, water within the lakes can be maintained at an acceptable quality and this will avoid any adverse impact on surrounding marine water quality when lake water is discharged (see paragraph 1.8.17).

Integrated Pest Management (IPM) and Use of Biological Pest Control

1.8.9 It is proposed to follow the Agriculture, Fisheries and Conservation Department (AFCD) IPM approach in order to control pests through cultural and biological means. **Artificial chemical pesticides will not be used**. As part of adopting the IPM approach, biological pest control will be used. AFCD have registered a number of biological organisms for use in Hong Kong, and it is proposed that these form part of the IPM. Biological pest control uses naturally occurring organisms and so avoids problems associated with artificial chemical pesticides, which can bio-accumulate within the ecosystem. Biological pest control is non-toxic to non-target species and an environmentally safe alternative to artificial chemical pesticides.

Sub-surface Drainage Control

1.8.10 Much of the course (i.e. the greens, tees, fairways bunkers, rough and lakes) is located above the impermeable granite bedrock that was the former Chek Lap Kok island, as shown on Figure 1.4 Only the southern end of the site and a thin sliver along the northern boundary lie over areas of permeable reclamation fill. The clubhouse is deliberately located over the reclamation area so that the area of Golf Course located over reclamation fill is minimised. Subsurface drainage design (shown on Figure 1.3) significantly restricts vertical infiltration of water. Since organic nutrients and biological pest control will be used exclusively, any water that does infiltrate through the base of the site will be free from artificial chemicals. Only very small amounts of infiltrated water (estimated at <5%) will permeate through the compacted layer and into the ground beneath the site. Anecdotal evidence from elsewhere on the Airport Island indicates that the granite bedrock remains generally impermeable.

Containment of Surface Run-off

1.8.11 The existing site is essentially flat. The Golf Course will be formed as a gently undulating landform. A continuous bund, minimum 1.5m high, will be formed around the perimeter of the Golf Course to contain run-off. At the same time, the artificial lakes and stream system will be constructed with an impermeable liner system to retain water. All surface water run-off from rainfall and irrigation will be directed inwards to the lakes via surface falls (shown in Figure 1.3) and a subsoil drainage system (shown in Figures 1.3 and 1.5) such that there is no discharge off the Golf Course in an uncontrolled manner.

Water Cycle and Nutrient Removal

1.8.12 Irrigation water will be pumped from the lakes and sprayed onto the grass on a daily basis. The constant re-circulation of water for irrigation will provide natural filtering and will ensure that surplus nutrients within the lake water are taken up by the turfgrass during each irrigation cycle, thereby removing nutrients from the lakes. Water that is not held within the upper soil layers will infiltrate downwards through the highly permeable sand layer. Water not taken up by plant roots will infiltrate down to the upper surface of the compacted sub-base layer. At this point the majority of infiltrated water will then flow laterally towards the lakes following the falling gradient, augmented by a subsoil drainage system located in swales and other low-points in the topography. A profile of the sub-soil drainage layer is shown on Figure 1.3. Monitoring of lake water will be carried out regularly to confirm that water quality is acceptable. If not, the TMP may be modified to return lake water to an acceptable quality.

Artificial Lakes and Sediment Removal

1.8.13 The main purposes for retaining water in the lakes are to provide a source of water for irrigation and to prevent run-off from the Golf Course from directly entering the sea. The

lakes are approximately 11,000m^2 in area and hold 13,000m^3 of water at normal water level. 400mm of "freeboard" provides an additional 4,500m^3 capacity, giving a total of 17,500m^3. The salt content of the lake water will be maintained at an elevated level (by replenishment with saline borewater or by pumping in seawater, if necessary) such that irrigation water will be of sufficient salinity to discourage weed growth. This will not affect the *Paspalum* turfgrass, which is salt-tolerant (see below).

1.8.14 The lakes will allow any sediments contained within the run-off to settle out, thereby clarifying the remaining water. Drawing off water for irrigation and the use of ornamental fountains within the lake will prevent the lake from stagnating and will prevent the surface from becoming still. This will discourage mosquitoes from breeding in the lake, as will the elevated salt-content of the water (for some species). In keeping with the use of biological pest control, *Bacillus thuringiensis israelensis* and *Bacillus sphaericus* (both bacterial larvicides) will be used to kill mosquito larvae, if required, and are non-toxic to other species. As target-specific measures recommended by AFCD for use in the conditions that will exist in the golf course lake, the use of these larvicides is considered adequate.

Water Retention Design

1.8.15 When the 400mm freeboard is exceeded, and only when EM&A of lake water has shown that the quality is acceptable, the lake is designed to overflow through overflow pipes into Outfall No. 8. However, if monitoring indicates that water is not of acceptable quality then the overflow pipes will closed by a control valve and all flow to Outfall No. 8 will be prevented. Any subsequent rainfall may cause the Golf Course to flood and the 1.5m high bund will retain up to 90,000m^3 of floodwater (in addition to the 17,500m^3 lake capacity) to prevent discharge of water off site. In this situation, water samples from the flooded Golf Course will be taken more frequently and only when water has returned to an acceptable quality will the control valve be opened and can water then discharge through the overflow pipes into Outfall No. 8 (see Figure 1.5).

Use of *Paspalum* Turfgrass

1.8.16 It is proposed to use *Paspalum* (and its variant "SeaIsle1") as the predominant turfgrass species. *Paspalum* has excellent salt tolerance and can be irrigated with brackish water or even undiluted seawater with proper management. It tolerates grey water and effluent and handles a wide range of soil pH levels. *Paspalum* has a high tolerance to salt spray, water logging and periodic inundations (e.g. should the Golf Course flood). It has low nutrient requirements and a reduced susceptibility to pests. Because of its salt tolerance, saline water can be used for irrigation which will minimise use of fresh water and also deter the growth of weeds (since most weeds do not tolerate salt). *Paspalum* has been used on two other golf courses in Hong Kong (Shek O Country Club and OGC Golf City, Kai Tak) and at two golf centres in Shenzhen (Sand River Golf Club and Shenzhen Golf Club). It has proved to be both very playable and also environmentally friendly.

Turfgrass Management Plan (TMP)

1.8.17 A TMP will be developed during the design of the Project and followed throughout the establishment and maintenance of the Golf Course. An outline TMP is included in Appendix B for reference, however, it should be noted that a Project-specific TMP will be prepared and submitted to EPD and AFCD for review and approval prior to the commencement of the turfgrass establishment period). The TMP will specify nutrient application and biological pest control during establishment and maintenance periods, and irrigation requirements throughout the year. To prevent run-off and to maintain water quality within the lakes, the TMP will specify there shall be no application of organic nutrients or biological pest control when it is raining, when rain is expected or when a Rainstorm Warning or a Typhoon Signal No. 3 or above is issued.

Figure 1.1 : Location of SkyCity Golf Course on the Airport Island

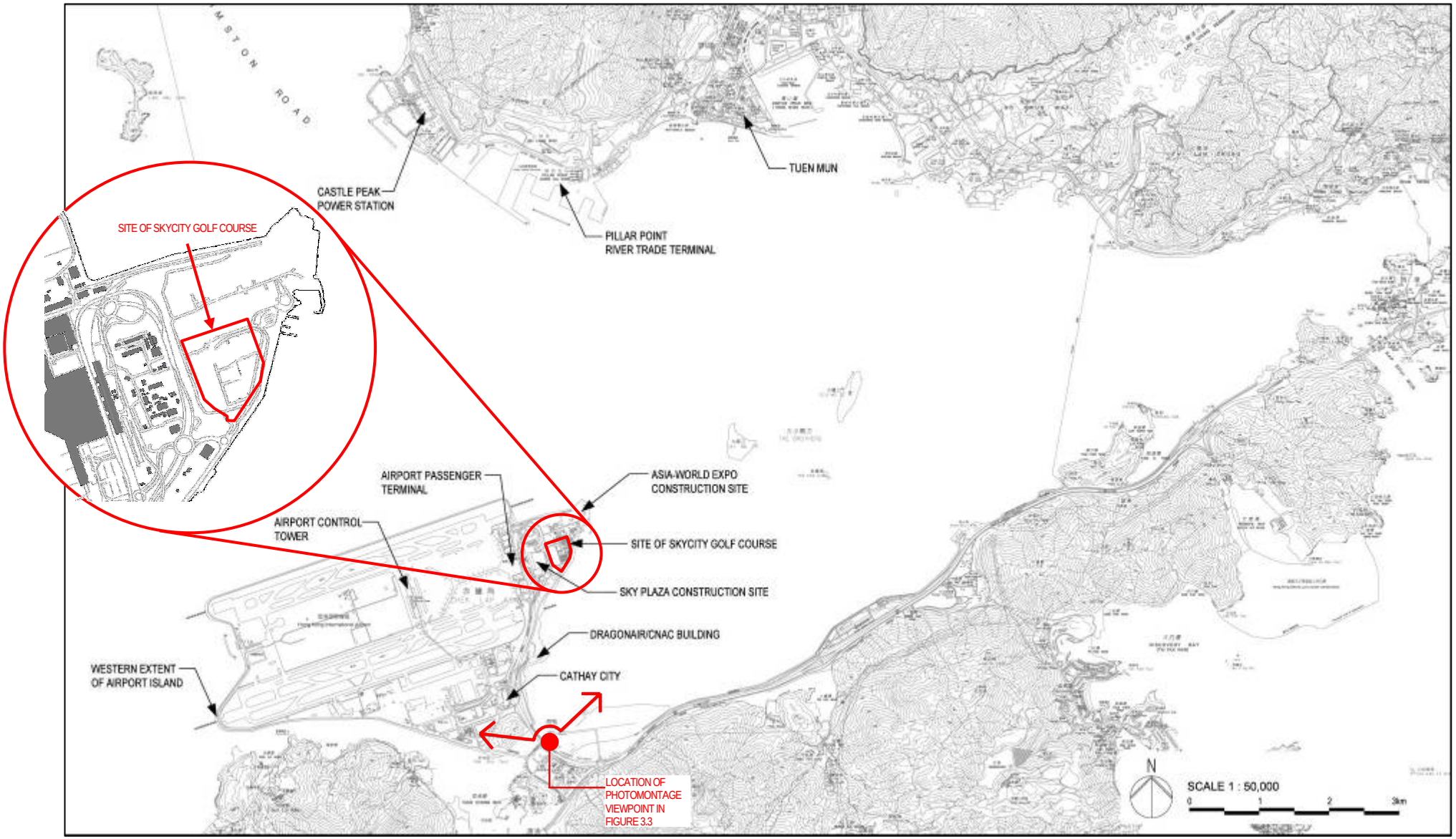


Figure 1.2 : Indicative Layout

HOLE	PAR	LENGTH (m)	LENGTH (yd)
1	3	110	120
2	3	150	165
3	3	130	145
4	3	180	195
5	4	290	320
6	3	90	100
7	3	130	140
8	3	105	115
9	4	305	330
	29	**1490**	**1630**

Figure 1.3 : Typical Cross-section

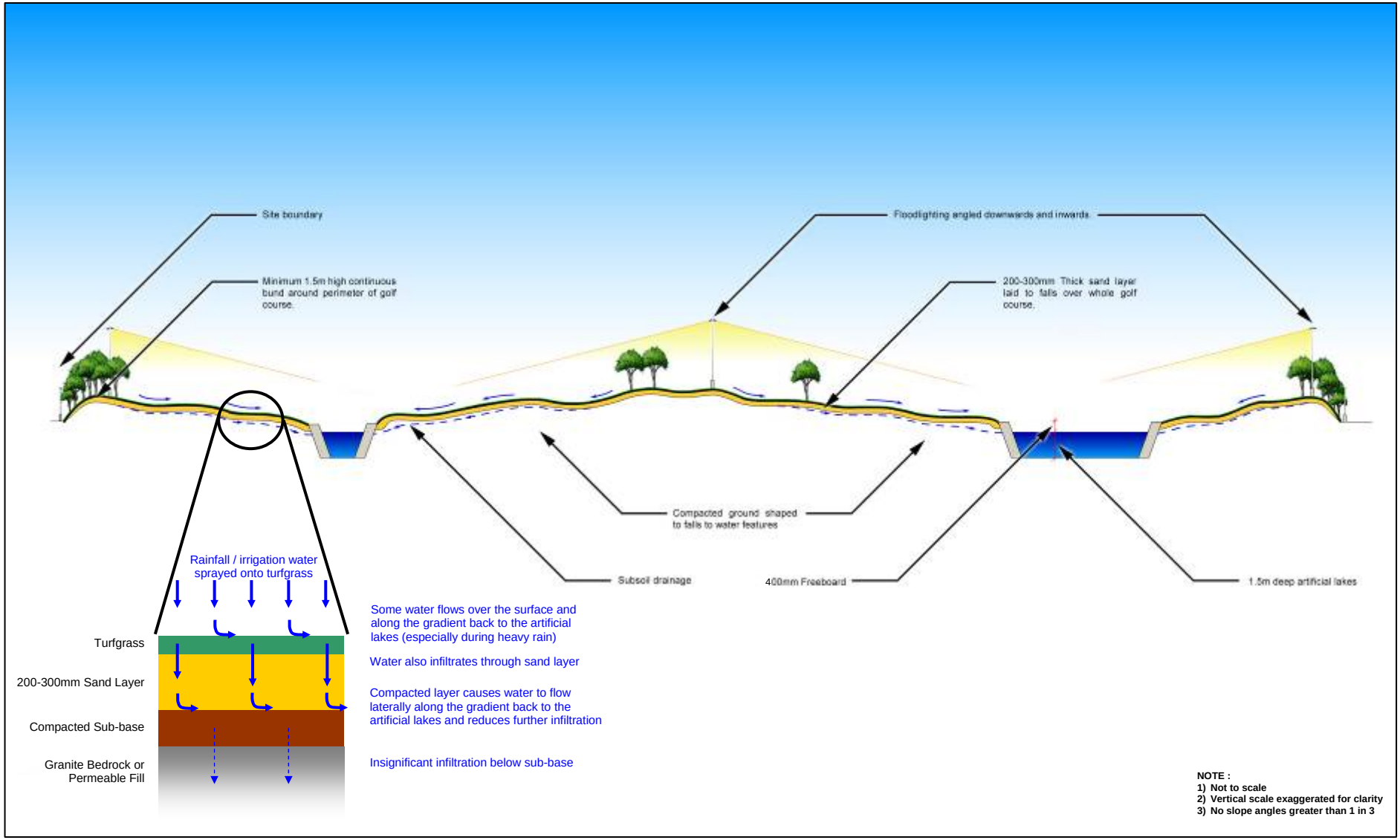


Figure 1.4 : Summary of Environmental Design Features

Use of Organic Nutrients. During establishment and maintenance of the Golf Course, **artificial chemical fertilisers will not be used**. By using organic nutrients instead, no artificial chemicals, such as inorganic nitrogen, will be washed off the Golf Course. Total Inorganic Nitrogen (TIN), which is of concern in the waters surrounding the Airport Island, is not present in organic nutrients. The use of organic nutrients will avoid any adverse impact on marine water quality in the surrounding environment.

Integrated Pest Management. It is proposed to follow the Agriculture, Fisheries and Conservation Department (AFCD) IPM approach in order to control pests through cultural and biological means. **Artificial chemical pesticides will not be used**.

Use of Biological Pest Control. During establishment and maintenance of the Golf Course, **artificial chemical pesticides will not be used**. As part of adopting the IPM approach, biological pest control will be used. AFCD have registered a number of biological organisms for use in Hong Kong, and it is proposed that these form part of the IPM. Biological pest control uses naturally occurring organisms and so avoids problems associated with artificial chemical pesticides, which can bio-accumulate within the ecosystem. Biological pest control is non-toxic to non-target species and an environmentally safe alternative to artificial chemical pesticides.

Closed-loop Water Cycle. Irrigation water will be pumped from the lakes and sprayed onto the grass every morning. The constant re-circulation of water for irrigation will provide natural filtering and will ensure that surplus nutrients within the lake water are taken up by the turfgrass during each irrigation cycle, thereby removing nutrients from the lakes. Water that is not held within the upper soil layers will infiltrate downwards through the highly permeable sand layer. Water not taken up by plant roots will infiltrate down to the compacted sub-base layer. At this point the majority of infiltrated water will then flow laterally towards the lakes following the falling gradient, augmented by a subsoil drainage system located in swales and other low-points in the topography. A profile of the sub-soil drainage layer is shown on Figure 1.3. Monitoring of lake water will be carried out regularly to confirm that water quality is acceptable. If not, the TMP may be modified to return lake water to an acceptable quality.

Turfgrass Management Plan. A TMP will be developed during the design of the Project and followed throughout the establishment and maintenance of the Golf Course. An outline TMP is included in Appendix B for reference, however, it should be noted that a Project-specific TMP will be prepared and submitted to the appropriate Authority for review and approval prior to the commencement of the establishment period for the turfgrass). The TMP will specify nutrient application and biological pest control during establishment and maintenance periods, and irrigation requirements throughout the year. To prevent run-off and to maintain water quality within the lakes, the TMP will specify there shall be no application of organic nutrients or biological pest control when it is raining, when rain is expected or when a Rainstorm Warning or a Typhoon Signal No. 3 or above is issued. This will prevent the application from needlessly being washed off and thereby will maintain the water quality in the artificial lakes.

Artificial Lakes and Sediment Removal. The main purposes for retaining water in the lakes are to provide a source of freshwater for irrigation and to control run-off from the Golf Course. The lakes are approximately 11,000m² in area and hold 13,000m³ of water at normal water level. The lakes are also designed with a minimum 400mm freeboard between normal lake water level and the overflow level to allow water levels to fluctuate in response to rainfall and irrigation. The 400mm of freeboard provides an additional 4,500m³ capacity, giving a total of 17,500m³. The lakes will allow any sediments contained within the run-off to settle out, thereby clarifying the remaining water. Drawing off water for irrigation and the use of ornamental fountains within the lake will prevent the lake from stagnating and will prevent the surface from becoming still. One benefit of this to discourage mosquitoes from breeding in the lake and the high salt-content of the water is also unattractive to a number of mosquito species.

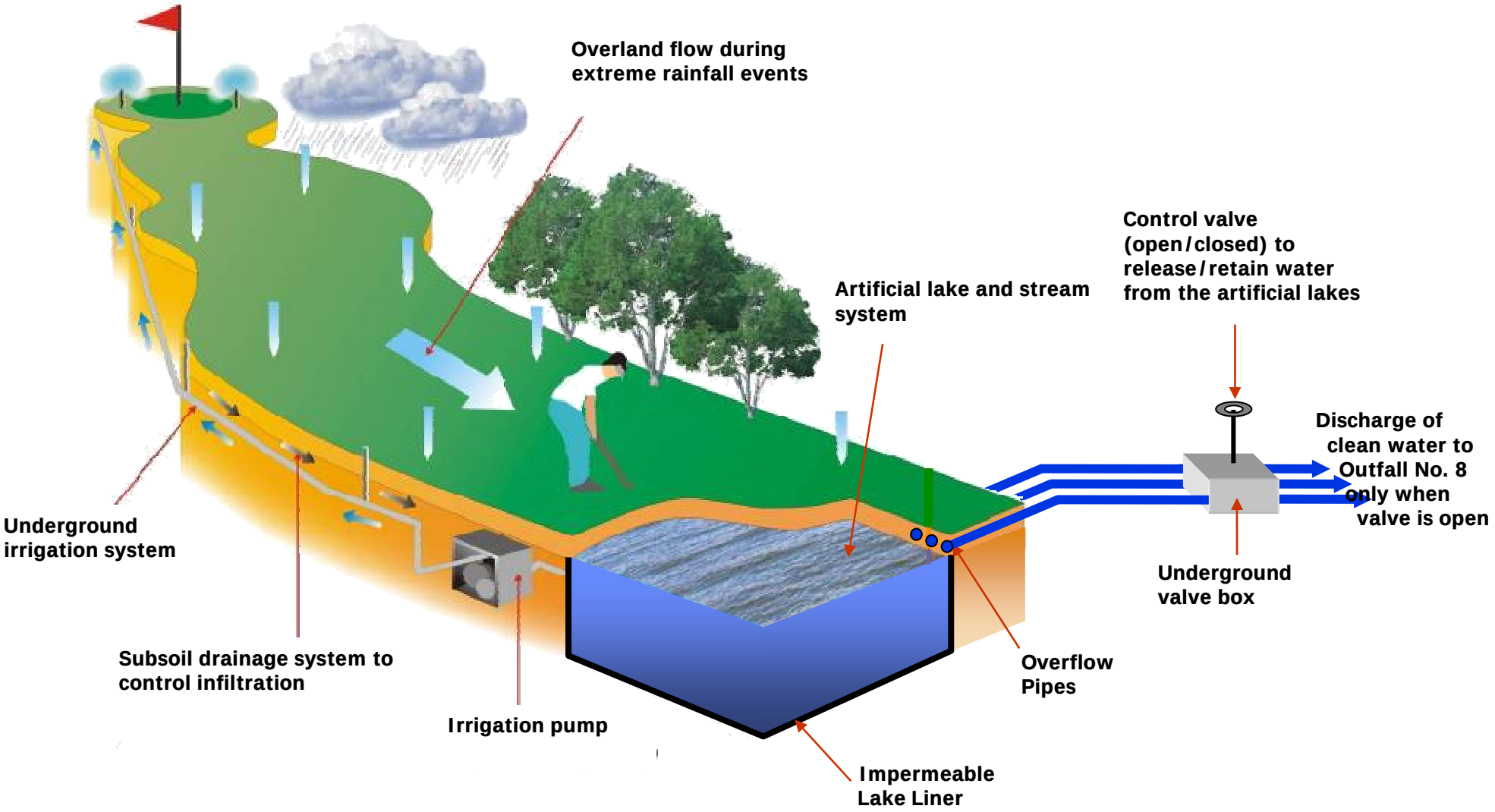
Containment of Surface Run-off. The existing site is essentially flat. The Golf Course will be formed as a gently undulating landform. A continuous bund, minimum 1.5m high, will be formed around the perimeter of the Golf Course to contain run-off. At the same time, the artificial lakes and stream system will be constructed, all with an impermeable liner system to retain water. All surface water run-off from rainfall and irrigation will be directed inwards to the lakes via surface falls (shown in Figure 1.3) and a subsoil drainage system (shown in Figures 1.3 and 1.5) such that there is no discharge off the Golf Course in an uncontrolled manner.

Sub-surface Drainage Control. Much of the course (i.e. the greens, tees, fairways bunkers, rough and lakes) is located above the impermeable granite bedrock that was the former Chek Lap Kok island. Only the southern end of the site and a thin sliver along the northern boundary lie over areas of permeable reclamation fill. The clubhouse is deliberately located over the reclamation area so that the area of Golf Course located over reclamation fill is minimised. Subsurface drainage design restricts vertical infiltration of water. Since organic nutrients and biological pest control will be used exclusively, any water that does infiltrate through the base of the site will be free from artificial chemicals.

Use of Paspalum Turfgrass. It is proposed to use Paspalum as the predominant turfgrass species. Paspalum has excellent salt tolerance and can be irrigated with brackish water or even undiluted seawater with proper management. It tolerates grey water and effluent and handles a wide range of soil pH levels. Paspalum has a high tolerance to salt spray, water logging and periodic inundations (e.g. should the Golf Course flood). It has low nutrient requirements and a reduced susceptibility to pests. Because of its salt tolerance, saline water can be used for irrigation which will minimise the use of fresh water and also deter the growth of weeds (since most weeds do not tolerate salt), thereby obviating the need for herbicides. Paspalum has been used on two other golf courses in Hong Kong (Shek O Country Club and OGC Golf City, Kai Tak) and at two golf centres in Shenzhen (Sand River Golf Club and Shenzhen Golf Club). It has proved to be both very playable and also environmentally friendly. The use of Paspalum will enable saline water to be used for irrigation, thus minimising the use of fresh water, and also enhancing weed control.

Water Retention Design. When the 400mm freeboard is exceeded, and only when EM&A of lake water has shown that the quality is acceptable, the lake is designed to overflow through overflow pipes into Outfall No. 8. However, if monitoring indicates that water quality is not of acceptable quality then the overflow pipes will be closed by a control valve and all flow to Outfall No. 8 will be prevented. Instead, the Golf Course will flood and the 1.5m high bund will retain up to 90,000m³ of floodwater (in addition to the 17,500m³ lake capacity) to prevent discharge of water off site. In this situation, water samples from the flooded Golf Course will be taken more frequently and only when water has returned to an acceptable quality will the control valve be opened and can water then discharge through the overflow pipes into Outfall No. 8 (see Figure 1.5).

Figure 1.5 : 3D Visualisation of Irrigation / Drainage Scheme



2. OUTLINE PLANNING AND IMPLEMENTATION PROGRAMME

2.1.1 According to the conceptual land use outline in the NAMP, an Outline Zoning Plan (OZP) was developed. With reference to the latest OZP No. S/I-CLK/8, the north-eastern part of the Airport Island, where the proposed interim golf facility will be located, is zoned "Commercial". This area is designated as the North Commercial District by the Airport Authority Hong Kong.

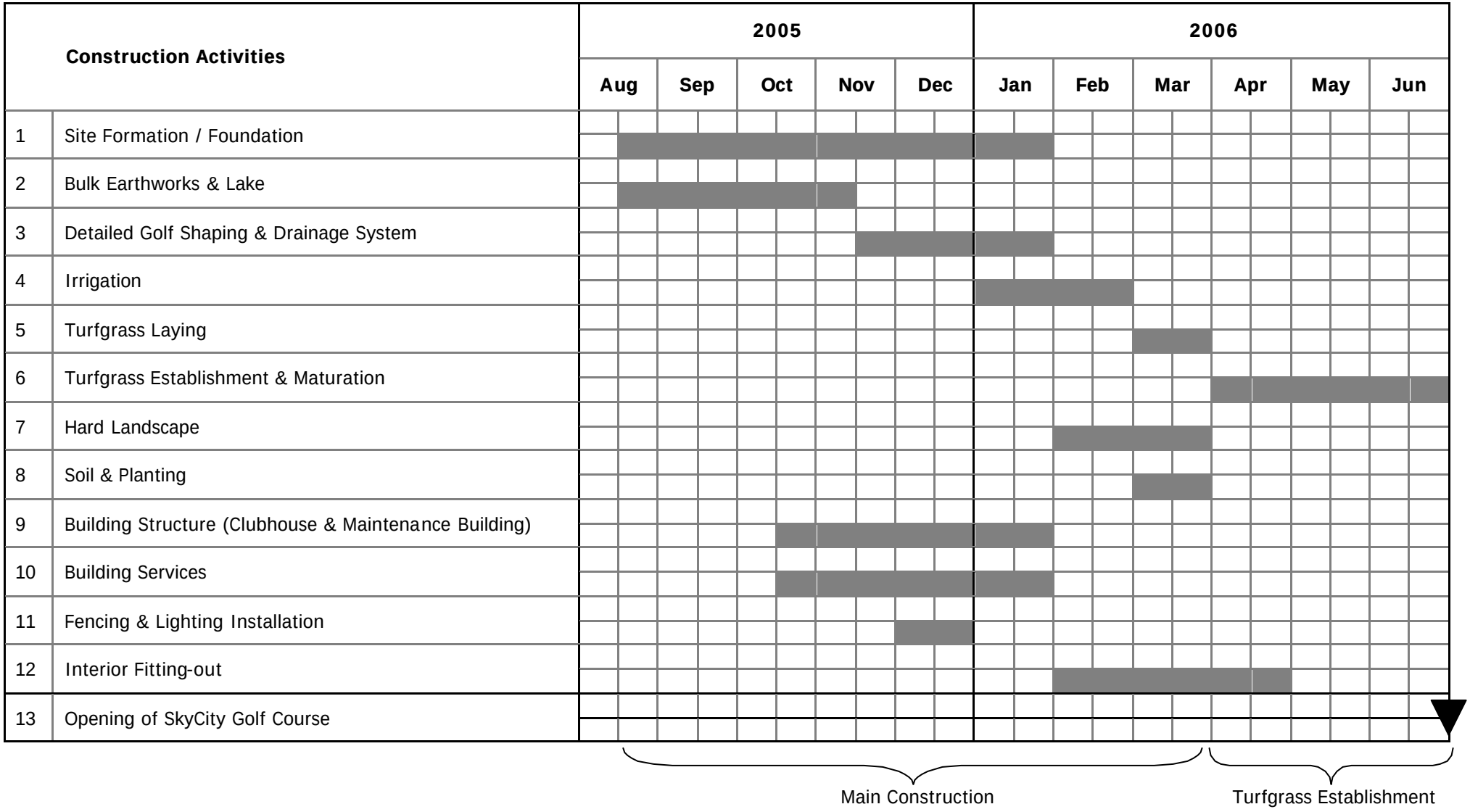
2.1.2 The North Commercial District will be developed as "SkyCity" in which Sky Plaza, an exhibition centre, a cross-boundary passenger ferry terminal complex and hotel, a business park, and an Automated People Mover (APM) are planned. The concept of the SkyCity is in its planning stage with various phases to be implemented at different time frames.

2.1.3 As an interim arrangement, it is proposed to develop part of the area as a temporary golf facility until later phases of the SkyCity are implemented. On 15th August 2003, the Town Planning Board approved an application from the Airport Authority for a temporary golf facility for a period of 10 years. As this period will need to include design and construction, construction should commence as soon as possible to allow the maximum operation period. When the Golf Course land use is replaced by the later expansion of SkyCity, the temporary Golf Course will be decommissioned. Decommissioning of the Project is not included as part of this Project Profile, but is discussed in Appendix A, which concludes that no adverse environmental impacts are expected from decommissioning.

2.1.4 The existing infrastructure, such as sewerage and drainage systems that serve the North Commercial District, will support the proposed interim golf facility and associated facilities. In addition to being a recreational facility for airport passengers, overseas visitors and local residents, the proposed development will also add landscape and visual value to the surroundings.

2.1.5 The current construction programme for the Project is shown in Figure 2.1, with the construction broken down into "main construction" and "turfgrass establishment", which is discussed in Section 3.3.

Figure 2.1 : Programme



3. POSSIBLE IMPACT ON THE ENVIRONMENT

3.1 Summary

Construction Phase

3.1.1 The main construction activities include earthworks, landscaping, construction of connecting infrastructure (such as drainage), minor building works for the clubhouse and car park and the establishment of turfgrass.

3.1.2 Possible water quality concerns relating to run-off into the marine environment will be addressed through good site practice during construction and through the adoption of de-silting chambers and/or sedimentation tanks, the designs of which have been proved to be effective. The Contractor will also be required to apply for a Discharge Licence under the Water Pollution Control Ordinance (WPCO) and to meet conditions stipulated in the Licence to protect off-site water quality. There will not be any significant impacts during construction in terms of air, noise, waste, ecology, fisheries, landscape and visual or cultural heritage.

3.1.3 In summary, therefore, **environmental impacts anticipated during the construction phase of this Project will not be adverse** and are expected to be negligible. Based on the assessments carried out, the environmental impact of constructing SkyCity Golf Course is considered to fall well within the guidelines and criteria laid down in the EIAO-TM, and the effectiveness of proposed mitigation measures has been demonstrated in practice.

Operation Phase

3.1.4 The main operation phase activities are establishment and maintenance of the Golf Course.

3.1.5 Possible water quality concerns relate to discharge of water to the marine environment and have been fully addressed by the environmental protection features built-into SkyCity Golf Course that are an integral part of its design. There will not be any significant impacts during the operation phase in terms of air, noise waste, ecology, fisheries, landscape and visual, cultural heritage, land contamination or aircraft safety.

3.1.6 In summary, therefore, **environmental impacts anticipated during the operation phase of this Project will not be adverse** and are expected to be negligible. Based on the assessments carried out, the environmental impact of operating SkyCity Golf Course is considered to fall well within the guidelines and criteria laid down in the EIAO-TM, and the effectiveness of proposed mitigation measures has been demonstrated in practice.

3.2 Air Quality Impact

3.2.1 Other than the airport terminal and ancillary buildings, there are no Air Sensitive Receivers (ASRs) close to the Project. The site is also outside the Tung Chung Airshed.

Construction Phase

3.2.2 Air quality impacts will include gaseous emissions, dust and odour (from plant exhaust) arising from the construction works. The quantity of plant on site that would generate exhaust emissions will be limited and therefore gaseous emissions will be of minor concern. The Contractor will comply with the mitigation measures specified in the Air Pollution Control (Construction Dust) Regulation of Air Pollution Control Ordinance (APCO).

3.2.3 Construction dust could arise during site formation earthworks. Laying of topsoil and sand for the establishment of turfgrass is also a major construction activity and possible fugitive dust emissions can be expected, however, this can be mitigated by the regular dampening of exposed areas by water spraying, which will be a contractual requirement.

3.2.4 No odour impacts are anticipated and so, therefore, the **air quality impacts anticipated during the construction phase will not be adverse** and are expected to be negligible.

Operation Phase

3.2.5 In the NAMP, it was assumed that the site would be developed for airport-related commercial land use. Since the interim golf facility is not expected to cause more traffic flow on local access roads than the long-term commercial development, the operational air quality assessment carried out in the NAMP EIA remains valid.

3.2.6 Operational air quality assessment for airport operations has shown that the air pollutant levels at the subject site would meet corresponding Air Quality Objectives (AQOs), despite the emissions caused by vehicle and aircraft movement. Concentration contours showing the predicted levels of nitrogen dioxide and carbon monoxide around the site were provided in the NAMP EIA. Air quality is not an issue as the source contribution from this Project will be minimal.

3.2.7 Bunker sand will be stockpiled within the maintenance area. A properly designed three-sided sand enclosure together with the general coarseness of the sand will mitigate any wind-blown dust nuisance from the stockpile.

3.2.8 No odour impacts are anticipated and so, therefore, the **air quality impacts anticipated during the operation phase will not be adverse** and are expected to be negligible.

3.3 Noise Impact

3.3.1 There are no Noise Sensitive Receivers (NSRs) in the vicinity of the Golf Course. The Regal Airport Hotel, which is 500m from the Project, uses central air conditioning and so is considered to be a noise tolerant use, rather than a NSR.

Construction Phase

3.3.2 Some site formation work will be required for the construction of the Golf Course, however the duration of the work is short and construction noise created by powered mechanical equipment will be minimal.

3.3.3 Construction noise impact may arise from the operation of construction plant for earth moving to create the required topographical details of the Golf Course, however the surrounding airport-related users are considered to be noise tolerant. It should also be noted that construction of SkyCity and the new Exhibition Centre are much larger construction projects than the Golf Course and are currently being carried out in this area.

3.3.4 Existing NSRs in North Lantau New Town are located 2.3km distant from the site and noise is unlikely to be perceived at these NSRs. Therefore, **noise impacts anticipated during the construction phase will not be adverse** and are expected to be negligible.

Operation Phase

3.3.5 The Public Address system to be installed at the interim golf facility is likely to be the only noise source during the operation phase. The noise impact of the PA system is expected to be minimal due to the large buffer distance between the golf facility and NSRs in North Lantau New Town.

3.3.6 Planned developments in the vicinity, including new hotels and the International Exhibition Centre, would also be considered noise tolerant by virtue of their central air conditioning. Therefore, **noise impacts anticipated during the operation phase will not be adverse** and are expected to be negligible.

3.4 Water Quality Impact

3.4.1 There are potentially two main water quality issues. The first relates to silt-laden run-off discharging from the site during main construction and the second relates to discharge of water to the marine environment during turfgrass establishment (construction phase) and during the operation phase. Because of grass growing climatic requirements and programme constraints, the turfgrass establishment period cannot be scheduled during the dry season, nevertheless, measures will be in place to ensure that only water of an acceptable quality is discharged from the Golf Course during the (wet-season) establishment period, as described under "Turfgrass Establishment", below.

Construction Phase

3.4.2 In terms of water quality assessment, the construction phase has been considered in two parts. The first part, "main construction", occurs before any organic nutrients or biological pest control are applied and so the key water quality issue will be the potential for silt-laden run-off. The second part, "turfgrass establishment", includes the application of organic nutrients and biological pest control if required, however, the drainage system and lakes will be in place and so the release of water can be controlled in the same manner as during the operation phase. There are no off-shore construction activities required and consequently no physical disturbance to the marine environment will be necessary.

Main Construction

3.4.3 Earthworks for site formation and landscaping will occur during main construction and so there is potential for silt-laden run-off from works areas if good site practice is not maintained. The Contractor will be required to apply for a Discharge Licence under the WPCO and to meet any conditions stipulated in the Licence to protect off-site water quality. Prior to the completion of the lakes, de-silting chambers and/or sedimentation tanks (the designs of which have been proved to be effective) will be used to prevent silt-laden run-off from leaving the site and to enable compliance with the Discharge Licence. The Contractor will also be required to follow good site practice, such as paragraphs 2 to 9 of *ProPECC PN 1/94*.

3.4.4 As nutrients and biological pest control will not be required during main construction, the only "worst case" scenario relates to silty water being discharged from site via Outfall No. 8, and this assumes that the de-silting chambers and sedimentation tanks have somehow failed.

3.4.5 Under this worst case scenario, the Golf Course is no different than any other construction project where mitigation measures fail – the Contactor would be required to implement immediate measures to contain muddy water from discharging from site, to operate backup mitigation measures and then to repair/reinstate the main mitigation measures.

3.4.6 The existing site is essentially flat, but the Golf Course will be formed as a gently undulating landform. A continuous bund, minimum 1.5m high, will be formed around the perimeter of the Golf Course. At the same time, the lakes will be constructed with an impermeable liner system to retain water and to prevent any leakage into the surrounding ground. Once the lakes have been completed (half way through the main construction), all rainwater will be directed inwards to the lakes via surface falls and the subsoil drainage system.

3.4.7 At this point the temporary de-silting chambers and/or sedimentation tanks can be removed and all de-silting and sedimentation will occur entirely within the lakes. This is a "fail-safe" system in that by their very nature, the lakes cannot "fail" as sediment traps. Furthermore, there is unlikely to be discharge off-site after completion of the lakes since for the remainder of the main construction the lakes will actually be filling up with rainwater/run-off.

3.4.8 Appendix C contains water balance calculations for the construction phase of the Golf Course. From Table C.8 in Appendix C, it can be seen that once construction of the lakes has been completed (in November 2005, according to Figure 2.1), then the 17,500m^3 capacity of the lakes is sufficient to contain all of the rainfall (less evaporation) expected from December

2005 to March 2006 (cumulative 12,234m^3). This means that after the temporary de-silting chambers and/or sedimentation tanks have been removed and the lakes begin to fill (entirely by collecting rainfall and run-off from the site) there is unlikely to be discharge off-site for the remainder of the main construction and therefore no off-site water quality impacts (if the lake fills more quickly than anticipated then the EM&A programme will also start earlier).

Turfgrass Establishment

3.4.9 It is proposed to use *Paspalum* (and its variant "SeaIsle1") as the predominant turfgrass species. *Paspalum* has excellent salt tolerance and can be irrigated with brackish water or even undiluted seawater with proper management. It tolerates grey water and effluent and handles a wide range of soil pH levels. *Paspalum* has a high tolerance to salt spray, water logging and periodic inundations (e.g. should the Golf Course flood). It has low nutrient requirements and a reduced susceptibility to pests. Because of its salt tolerance, saline water can be used for irrigation which will minimise the use of fresh water and also deter the growth of weeds (since most weeds do not tolerate salt). *Paspalum* has been used on two other golf courses in Hong Kong (Shek O Country Club and OGC Golf City, Kai Tak) and at two golf centres in Shenzhen (Sand River Golf Club and Shenzhen Golf Club). It has proved to be both very playable and also environmentally friendly.

3.4.10 When turfgrass has been laid, there will be no exposed earth on the site and so silt-laden run-off will be negligible.

3.4.11 The drainage infrastructure will be in place before the start of turfgrass establishment. Thus, any run-off from the turfgrass can only flow into the lakes. The lakes will allow any sediments to settle out and the constant re-circulation of water for irrigation will ensure that any surplus nutrients within the lake water are taken up by the turfgrass during each irrigation cycle, thereby constantly removing nutrients from the lakes.

3.4.12 Table C.8 in Appendix C shows the water balance and nutrient concentrations during the three-month turfgrass establishment (from April to June 2006). By the start of the turfgrass establishment, the lakes will be almost full and regular EM&A of lake water will have commenced.

3.4.13 Provided that the EM&A results show that lake water remains at an acceptable quality there will be no environmental impacts from any discharge of lake water, and so rainfall may cause the lakes to overflow into Outfall No. 8, through overflow pipes – this is intended as part of the design and is not an "emergency" occurrence. From Table C.8 in Appendix C, the average overflow from the lake in April, May and June is 8,045m^3, 28,351m^3 and 34,452m^3, respectively (this assumes that the lake has already contained a maximum of 17,500m^3 of water). Table C.8 also shows the nutrient application during turfgrass establishment. In practice, nutrients would be applied in smaller quantities on a weekly basis, giving the total application shown for each month.

3.4.14 However, if monitoring indicates that water is not of acceptable quality then the overflow pipes will be closed by a control valve and all flow to Outfall No. 8 will be prevented. The "Limit Level" contingency plan will be initiated, as described in Section 6, which requires water samples will be taken more frequently and only allows the overflow pipes to be re-opened when water has returned to an acceptable quality. With the overflow pipes closed, any subsequent rainfall may cause the Golf Course to flood and the 1.5m high bund will retain an additional 90,000m^3 of floodwater to prevent immediate discharge. This capacity is sufficient to hold all of the rainfall expected during turfgrass establishment with zero discharge (from Table C.8 in Appendix C, cumulative rainfall from April to June is 89,692m^3, excluding evaporation and irrigation).

3.4.15 For the purpose of flow rate comparison, it should be noted that the Airport Authority (AA) can discharge up to 385,000m^3 per day of cooling water into Outfall No. 7 under their WPCO Discharge Licence. The maximum discharge from the Golf Course lake into Outfall No. 8 is 33,009m^3 in a month, which is just 0.28% of AA's allowable discharge into Outfall No. 7.

3.4.16 To assess the worst case nutrient loading, it is assumed that there is zero uptake of nutrients by the turfgrass during establishment and therefore all of the nutrients wash into the lake. Furthermore, it is also assumed that the total month's nutrient application washes into the lake in a single instance. Based on the net lake volume (i.e. including the month's overflow), Table C.8 in Appendix C calculates nutrient loadings in water discharged from Outfall No. 8 and also these loadings as a percentage of the relevant WPCO standard (shown in the shaded column of Table C.1 in Appendix C). Table 3.1 summarises these results :

Table 3.1 : Worst Case Nutrient Loading During Construction

Month	Nitrogen		Phosphorous		Potassium	
	mg/	% WPCO	mg/	% WPCO	mg/	% WPCO
April	4.7	15.7%	1.8	35.1%	2.9	n/a
May	1.0	3.3%	1.6	32.4%	0.0	n/a
June	1.4	4.8%	0.0	0.0%	0.0	n/a

Source : From Table C.8 in Appendix C.

3.4.17 From Table 3.1, it can be seen that all nutrient loadings are well within the most stringent WPCO standards for discharge (there is no WPCO standard for potassium). Water Quality Objectives (WQOs) for nutrients (shown in Table C.2 in Appendix C) refer to inorganic nitrogen – since only organic nutrients will be used, there will zero inorganic nitrogen present and so WQOs for nutrients are considered to have been met (but see paragraph 3.4.37).

3.4.18 In conclusion, **water quality impacts anticipated during the construction phase will not be adverse**. This is because (during main construction) there must be compliance with the WPCO Discharge Licence, no use of nutrients and no off-site discharge after completion of the lakes, and because (during turfgrass establishment) the worst case concentrations of nutrients within discharged water are within acceptable (WPCO and WQO) standards and because, if necessary, there can be zero discharge (by flooding the Golf Course) during the entire turfgrass establishment if water fails to achieve acceptable quality.

Operation Phase

3.4.19 The only Water Sensitive Receivers (WSRs) in the vicinity of Outfall No. 8, which is the sole surface water discharge point for the 38ha catchment, are artificial reefs deployed to the east of the Airport Island and various intakes along the North Lantau coastline. Appendix C provides details of the WQOs for the North Western Water Control Zone (NWWCZ), historic compliance with WQOs at EPD's water quality monitoring stations in NWWCZ and water quality monitoring data from the Airport Authority's non-statutory marine water monitoring programme (locations of which are shown in Figure C.1 in Appendix C).

<u>The TIN Issue : Artificial Chemical Fertilisers vs. Organic Nutrients</u>

3.4.20 The water quality monitoring data presented in Appendix C show that the water quality near the Airport Island generally complies with the WQOs. During the past four years, however, the yearly average concentration of Total Inorganic Nitrogen (TIN) at certain locations within the NWWCZ has exceeded the WQO. As with other parts of Hong Kong, this non-compliance is indicative of the influences of the Pearl River and Deep Bay rather than any local discharge. Indeed, paragraph 8.7 of *Marine Water Quality 2001* (EPD Water Policy and Planning Group, December 2002), noted that :

> *"Increases in nitrogen (i.e. ammonia nitrogen, nitrate nitrogen and TIN) were also found at the stations NM3 and NM5 along the Urmston Road which are highly susceptible to the influence of the Pearl River and Deep Bay."*

3.4.21 Furthermore, paragraph 8.9 of *Marine Water Quality 2002* (EPD Water Policy and Planning Group, November 2003), noted that :

> *"If the increasing trends continue, the compliance with the TIN objective may be undermined in the future."*

3.4.22 Paragraphs 8.3 and 8.5 of *Marine Water Quality 2003* (EPD Water Policy and Planning Group, November 2004) noted that :

> *"In addition, the levels of total inorganic nitrogen (TIN) and total phosphorus increased by 0.04mg/ (9%) and 0.005mg/ (13%) respectively in 2003 … For TIN, four of the six monitoring stations in the North Western WCZ complied with the WQO in 2003. The two non-compliance stations (i.e. NM5 and NM6) were nearer to the Pearl River flow and had a lower track record of WQO compliance in the past."*

3.4.23 From EPD's monitoring data (shown in Table C.3 in Appendix C), the ambient concentration of TIN in the waters surrounding the Airport Island already exceeds the WQO standard of 0.5mg/ at monitoring stations NM5 and NM6, although for the stations closest to Outfall No. 8, (i.e. NM2 and NM3) the ambient TIN concentration is within the WQO.

3.4.24 Therefore, the key parameter to be examined in terms of the operation of the Golf Course should be TIN, the concentrations of which are clearly of concern in the waters surrounding the Airport Island because of the influence of the Pearl River. The reason that TIN is an important consideration is that the greatest source of TIN from a "typical" golf course is from artificial chemical fertilisers contained in uncontrolled surface run-off. In order to remove any potential for additional adverse TIN impact on the surrounding marine environment only organic nutrients will be used, instead of artificial chemical fertilisers, as these do not contain any TIN. Thus, there will be no TIN contribution from the Golf Course.

3.4.25 The proportions of nitrogen, phosphorous and potassium are indicated by their N•P•K ratios (percentages). The Project Proponent has examined the use of the following organic nutrients for use on the Golf Course, which by their organic nature are generally considered to be more environmentally friendly that than inorganic chemical fertilisers :

- Milorganite 6•2•0 (organic nitrogen, phosphorous, calcium, iron, chloride, organic matter).
- Nu-Gro 4•6•0 (organic nitrogen, phosphorous, iron, magnesium, organic matter).
- Indusol 8•4•4 (organic nitrogen, carbon, phosphorous, potassium, calcium, magnesium, sulphur, sodium, iron, micro-nutrients, organic matter).
- Alaska Fish Fertiliser 5•1•1 (organic nitrogen, phosphorous and potassium from sea fish).
- Nutri-smart (phosphate rock, weathered coal, starch, strains of specially-treated yeasts).

3.4.26 The use of organic nutrients has the following advantages :

- Provides nitrogen as organic nitrogen, not inorganic nitrogen.
- Odour free and hygienic.
- Activates the soil organisms and regenerates the soil with lasting effect.
- Improves root penetration and formation of endomycorrhiza.
- Improves soil water and nutrient holding capacity.
- Creates an environment that encourages beneficial soil organisms.

Nutrient Loading

3.4.27 Although the exclusive use of organic nutrients eliminates any concerns related to inorganic chemicals in artificial fertilisers, organic nutrients still contain nitrogen, phosphorous and potassium and these nutrients can still impact the marine environment if not adequately controlled. Inorganic nutrients in artificial chemical fertilisers are readily available for the plant to absorb, but this can result in short-term leaching problems. Organic nutrients, on the other hand, take longer to breakdown and this can help in reducing the potential loss of nutrients by short-term leaching. Once the limited amounts of soluble nutrients from the organic nutrients are released, the roots of the turfgrass will take them up immediately. Because of this process, minimal residual organic nutrients will remain in the soil.

3.4.28 Water that is not held within the upper soil layers will infiltrate downwards through the highly permeable sand layer. Water not taken up by plant roots will infiltrate down to the compacted sub-base layer. At this point the majority of infiltrated water will then flow laterally towards the lakes following the falling gradient, augmented by a subsoil drainage system located in swales and other low-points in the topography (as shown in Figure 1.3).

3.4.29 An insignificant amount of infiltrated water (estimated <5%, based on compaction of sub-layer) will permeate through the compacted layer and into the ground beneath the site. Anecdotal evidence from elsewhere on the Airport Island indicates that the granite bedrock remains generally impermeable. Only trace amounts of nutrients are likely to be present in any infiltrated water below the sub-layer and will not give rise to adverse environmental impacts.

3.4.30 Irrigation water will be pumped from the lakes and sprayed onto the grass on a daily basis. The constant re-circulation of water for irrigation will provide natural filtering and will ensure that surplus nutrients within the lake water are taken up by the turfgrass during each irrigation cycle, thereby removing nutrients from the lakes. To confirm this is the case, regular monitoring of lake water will be carried out at three locations (shown on Figure 1.4) to demonstrate that water quality is acceptable. Acceptability criteria are discussed in Section 6 and include suspended solids and nutrients.

3.4.31 Provided that the EM&A results show that lake water remains at an acceptable quality there will be no environmental impacts from any discharge of lake water, and so rainfall may cause the lakes to overflow into Outfall No. 8, through overflow pipes– this is intended as part of the design and is not an "emergency" occurrence. From Table C.9 in Appendix C, the average overflow from the lake ranges from zero (from November to January) to a maximum of 35,619m^3 in August, at the height of the wet season.

3.4.32 However, if monitoring indicates that water is not of acceptable quality then the overflow pipes will be closed by a control valve and all flow to Outfall No. 8 will be prevented. The "Limit Level" contingency plan will be initiated, as described in Section 6, which requires water samples will be taken more frequently and only allows the overflow pipes to be re-opened when water has returned to an acceptable quality. With the overflow pipes closed, any subsequent rainfall may cause the Golf Course to flood and the 1.5m high bund will retain an additional 90,000m^3 of floodwater to prevent immediate discharge. This capacity is sufficient to hold all of the rainfall expected in the dry season (actually, from Table C.9 in Appendix C, cumulative rainfall from September to April is 84,620m^3, excluding evaporation and irrigation). During the wet season, this capacity is sufficient to hold all of the rainfall expected in the two wettest months (from Table C.9, July and August have the highest cumulative rainfall of 75,065m^3, excluding evaporation and irrigation).

3.4.33 For the purpose of flow rate comparison, it should be noted that AA can discharge up to 385,000m^3 per day of cooling water into Outfall No. 7 under their WPCO Discharge Licence. The maximum discharge from the Golf Course lake into Outfall No. 8 is 35,619m^3 in August, which is just 0.3% of AA's allowable discharge into Outfall No. 7.

3.4.34 Unlike turfgrass establishment, the frequency of nutrient application during operation varies with the playing area (fairways, greens and tees) and with the season. Also, applications may not always be on a monthly basis (e.g. every six weeks), which could lead to peaks in the application rate in certain months. To address this, and thereby provide the worst case nutrient application rates, Table C.9 assesses double the average monthly nutrient application rates that were calculated in Table C.7.

3.4.35 To assess the worst case nutrient loading, the worst case (i.e. double) nutrient application rates are used, it is assumed that there is zero uptake of nutrients by the turfgrass and all of the nutrients wash into the lake in a single instance. Based on the net lake volume (i.e. including the month's overflow), Table C.9 in Appendix C calculates the range of nutrient loadings in water discharged from Outfall No. 8 (there is zero discharge from the lake from

November to January, therefore no effect on Outfall No. 8) and also these loadings as a percentage of the relevant WPCO standard (shown in the shaded column of Table C.1 in Appendix C). Table 3.2 summarises these results :

Table 3.2 : Worst Case Nutrient Loading During Operation

	Nitrogen		Phosphorous		Potassium	
	mg/	% WPCO	mg/	% WPCO	mg/	% WPCO
Minimum	3.0	10.0%	0.1	2.1%	3.7	n/a
Month	August and October		August		August	
Maximum	5.2	17.2%	0.5	10.8%	7.9	n/a
Month	April		February		February	

Source : From Table C.9 in Appendix C.

3.4.36 From Table 3.2 it can be seen that all nutrient loadings are well within WPCO standards. There are no WPCO standards for potassium. Even if there were residual nutrients in the lake from the preceding month, the cumulative concentrations would still be well within the respective WPCO standards. WQOs for nutrients (shown in Table C.2 in Appendix C) refer to inorganic nitrogen – since only organic nutrients will be used, there will zero inorganic nitrogen present and so WQOs for nutrients are considered to have been met (but see below).

3.4.37 In terms of WQO, it has been stated previously that the standards for nutrients have been met because this is measured in terms of TIN. However, as indicated in Table C.2 in Appendix C, the WQO also requires that *"Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants"*.

3.4.38 Section 7 of the NAMP-EIA examined the impacts of nutrients (specifically, nitrogen loading resulting from dredging for construction of the Airport Island) on the potential for enhanced phytoplankton growth in East Tung Chung Bay. The EIA found that a nitrogen loading of 3,767kgN/month represented an annual depth average concentration of 0.33mg/ . It also noted that this concentration was less than the critical threshold region of 0.4 to 1.0mg/ for stimulation of enhanced phytoplankton growth and so was unlikely to stimulate "red tides".

3.4.39 The maximum application rate of nitrogen onto the Golf Course occurs in the summer months, when 576.2kgN/month is applied (see Table C.8 in Appendix C). To assume a worst case scenario in which this entire application entered the marine environment directly would represent an annual depth average concentration of just 0.05mg/ , based on the NAMPEIA calculation. This is significantly below the 0.4 to 1.0mg/ threshold region for stimulation of enhanced phytoplankton growth and so it can be concluded that worst case nutrient discharge from the Golf Course lake would not cause *"excessive or nuisance growth of algae or other aquatic plants"* . Thus, the WQO would be met for any discharged water from SkyCity Golf Course, there would be no discernible impact on surrounding marine waters or Tung Chung Bay and there would be no increase in "red tides" attributable to this Project.

3.4.40 For reference, EPD's marine water quality monitoring data between 1998 and 2003 indicates the depth average total nitrogen concentrations (ambient conditions) at stations NM3 and NM6 (see Figure C.1 in Appendix C) were 0.62mg/ and 0.73mg/ , respectively. Thus, the worst case nutrient discharge from the Golf Course lake (of just 0.05mg/) is between 12 times and 15 times less than the ambient concentrations of total nitrogen in surrounding marine waters and therefore well within the assimilative capacity of the receiving water body.

3.4.41 For further reference, it should be noted that existing landscape maintenance at the airport includes bi-annual phased application (spread over a number of weeks) of 15•15•15 fertiliser at a rate of 100g/m^2 to the landside and airside landscaping – this application rate is within the range of nitrogen application rates used by existing golf facilities in Hong Kong. The combined airside and landside landscaping area is 360ha, which means that some 162,000kg of nutrients (54,000kg each of nitrogen, phosphorous and potassium) are applied annually. On a monthly basis, this is 13,500kg, compared to a worst case of just 1,312kg from the Golf

Course from April to September (see Table C.8 in Appendix C). This is less than 10% of the airport's nutrient application and the AA's own non-statutory marine environmental monitoring (shown in Tables C.4 and C.5 in Appendix C) has shown that there has been no discernable impact on local water quality because of this bi-annual fertiliser application.

Pesticides vs. Integrated Pest Management (IPM)

3.4.42 Pests and diseases will be controlled through IPM, which relies on cultural and biological means of control, if necessary, in this order of priority.

3.4.43 Cultural control includes methods such as turfgrass selection, hand/mechanical weeding, adjustment of mowing frequency, level of irrigation, etc. Biological control relies on using natural predators, parasites and pathogens that occur naturally in the environment – there are no artificial chemicals that can bio-accumulate within the ecosystem. Biological pest control is non-toxic and are environmentally safe to use.

3.4.44 The outline TMP provided in Appendix B includes typical details of the implementation of IPM, including cultural practice (Sections B.1, B.4 and B.5), nutrient requirements during turfgrass establishment and maintenance (Sections B.2 and B.3) and IPM requirements (Section B.4), which includes typical pest/diseases in Hong Kong and corresponding biological pest control. However, please note that the TMP provided in Appendix B is only for reference. A Project-specific TMP will be prepared and submitted to the appropriate authority for review and approval prior to the commencement of the establishment period for the turfgrass.

3.4.45 The Project Proponent has already examined the use of a number of AFCD-registered biological pest control organisms, as shown in Table 3.3, below :

Table 3.3 : Biological Pest Control Considered for SkyCity Golf Course

Organism	Characteristic	Target Pest
Spodoptera litura Nuclear Ployhedrosis virus (SlNPV) AFCDF Reg-No 2P242(WP) (viral pest control)	• Nuclear Ployhedrosis virus (NPVs) are insect viruses. • These viruses kill various larval pests that feed on food crops and certain other plants. • Some species of NPV are relatively specific regarding their target insect host. • It must be noted that NPV s become active only after susceptible larvae ingest the occlusion bodies. • In the larval gut, the protein overcoat quickly disintegrates, etc. and the viral particles proceed to infect digestive cells. A few days after ingesting the viral occlusion bodies, the larvae stop eating, weaken, and die. • USEPA has conducted toxicity test on NPVs and the test results show that the NPVs do not harm other organisms, including plants, beneficial insects, other wildlife, or the environment.	*Sl*NPV is specifically used for controlling *Spodoptera litura* (beet armyworm)
Beauveria bassiana AFCD Reg-No 2P239 (fungal pest control)	• These fungi occur naturally in their insect hosts and are known to provide broad-spectrum insect control. • Many strains of Beauveria bassiana are found world-wide in the soil. • They control insects by growing on them, secreting enzymes that weaken the insects' outer coat, and then getting inside the insect and continuing to grow, eventually killing the infected pest. • USEPA has conducted toxicity tests of this fungus and the results show that it is non-toxic on mammals, birds or and plants, etc.	1. Orthoptoroidea - *Gryllotalpidae* - *Gryllidae* 2. Isoptera - *Termitidae* 3. Coleoptera - *Scarabaeoidae* 4. Lepidoptera

Organism	Characteristic	Target Pest
Bacillus thuringiensis (Bt) AFCD Reg-No 2P12(GR) (bacterial pest control)	• It is a protein (or toxin) produced by *Pseudomonas fluorescens* (a common bacteria) • The Bt toxin kills the larvae of certain species of insects after ingested by the larvae. This Bt toxin causes death by attaching to specific receptors in the larval gut, eventually rupturing the gut and killing the larvae in a few days. • According to USEPA information, Bt toxin kills only the target pests because only the target pests contain the necessary binding receptors. When organisms without the specific receptor ingest the same toxin, it does no harm. • USEPA has evaluated the active ingredients for potential hazardous effects on the environment, including effects on such non-target organisms as mammals, birds, fish, beneficial insects, marine animals and endangered species. USEPA found that these active ingredients do not pose a risk to the environment nor non-target organisms. Organisms other than target insects appear to lack the gut receptors that make the toxins hazardous.	1. Diptera 2. Coleoptera - *Scarabaeoidae* 3. Lepidoptera 4. Various mosquito species
Neem oil (AFCD Reg-No 2P262) and its substrate product, *Azadirachta indica* (AFCD Reg-No 2P261) (vegetable pest control)	• Deters certain insects from feeding and it interferes with the normal life cycle of insects, including feeding, moulting, mating and egg laying. • According to USEPA information, Neem oil and *Azadirachta indica* are not expected to harm non-target organisms, when used as directed on product labels. The substances are found in the environment, where they degrade naturally.	A wide variety of insect pests, including whitefly, thrips, leafminers, caterpillars, aphids, beetles and mealybugs

3.4.46 In summary, advantages of biological pest control are :

- The organisms used in biological pest control are essentially non-toxic and non-pathogenic to wildlife, humans, or other organisms not closely related to the target pest. The safety offered by biological pest control is their greatest strength. Conventional chemical pesticides, by contrast, are generally synthetic materials that directly kill or inactivate the pest.
- The toxic action of biological pest control is often specific to a single group or species of insects, and this specificity means that most biological pest control does not directly affect beneficial insects (including predators or parasites of pests) in treated areas. Conventional chemical pesticide that may affect organisms as different as birds, insects and mammals.
- The residues of biological pest control present no hazards to humans or other animals.

Sewage Collection and Disposal

3.4.47 The sewage collection system of the subject site will be designed to tie into the existing infrastructure of the Airport. A new foul sewer will be connected to the golf facility and will transfer it to the nearest foul manhole of the existing airport sewerage system. Finally, the sewage will be discharged to North Lantau New Town and then to Siu Ho Wan Sewage Treatment Works for treatment, as is the case for all airport foul sewage.

3.4.48 The amount of sewage to be generated by the Project is minimal. There will be about 50 full time staff employed to serve up to 464 golfers, which translates to an average flow of about 68m³/day (see Appendix D for details of estimation). It is expected that the sewage flows from the Project will be low and will only marginally increase the loading of the existing airport sewerage system.

Conclusion

3.4.49 In conclusion, **water quality impacts anticipated during the operation phase will not be adverse**. This is because there will be no discharge of water of unacceptable quality from the Golf Course lakes. Worst case assessments have shown that nutrient loading in water that is discharged (i.e. of acceptable quality) is well within acceptable WPCO and WQO standards, that there will be no discernible impact on surrounding marine waters or Tung Chung Bay and there would be no increase in "red tides" attributable to this Project.

3.4.50 The worst case nutrient discharge from the Golf Course lake is at least 24 times less than the ambient concentrations of total nitrogen in surrounding marine waters and therefore well within the assimilative capacity of the receiving water body. The nitrogen application rate for the Golf Course is less than 6.5% of that currently applied to airport landscaping, which on-going monitoring has shown to have no discernable effect on local marine water quality.

3.5 Waste Impact

Construction Phase

3.5.1 Site formation to the required level shall be undertaken by cut and fill and it is unlikely that a large quantity of construction waste, such as inert excavated soil, will be generated during the site formation because some of this material may be reused on-site for landscape works. It is intended that there will be less cut than fill and any shortfall in fill will be made up by importing granular fill for ground compaction in accordance with Specification requirements.

3.5.2 Sand will be imported for the fairway, tees and green landscape construction. The general practices by Contractor and waste collector for the collection and management of waste within a construction site and the transportation and disposal of waste to landfill/public fill will be followed in accordance with the Waste Disposal Ordinance.

3.5.3 Overall, **waste impacts anticipated during the construction phase will not be adverse** and are expected to be negligible.

Operation Phase

3.5.4 The volume of solid waste to be generated by the interim golf facility will be minimal and will only cause a marginal increase to the current volume of waste generated by the Airport. Solid waste generated will be transported to the North Lantau Refuse Transfer station (NLRTS) for processing before it is disposed of at the WENT landfill. All current procedures for disposal of solid waste from the Airport to NLRTS will be followed.

3.5.5 The generation rate of vegetation and landscape waste, including grass clippings and plant waste from the operation of the Golf Course will depend on the growth rate of the turfgrass and the frequency of mowing.

3.5.6 Overall, **waste impacts anticipated during the operation phase will not be adverse** and are expected to be negligible.

3.6 Ecological Impact

3.6.1 The existing land use of the Project site is an open area with some old paving and base slabs of buildings. The ecological value of the existing site in terms of terrestrial ecology is low as the land is man-made, reclaimed in the early 1990s.

3.6.2 In terms of marine ecology, potential impacts on Chinese White Dolphins are a particular concern. These marine mammals prefer estuarine habitat and thus gravitate towards areas influenced by freshwater input from the Pearl River. They are mainly seen in the western

waters, including outer Deep Bay, north, south east and west Lantau and west Lamma, and are infrequently found in the eastern waters, such as Port Shelter. The location of the proposed golf course, on the eastern side of the Airport Island, means that dolphins are an issue to be considered, as these animals occur all around the Airport Island, and are common in some seasons around the nearby Brothers Islands. Figure 3.2 shows recorded distribution of Chinese White Dolphins.

Construction Phase

3.6.3 In terms of terrestrial ecology, the existing site is barren ground, devoid of vegetation, and so has very low ecological value. As such, construction will not cause adverse impacts, nor will it result in the loss of significant or important terrestrial flora and fauna.

3.6.4 In terms of marine ecology, the water quality assessment concluded that impacts anticipated during the construction phase will not be adverse and that, if necessary, there can be zero discharge (by flooding the Golf Course) during the entire turfgrass establishment if water fails to achieve acceptable quality. As such, no significant impacts to marine ecology (including Chinese White Dolphins) are anticipated during the construction phase.

3.6.5 Overall, therefore, **terrestrial and marine ecological impacts anticipated during the construction phase will not be adverse** and are expected to be negligible.

Operation Phase

3.6.6 In terms of terrestrial ecology, the development of the Project will improve ecological value, compared to the existing situation. Adoption of organic nutrients and biological pest control instead of artificial chemicals will ensure that there are no adverse impacts to the terrestrial environment and the Golf Course will provide a richer ecological habitat than at present.

3.6.7 In terms of marine ecology, as the water quality assessment concluded that impacts anticipated during the operation phase will not be adverse, there will also be no adverse impacts to marine ecology. Nevertheless, it is acknowledged that there is significant public concern related to Chinese White Dolphins.

3.6.8 There are five classes of chemical compounds that are of particular concern for the Hong Kong dolphin population – DDTs, PCBs, HCHs, mercury, and butyltins. The pesticide DDT (and its derivatives) was heavily used in past decades, because of its high toxicity to insects and its low cost. It has been banned in most developed countries, and also in China, but it may still be used illegally in some parts of the Mainland. Polychlorinated biphenyls (PCBs) are a group of several dozen compounds used in electrical equipment, and in the manufacture of paints, plastics, adhesives, etc. They are rarely used anymore, but their persistency ensures that they will continue to have damaging effects for many years. Lidane (HCH) is another pesticide that has toxic effects and it may still be used extensively in China. The trace metal, mercury has had a variety of uses, but it was discovered in the early 1960s that mercury is highly toxic. Finally, tributyltin (TBT) and related compounds have only recently been identified as a major concern in terms of their extreme toxicity. They have been heavily used in anti-fouling paints, and therefore are a concern around drydocks and boatyards.

3.6.9 Organochlorine pesticides such as DDT and HCHs, but also other types of chemical pesticides, are the pollutants currently of greatest concern for the dolphin population and have a number of damaging effects. As they bioaccumulate in top predators, they are a serious problem for cetaceans and are passed from generation to generation. Also, due to the absence or reduction of certain enzymes, cetaceans have a low capacity to metabolize (and thus detoxify) these compounds.

3.6.10 The golf course is to be built entirely upon existing land and will not require any reclamation, and therefore there will be no dolphin habitat loss associated with the Project. Its location on land, and the small amount of actual construction work required, means that potential noise impacts on the dolphin population will be insignificant.

3.6.11 The remaining issue of concern would be the potential for contamination of the surrounding waters by hazardous chemicals. However, as none of the five classes of contaminants that are of concern for the dolphins (see above) will be used in the construction or operation of Sky City Golf Course, there is no potential for these hazardous chemicals to enter the dolphins' marine habitat and therefore no threat to the local dolphin population.

3.6.12 Given that only organic nutrients will be applied to the Golf Course and that only biological pest control will be applied when necessary, there is no reason to anticipate that there will be any harmful effects on the Chinese White Dolphins, i.e. the built-in environmental protection features of the Golf Course have been designed to avoid any adverse impacts on the marine environment and thereby avoid any adverse impacts on Chinese White Dolphins.

3.6.13 Another consideration is the ecologically important Tung Chung Bay, which is some distance to the south of the Golf Course. However, as only water of an acceptable quality will be discharged from the Golf Course, there will be no adverse impacts on surrounding waters, including the ecology of Tung Chung Bay. The water quality assessment concluded that the nutrient loading from the Golf Course would not trigger any algal blooms, not cause "red tides" nor otherwise lead to eutrophication, and would not exceed WPCO or WQO standards.

3.6.14 Overall, therefore, **terrestrial and marine ecological impacts anticipated during the operation phase will not be adverse** and are expected to be negligible.

3.7 Fisheries Impact

3.7.1 There are no fish nursery grounds or mariculture zones in the vicinity although there is a fish spawning ground to the north of the Airport Island. This will not be directly affected by the Project because no adverse water quality impacts are anticipated during the construction or operation phases. The water quality assessment concluded that the nutrient loading from the Golf Course would not trigger any algal blooms, not cause "red tides" nor otherwise lead to eutrophication, and would not exceed WPCO or WQO standards. Overall, therefore, **fisheries impacts anticipated during the construction and operation phases will not be adverse** and are expected to be negligible.

3.8 Landscape and Visual Impact

3.8.1 The Project site is located at the north-eastern part of the Airport Island. There are no sensitive landscape resources on the site which is an open area with no vegetation other than weeds, some old paving and base slabs of buildings. The only existing visually sensitive receivers on the Airport Island are the Regal Airport Hotel (a fixed visual receiver, 500m distant) and passengers in the passenger terminal (non-fixed visual receivers, 400m distant). The Project can be seen at a distance of 2.3km by the high-rise developments along the northern edge of North Lantau New Town.

Construction Phase

3.8.2 The visually sensitive receivers identified above are located at some distance from the Project. Views from receivers on the Airport Island will be partially blocked by the Airport Railway station and other airport facilities. Views of construction activities from the North Lantau New Town are insignificant due to the distance involved. Hence, the visual impact of the Project during the construction phase is expected to be minimal and acceptable.

3.8.3 Beneficial landscape and visual value to the environment is expected from the Golf Course once landscaping is completed and the turfgrass has been established. At this point, there will be a significant landscape and visual improvement compared to the existing situation.

3.8.4 Overall, therefore, **landscape and visual impacts anticipated during the construction phase will not be adverse** and are expected to be beneficial.

Operation Phase

3.8.5 Floodlighting of the Golf Course will be required for night-time operation. As shown on Figure 1.3, the floodlights will be approximately 15-18m high and will be angled downwards to illuminate the Golf Course and glare will not be an issue outside the site. As any lighting within the Airport Island has to be considered in terms of aircraft safety, all floodlighting will be approved by the Civil Aviation Department (CAD) and the AA.

3.8.6 The nearby existing visually sensitive receivers on Airport Island, namely the Regal Hotel and Passenger Terminal, will have their views of the Golf Course obscured by the planned Sky Plaza development.

3.8.7 Planned developments in the vicinity, including the Sky Plaza development and the International Exhibition Centre, that will be developed during the operation phase of the Project would take any glare from the Golf Course into consideration in their design.

3.8.8 Visually Sensitive Receivers (VSRs) in the residential developments along the north edge of North Lantau New Town will be able to see the floodlit Golf Course from a distance of 2.3km. However, the change in night-time view experienced by the receivers in the New Town will not be significant for the following reasons :

- The large distance (2.3km) separating the Golf Course from North Lantau New Town.
- The floodlit Golf Course will be seen in the context of the whole Airport Island development, which is brightly lit up.

3.8.9 To confirm these assertions, Figure 3.3 shows a photomontage depicting the night-time view from Tower 1 in Seaview Crescent in Tung Chung with and without the Golf Course. Tower 1 (the westernmost tower) in Seaview Crescent is the residential tower in Tung Chung that is located closest to the Golf Course, and as such is representative of the 'worst case' visual impact that may be felt by VSRs in Tung Chung. As can be seen from Figure 3.3, the glare impact from Sky City Golf Course will be insignificant within the existing visual context.

3.8.10 Overall, therefore, **landscape and visual impacts anticipated during the operation phase will not be adverse** and are expected to be beneficial.

3.9 Cultural Heritage Impact

3.9.1 Other than the Ha Law Wan Archaeological Site on Scenic Hill, there are no cultural heritage sensitive receivers on the Airport Island, and Ha Law Wan will not be affected by the Project. Sensitive receivers on Lantau will not be affected, either directly or indirectly, by the Project.

3.9.2 Overall, therefore, **cultural heritage impacts anticipated during the construction and operation phases will not be adverse** and are expected to be beneficial.

3.10 Land Contamination

3.10.1 In terms of land contamination, the only opportunity for this to occur would be from a build-up of chemicals within the site. The only route for such a build-up would be the accumulation of nutrient-containing sediments within the lakes. However, since the lakes will be formed using an impermeable liner, there is no possibility for sediment to escape from the confines of the lake and therefore no contamination of the surrounding land. Overall, there will be **no land contamination during the construction and operation phases**.

3.10.2 However, as stated earlier, the lakes act as sediment traps and so sediment will build-up within the lakes. Although the irrigation (recirculation) of lake water provides a natural and efficient means to remove nutrients from the water, nutrients may nevertheless accumulate in the lake sediment.

3.10.3 The Project Proponent will monitor the depth of lake sediment and should the level of sediment begin to affect the storage capacity of the lakes or their effectiveness as sediment traps, then sediment removal shall be carried out without affecting the operation of the lakes (i.e. the lakes will not be drained). Instead, sediment will be pumped out and collected in tanks for appropriate off-site disposal (or re-used on the Golf Course as an organic nutrient if it contains sufficient levels of nutrients). Samples can be taken to determine nutrient content if required.

3.11 Aviation Safety

3.11.1 Although not a specific requirement of the EIAO, the Project design takes into account the need to promote aviation safety due to the location of the Golf Course at the Airport. There are three issues of concern regarding aviation safety :

- Prevention of bird-strike (of aircraft).
- Prevention of glare from floodlighting affecting pilots.
- Golf balls shall not project above the height limits specified according to the Hong Kong Airport (Control of Obstructions) Ordinance.

3.11.2 The SkyCity Golf Course is required to satisfy AA and Civil Aviation Department (CAD) that all necessary measures to promote aviation safety have been taken into account in the Golf Course design and operation. Liaison with AA and CAD has been undertaken, and as a result a number of design measures are incorporated the Golf Course design to promote aviation safety. AA and CAD have confirmed the proposals.

3.11.3 Measures to prevent bird-strike have been developed in consultation with the Airport Authority's bird control expert and include :

- Water surface area shall not exceed approximately 10% of site area, and edges of water features shall be vertical or near vertical walls to prevent birds from wading.
- Plant species shall follow the Airport Authority's approved list. Turfgrass shall be managed such that it will not produce seed and therefore will not attract foraging birds.
- Planting style shall be such that the understorey beneath trees is kept clear so that no dense, structurally diverse 'thicket' develops that is suitable for nesting or perching.

3.11.4 Measures to prevent glare having any impact on arriving and departing planes include :

- Floodlights shall be angled downwards.
- Floodlight columns shall be randomly located, not in straight lines.
- Floodlights shall not be angled towards the aircrafts' line of approach to the runways.
- Floodlights shall be flexible in setting so that CAD can inspect the as-built floodlights and make any adjustments they feel necessary.

3.11.5 The orientation and layout of the golf course avoids any conflict with the height limits specified according to the Hong Kong Airport (Control of Obstructions) Ordinance Cap. 301. The height limits are lowest at the south end of the Golf Course, where the Clubhouse, Maintenance Yard and car park are located. Golf ball trajectories have also been plotted hole by hole and cleared with CAD as being in accordance with requirements of the Ordinance.

3.11.6 The AA and CAD have the right to inspect the Golf Course after construction to ensure that the measures are properly implemented, and to instruct any necessary changes should they feel this to be necessary. During the operation of the Golf Course, the presence of birds will be monitored and reported to the AA and CAD on a regular basis. Any measures deemed necessary by the AA and CAD to ensure continued aviation safety will be adopted in the operation of the Golf Course.

Figure 3.1 : Extent of Catchment Discharging Through Outfall No. 8

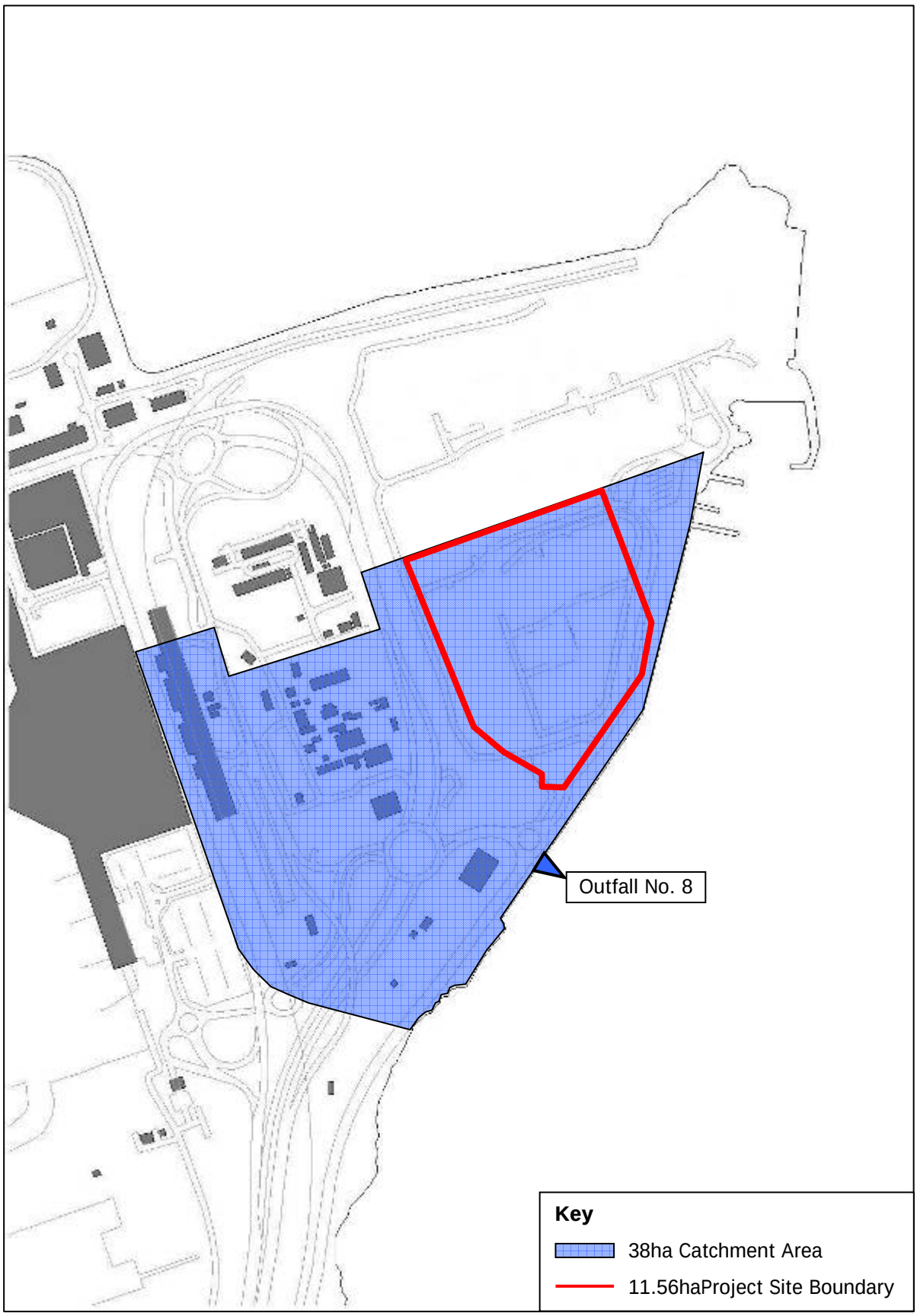


Figure 3.2 : Sightings of Chinese White Dolphin within Hong Kong Waters (1995 to 2001)

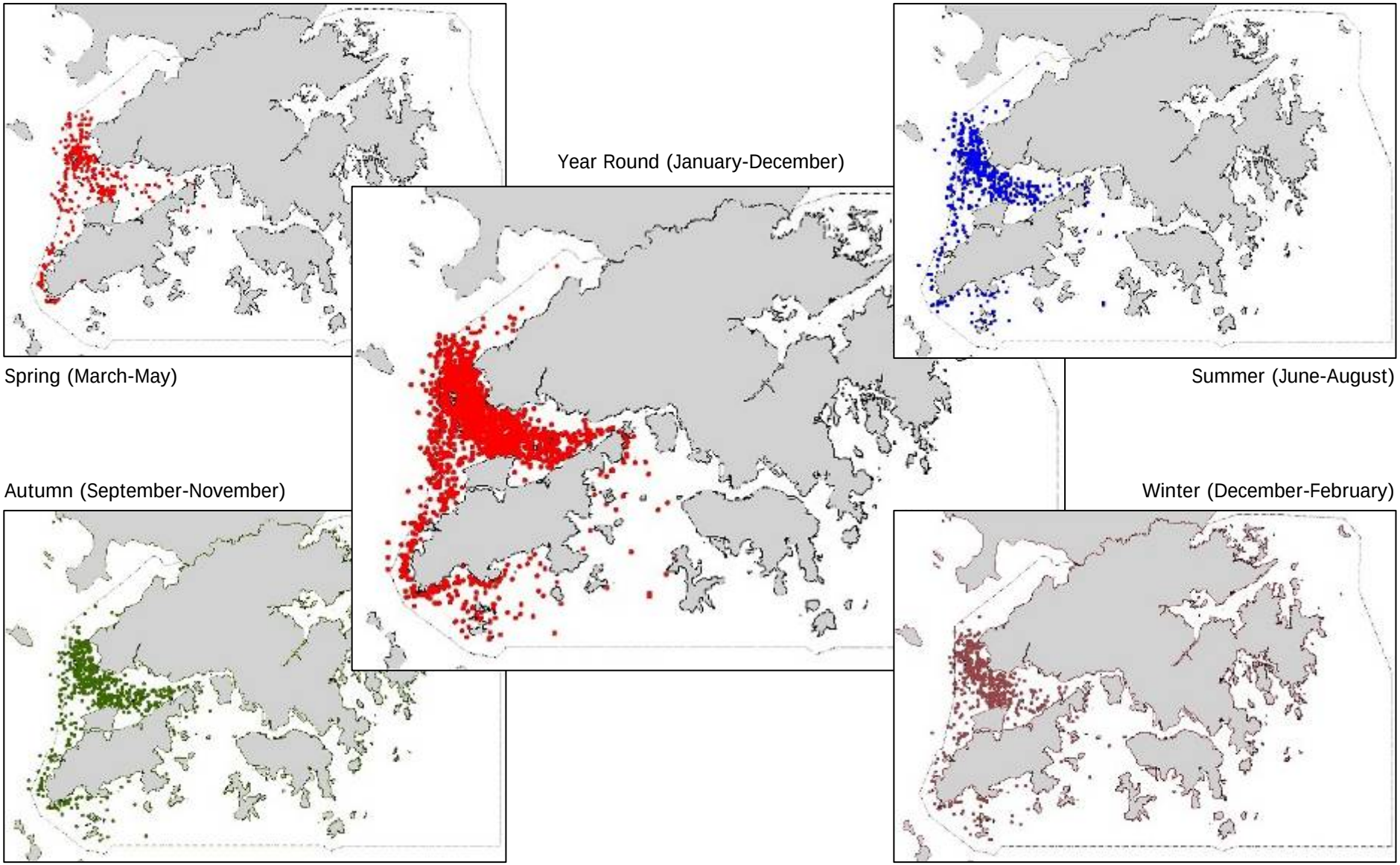


Figure 3.3 : Photomontage – Night-time View from Seaview Crescent, Tung Chung

Note : Please refer to Figure 1.1 for location map and viewing angle.

4. MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

4.1.1 The Project is located at the northeast corner of the Airport Island, off the northwest coast of Lantau. Currently, the majority of land use on the Airport Island is to the north, west and south of the Project.

4.1.2 The Project site itself is open space with concrete base slabs left from temporary buildings, and is considered to be disturbed urban area. It is surrounded by local access roads (including NCD East Coast Road, NCD North Road and NCD West Road) and immediately northeast of the site is a bus and ferry terminus.

4.1.3 The airport runways are located about 800m northwest and 1,000m southwest of the Project boundary. A range of airport facilities are located at significant distances to the west and south of the Project site boundary, including the Airport Railway terminal with a transport centre and airport cargo area.

4.1.4 There are no non-airport-related ASRs or NSRs found near to the Project. There are also no residential developments, educational institutions, health care facilities nor places of worship located in the vicinity. The largest residential development is the North Lantau New Town, which at 2.3km from the Project will not be adversely affected.

4.1.5 In terms of existing developments, the Regal Airport Hotel, which is 500m from the Project, is installed with central air conditioning and so is considered to be a noise tolerant use. Planned developments in the vicinity, including new hotels and the International Exhibition Centre, would also be considered noise tolerant by virtue of their central air conditioning.

4.1.6 The entire 11.56ha Project site is located within a 38ha water catchment on the Airport Island that discharges through a single outfall (Outfall No. 8) into marine waters. Figure 3.1 shows the extent of the catchment for Outfall No. 8 and it can be seen that the Project occupies only part of this catchment. All WSRs are distant from Outfall No. 8, although Chinese White Dolphins have occasionally been sighted closer to Outfall No. 8, as shown in Figure 3.2.

4.1.7 There are no areas of ecological concern in the immediate vicinity, with the exception of the habitat of Chinese White Dolphins that includes the waters off Northwest Lantau and those surrounding the Airport Island. The Chinese White Dolphin is a marine conservation species in Hong Kong, and so potential impacts on its habitat need to be carefully considered.

4.1.8 In terms of fisheries, landscape and visual and cultural heritage, there are no sensitive receivers in the immediate vicinity.

5. ENVIRONMENTAL PROTECTION MEASURES

5.1 Summary

5.1.1 Section 3 has demonstrated that there will be no significant impacts to the environment from the construction and operation of the Project, provided that certain environmental protection measures and the TMP are implemented.

5.1.2 Potential water quality impacts are of most concern and this Section focuses primarily on these impacts, although other environmental protection measures are also presented.

5.2 Air Quality

Construction Phase

5.2.1 The requirements of the Air Pollution (Construction Dust) Regulation shall be included in the Specification as a standard clause for environmental protection. To comply with APCO, the Contractor should at all times prevent dust nuisance as a result of his activities. Site formation works have the potential to cause short-term dust impacts and therefore preventive measures for dust suppression, such as regular watering of exposed areas and haulage routes, etc., should be implemented as of good site practice.

5.2.2 Other dust suppression measures are highlighted below :

(i) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. Effective dust suppression measures shall be employed to ensure that the air quality at the boundary of his site and at any ASRs, complies with the Hong Kong Air Quality Objectives.

(ii) The Contractor shall ensure that there will be adequate water supply / storage for dust suppression purposes.

(iii) The Contractor shall frequently clean and water the site to minimise fugitive dust emissions.

(iv) Effective water sprays shall be used during the delivery and handling of aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(v) Watering of exposed surfaces shall be exercised as often as possible depending on the circumstance.

(vi) Areas within the site where there is a regular movement of vehicles shall be regularly watered.

(vii) Where dusty materials are being discharged to a vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system.

(viii) The Contractor shall restrict all motorized vehicles within the site, excluding those on public roads, to a maximum speed of 15 km per hour and confine haulage and delivery vehicles to designated roadways inside the site.

(ix) Wheel washing facilities shall be installed and used by all vehicles leaving the site. No earth, mud, debris, dust and the like shall be deposited on public roads. The water in wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit detailed proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel washing facilities shall be usable prior to the commencement of any earthworks excavation activity on the site. The Contractor shall also provide a hard-surfaced road between any washing facilities and the public road.

(x) The Contractor shall devise, arrange methods of working and carrying out the works in such a manner so as to minimize dust impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

(xi) All site vehicles' exhausts shall be directed vertically upwards or directed away from the ground.

(xii) Any stockpile of dusty material shall be either: (a) covered entirely by impervious sheeting; (b) placed in an area sheltered on the top and the three sides; or (c) sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

5.2.3 After the establishment of the turfgrass, the landscape area of the Project will be vegetated and no bare ground will be exposed. No further construction dust impact is anticipated after landscaping and turfgrass establishment.

Operation Phase

5.2.4 No mitigation measures during the operational phase of the Project are required, other than an appropriate three-sided enclosure for stockpiled bunker sand in the maintenance area to minimise the potential dust nuisance.

5.3 Noise

Construction Phase

5.3.1 Given the relatively small scale of construction works compared to other projects in the area, and the fact that the surrounding airport-related users are considered to be noise tolerant, construction noise impact is not anticipated. As such, no noise mitigation measures are considered necessary, however, if available, "quiet" plant should be used by the Contractor in preference to non-"quiet" plant.

Operation Phase

5.3.2 There will be no noise impacts from the operation of the Project and so no noise mitigation measures are considered necessary.

5.4 Water Quality

Main Construction

5.4.1 The Contractor will be required to apply for a Discharge Licence under the WPCO and to meet any conditions stipulated in the Licence to protect off-site water quality. Prior to the completion of the lakes, de-silting chambers and/or sedimentation tanks (the designs of which have been proved to be effective) will be used to prevent silt-laden run-off from leaving the site and to enable compliance with the Discharge Licence.

5.4.2 The Contractor shall follow good site practice and be responsible for the design, construction, operation and maintenance of all the mitigation measures as specified in *ProPECC PN 1/94* on construction site drainage :

5.4.3 Surface run-off from construction sites shall be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Channels or earth bunds or sand bag barriers shall be provided on site to properly direct stormwater to such silt removal facilities. Perimeter channels at site boundaries shall be provided where necessary to intercept storm run-off from outside the site so that it will not wash across the site. Catchpits and perimeter channels shall be constructed in advance of site formation works and earthworks.

5.4.4 Silt removal facilities, channels and manholes shall be maintained and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times.

5.4.5 For the purpose of preventing soil erosion, temporarily exposed slope surfaces shall be covered e.g. by tarpaulin, and temporary access roads shall be protected by crushed stone or gravel, as excavation proceeds. Intercepting channels shall be provided (e.g. along the crest/edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements shall always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.

5.4.6 Earthworks final surfaces shall be well compacted and the subsequent permanent work or surface protection shall be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms. Appropriate drainage like intercepting channels shall be provided where necessary.

5.4.7 Measures shall be taken to minimise the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they shall be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavations shall be discharged into storm drains via silt removal facilities.

5.4.8 Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites shall be covered with tarpaulin or similar fabric during rainstorms. Measures shall be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.

5.4.9 Manholes (including newly constructed ones) shall always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers.

5.4.10 Discharge of surface run-off into foul sewers shall always be prevented in order not to unduly overload the foul sewerage system.

Operation Phase (including Turfgrass Establishment)

5.4.11 The drainage infrastructure will be in place before the start of turfgrass establishment. Thus, any run-off from the turfgrass can only flow into the lakes. The lakes will allow any sediments to settle out and the constant re-circulation of water for irrigation will ensure that any surplus nutrients within the lake water are taken up by the turfgrass during each irrigation cycle, thereby constantly removing nutrients from the lakes.

5.4.12 Provided that the EM&A results show that lake water remains at an acceptable quality there will be no environmental impacts from any discharge of lake water, and so rainfall may cause the lakes to overflow into Outfall No. 8, through overflow pipes. However, if monitoring indicates that water is not of acceptable quality then the overflow pipes will be closed by a control valve and all flow to Outfall No. 8 will be prevented. The “Limit Level” contingency plan will be initiated, as described in Section 6, and the overflow pipes will only be re-opened when water has returned to an acceptable quality. With the overflow pipes closed, any subsequent rainfall may cause the Golf Course to flood and the 1.5m high bund will retain an additional 90,000m^3 of floodwater to prevent immediate discharge.

Turfgrass Management Plan (TMP)

5.4.13 A TMP will be developed during the design of the project and followed throughout the construction and operation of the Golf Course (an outline TMP is included in Appendix B for reference). The TMP will specify nutrient application rates and IPM during establishment and maintenance periods, and irrigation requirements throughout the year. The nutrient application rates to be specified shall be no greater than those assessed in this Project Profile.

The TMP will be submitted to the appropriate authority for review and approval prior to the commencement of the establishment period for the turfgrass.

5.4.14 Under the TMP, there will be no application of organic nutrients or biological pest control when it is raining, when rain is expected or when a Rainstorm Warning or a Typhoon Signal No. 3 or above is issued. This will prevent the application from needlessly being washed off and thereby will maintain the water quality in the lakes.

Irrigation and Drainage

5.4.15 When there is insufficient rainfall, "pop up" sprinklers will be used to irrigate the Golf Course using water predominantly from the lakes. The topography of the Golf Course and the surrounding 1.5m high landscaped bund will ensure that rainfall and irrigation water flow into the lakes. The water level of the lakes will be controlled through extraction for irrigation and through pumping of groundwater to maintain lake level and water capacity.

Sewage Generation

5.4.16 All sewage generated by the Project will be handled by the existing sewage treatment facilities serving the airport. No additional environmental protection measures are required.

5.5 Waste Management

Construction Phase

5.5.1 The Contractor shall observe and comply with the Waste Disposal Ordinance (WDO) and its subsidiary regulations, especially the Waste Disposal (Chemical Waste) (General) Regulation. The Contractor shall apply for registration as a chemical waste producer under the Waste Disposal (Chemical Waste) (General) Regulation if chemical waste is to be produced. All chemical waste shall be properly stored, labelled, packaged and collected in accordance with the Regulation.

5.5.2 The Contractor shall minimise the generation of waste from his work. Avoidance and minimisation of waste generation can be achieved through changing or improving design and practices, careful planning and good site management.

5.5.3 The reuse and recycling of waste shall be practised as far as possible. The recycled materials shall include paper/cardboard, timber, metal, etc. Also, rather than import new fill, the Contractor will make use of existing stockpiles of fill at other locations within the Airport Island (with the permission of the Airport Authority and providing that these materials meet specification requirements). For alternative sources of aggregate, the Contractor will examine the use of recycled aggregate from CEDD's facility in Tuen Mun Area 38.

5.5.4 The Contractor shall ensure that Construction and Demolition (C&D) materials are sorted into public fill (inert portion) and C&D waste (non-inert portion). The public fill which comprises soil, rock, concrete, brick, cement plaster/mortar, inert building debris, aggregates and asphalt shall be reused in earth filling, reclamation or site formation works. The C&D waste which comprises metal, timber, paper, glass, junk and general refuse shall be reused or recycled where possible and, as the last resort, disposed of at landfills.

5.5.5 The Contractor shall record the amount of waste generated, recycled and disposed of (including the disposal sites). The Contractor shall use a trip ticket system for the disposal of C&D materials to any designated public filling facility and/or landfill.

5.5.6 In order to avoid dust or odour impacts, any vehicles leaving a works area carrying construction waste or public fill should have their loads covered. To avoid the excessive use of wood, reusable steel shutters should be used as a preferred alternative to formwork and falsework where possible.

Operation Phase

5.5.7 No operation phase waste management mitigation measures are considered necessary.

5.6 Ecology and Fisheries

Construction Phase

5.6.1 With the implementation of the proposed mitigation measures for water quality described in Section 5.4, the water quality of the nearby marine environment is expected not to be adversely affected. Therefore, no adverse impacts on the ecology of the aquatic ecosystem are expected and so no additional environmental protection measures are considered necessary.

Operation Phase

5.6.2 Adequate water protection measures have been proposed for the Project with respect to potential surface run-off and wastewater discharges and are included in the TMP. Furthermore, considering the scale of the proposed project, it is unlikely that the interim Golf Course will bring about more water impacts than that resulting from the original commercial development addressed in the NAMP EIA.

5.6.3 With the implementation of the proposed water protection measures and the environmental management plan described in previous sections on the design of the Golf Course, no adverse impacts on the ecology of the aquatic ecosystem nearby are expected. The water quality of the nearby marine environment is not expected to be adversely affected and so no additional environmental protection measures are considered necessary.

5.7 Landscape and Visual

Construction Phase

5.7.1 The visual intrusion of the works area is expected to be transient and localised. The Contractor shall keep the works area tidy and ensure that construction wastes are properly stored and disposed of.

Operation Phase

5.7.2 The floodlights will be installed at an angle to avoid glare impact and nuisance to visually sensitive receivers in the residential developments along the north edge of North Lantau New Town. Although these receivers are some distance from the Golf Course (approximately 2.3km) they will still be able to see the floodlit Golf Course and so glare will be avoided by appropriate angling of the floodlights onto the course and away from North Lantau New Town and by fixing of visors/louvers to the floodlights to prevent light "spillage".

5.7.3 No other mitigation measures are required as the Golf Course will enhance the landscape and visual quality of the area.

5.8 Cultural Heritage

5.8.1 No additional environmental protection measures are considered necessary for the construction or operation phases.

5.9 Land Contamination

5.9.1 No additional environmental protection measures are considered necessary for the construction or operation phases.

5.10 Aviation Safety

5.10.1 There are no construction phase mitigation measures required.

5.10.2 For the operation phase, floodlights will be installed in positions and angles to avoid glare impact and nuisance to pilots, in line with AA and CAD requirements.

5.10.3 The landscape design shall be designed and operated to prevent potential bird-strike, in accordance with AA and CAD requirements.

5.10.4 The presence of birds will be monitored and reported to the AA and CAD on a regular basis. Any measures deemed necessary by the AA and CAD to ensure continued aviation safety will be adopted in the operation of the Golf Course.

6. ENVIRONMENTAL MONITORING AND AUDIT

6.1 Need for EM&A

6.1.1 The only potential environmental impact of any significance arising from the Project will be to water quality. Other environmental issues are expected to be minor or have no impact. As such, environmental monitoring and audit (EM&A) is only proposed for water quality.

6.1.2 An EM&A programme is suggested for the regular monitoring of all discharge points during main construction to confirm that the recommended (de-silting) mitigation measures are operating such that water discharged from site does not contain unacceptable levels of silt.

6.1.3 An EM&A programme is also suggested for the regular monitoring of lake water during turfgrass establishment and the operation phase to confirm that water quality is of an acceptable level and will not cause adverse environmental impact when it is discharged to the marine environment.

6.2 Baseline Water Quality Monitoring

6.2.1 AA has already performed comprehensive water quality monitoring around the Airport Island covering the following parameters :

- Temperature.
- Salinity.
- Turbidity.
- Suspended Solids.
- Dissolved Oxygen.
- Biological Oxygen Demand.
- Total Kjeldahl Nitrogen.

6.2.2 A baseline for heavy metals, chlorinated pesticides, PAHs, and PCBs has also been established at locations in East Tung Chung Bay and the Southern Sea Channel. Also, EPD carry out water quality monitoring at various stations (NM1 to NM8 – see Figure C.1 in Appendix C) for a wide range of parameters, including the nutrients nitrogen and phosphorous.

6.2.3 These existing data may be used as a baseline reference but it is not anticipated that the Contractor or Project Proponent will need to carry out additional baseline monitoring.

6.3 Water Quality EM&A During Main Construction

6.3.1 During main construction phase (prior to the operation of the lakes) the Contractor shall ensure that the appropriate mitigation measures (i.e. de-silting chambers, sedimentation tanks, etc.) have been installed and are operating correctly, and that there is no uncontrolled discharge of water off-site. The Contractor shall carry out regular monitoring of suspended solids at the outlets of any de-silting chambers, sedimentation tanks, etc. installed within the site. Water samples shall be taken on a weekly basis compared to the standards shown for suspended solids in Table 6.1. Laboratory analysis of suspended solids shall be as described paragraph 6.4.4. If no water is being discharged at the time scheduled for monitoring, then monitoring shall be deferred to the following week.

6.3.2 The Contractor may be required to apply for a Discharge Licence under the WPCO. In this case, the monitoring required under that Licence (and at the specified frequency) may be used as monitoring data for this EM&A programme, instead of that described in paragraph 6.3.1 (i.e. no duplicate monitoring).

6.3.3 Should any monitoring results indicate that discharged water is not of an acceptable standard (as shown in Table 6.1 or as required by the Discharge Licence under the WPCO) then the Contractor shall implement the following contingency plan :

1. Notify EPD and AA of the exceedance, providing full details (time, location, level, etc.).
2. Implement immediate measures to contain muddy water from discharging from site.
3. Repair/reinstate the mitigation measures, or bring back-up mitigation measures into operation, whichever can happen sooner.
4. Carry out immediate follow-up monitoring to confirm that water quality has returned to acceptable levels.
5. Notify EPD and AA that water quality has returned to acceptable levels.

6.3.4 A simple EM&A Monitoring Report shall be prepared on a monthly basis and shall include :

- Location of Monitoring Point(s).
- Results of Monitoring (including laboratory documentation).
- Identification of any exceedance(s).
- If exceedance(s) occurred, a full account of the exceedance together with details of the implementation of the contingency plan, including follow-up monitoring results to confirm that water quality has returned to acceptable levels.

6.4 Water Quality EM&A During Turfgrass Establishment and Operation

Parameters

6.4.1 During turfgrass establishment and the operation phase the Project Proponent shall carry out regular monitoring of water quality parameters selected from the WPCO (Table C.1 in Appendix C) and the WQOs (Table C.2).

6.4.2 As there will be no artificial chemical fertilisers or artificial pesticides used on the Golf Course, the following parameters are considered the most appropriate :

Table 6.1 : Water Quality Monitoring Standards During Turfgrass Establishment and Operation

Parameter	Acceptable Standard (mg/)*	
	"Action Level"	"Limit Level"
Suspended Solids	20	30
BOD_5	2	3
Dissolved Oxygen	2.5	4
Total Nitrogen	20	30
Total Phosphorous	5	8

Source : * Limit Level from Tables C.1 and C.2 in Appendix C and Action Level at two-thirds of Limit Level.

6.4.3 To ensure that the acceptable standard for water quality provides the most rigorous level of control, "Limit Levels" have been drawn from the most conservative WPCO standards and the WQOs for NWWCZ. Where the same parameter is listed in both WPCO and WQOs, the more stringent value is adopted. "Action Levels", which are intended to act as a warning, have been set at two-thirds of the "Limit Level". It should be noted that there are no water quality standards for potassium, either in Hong Kong or elsewhere, as potassium is not considered to be environmentally damaging. Because there are no standards for comparison, it is not proposed to carry out EM&A of potassium concentrations within lake water.

Frequency

6.4.4 The frequency of monitoring and the frequency of reporting shall be as required by Table 6.2, below. Monthly monitoring for the first 3 months of operation has been specified to allow a more rapid accumulation of operational monitoring data and thereby provide greater confidence in the efficacy of the operation of the Golf Course and the EM&A programme itself.

Table 6.2 : Water Quality Monitoring and Reporting Frequency

	Turfgrass Establishment and First 3 Months of Operation		**After First 3 Months of Operation**	
	Below Action/Limit Level	Action/Limit Level Exceedance	Below Action/Limit Level	Action/Limit Level Exceedance
Monitoring	Weekly	Bi-weekly	Monthly	Weekly
Reporting	Monthly		Quarterly	

Monitoring and Sampling

6.4.5 Samples of lake water shall initially be taken at the monitoring locations indicated by "O" on Figure 1.4. These three locations allow samples to be taken adjacent to the overflow pipes, at the confluence of the eastern stream and the main lake and at the confluence of the western stream/lake and the main lake.

6.4.6 Samples shall be collected using a Kahlsico Sampler (or equivalent) which shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the correct water depth. Samples shall be taken from the same location each time and water shall be collected at 0.5m from the surface.

6.4.7 Equal volumes of sample from each location shall be thoroughly mixed to create a composite sample that is representative of lake water quality. The volume of the composite sample shall not be less than 1 and shall be shall be decanted into clean high density polythene bottles, packed in ice (cooled to 4^{O}C without being frozen), and delivered to a laboratory on the same day as the samples were collected.

6.4.8 Dissolved Oxygen (DO) readings shall be taken *in situ* using a portable, weatherproof instrument complete with cable and sensor, and shall be operable from a DC power source (such as YSI models or similar). It shall be capable of measuring DO levels in the range of 0 to 20mg/ and 0 to 200% saturation. It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 5m in length. Sufficient stocks of spare electrodes and cables shall be available for replacement where necessary.

6.4.9 The DO-measuring instrument shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with certified standard solutions before each use.

6.4.10 The Project Proponent may be required to apply for a Discharge Licence under the WPCO for discharges from the lake. In this case, the monitoring carried out under the Discharge Licence shall also be reported as part of this EM&A programme, but shall not replace it.

Laboratory Analysis

6.4.11 Laboratory work shall be carried out in a HOKLAS accredited laboratory for suspended solids, BOD_5, total nitrogen and total phosphorous. The determination work shall start within the next working day after collection of the water samples. It is anticipated that laboratory results will be available within 48 to 72 hours of sampling.

6.4.12 The analyses shall follow the standard methods as described in *APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition*, unless otherwise specified (APHA 2540D for suspended solids) with a detection limit of 1mg/ or less. The submitted information should include pre-treatment procedures, instrument use, Quality Assurance/ Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per-batch etc), detection limits and accuracy. The QA/QC details shall be in accordance with requirements of HOKLAS or another internationally accredited scheme.

6.4.13 With the prior agreement of EPD, and as an alternative to laboratory analysis, on-site/in-situ analysis may be carried out using electronic probes and/or "test kits". Suspended solids may also be calculated from turbidity readings with the prior agreement of EPD.

Auditing of Results

6.4.14 Monitoring results shall be compared to the standards shown in Table 6.1. Should monitoring results indicate that lake water has exceeded the "Action Level" then this will be considered as a warning of a potential water quality problem and the "Action Level" contingency plan shall be implemented immediately. Should monitoring results indicate that lake water quality has exceeded the "Limit Level" this means there is a water quality problem and the "Limit Level" contingency plan shall be implemented immediately.

Contingency Plan for "Action Level" Exceedance

1. Notify the Golf Facility Supervisor of the exceedance, providing full details (time, location, parameter, level, etc.).
2. Increase the frequency of monitoring of the particular parameter(s) to "Action/Limit Level Exceedance" as shown in Table 6.2.
3. If water quality continues to worsen, it may be prudent to review the TMP in terms of application of nutrients and agree any revisions with the Golf Facility Supervisor.
4. Notify the Golf Facility Supervisor when water quality falls below "Action Level" and reduce monitoring frequency to "Below Action/Limit Level" as shown in Table 6.2.

Contingency Plan for "Limit Level" Exceedance

1. Notify EPD, AA and Golf Facility Supervisor of the exceedance, providing full details (time, location, parameter, level, etc.).
2. Suspend any ongoing application of organic nutrients and close overflow pipes immediately using the control valve. This activity shall be recorded in a log book kept on-site, which shall be made available for inspection as required.
3. Determine the likely cause of the exceedance(s). Review the TMP in terms of application of nutrients and agree any revisions with the Golf Facility Supervisor. Continue to irrigate the Golf Course using lake water.
4. Increase the frequency of monitoring of the particular parameter(s) to "Action/Limit Level Exceedance" as shown in Table 6.2 (if not already at this frequency) to demonstrate the effectiveness of remedial measures and to confirm that water quality has returned to acceptable levels.
5. Notify EPD, AA and Golf Facility Supervisor when water quality falls below "Action Level" (not "Limit Level") and reduce monitoring frequency to "Below Action/Limit Level" as shown in Table 6.2.
6. Re-open overflow pipes from the lake using the control valve. This activity shall be recorded in a log book kept on-site, which shall be made available for inspection as required.

Reporting

6.4.15 A simple EM&A Monitoring Report shall be prepared within ten working days after the reporting period at the frequency shown in Table 6.2 and shall include :

- Location of Monitoring Point(s).
- Results of Monitoring (including any laboratory documentation).
- Identification of any exceedance(s) or flooding incidents (with excerpts from the log).
- If exceedance(s) or flooding occurred, a full account of the exceedance/flood together with the actions taken by the Project Proponent. Details of follow-up monitoring to confirm that water quality has returned to acceptable levels.
- Details of any correspondence relating to any WPCO Discharge Licence.

6.4.16 The EM&A report shall also include any relevant monitoring data from the AA's own non-statutory marine environmental monitoring, which is carried out at a number of locations around the Airport Island (as indicated in Figure C.1 in Appendix C), to further confirm that there are no adverse marine water quality impacts arising from the construction and operation of the Golf Course.

7. USE OF PREVIOUSLY APPROVED EIA REPORTS

7.1.1 Previous sections have made references to the EIA of the airport development – the New Airport Master Plan (Final Report, Environmental Impact Assessment) by Greiner–Maunsell for the Provisional Airport Authority Hong Kong (NAMP-EIA). That report was completed in December 1991, before the enactment of the EIAO in April 1998 with a registration number of (EIA-006/BC) under the EIAO.

7.1.2 The NAMP-EIA covered the construction and operation of the existing Hong Kong International Airport with the proposed Project site designated for commercial use.

7.1.3 Since there were several elements of the NAMP modified during the detailed design phase of the airport project, changes were made in the previously approved mitigation measures, identification of additional mitigation requirements as well as operational procedures to be developed. In February 1998, revisions were made and an updated report titled "New Airport Master Plan – Environmental Impact Assessment Update (NAMP EIA Update) for Airport Authority Hong Kong" was issued. The EIA Update addressed all environmentally significant modifications to the NAMP, both physical and operational, which were implemented or planned in year 1998.

7.1.4 The content of the NAMP-EIA and its Update were considered in the preparation of this Project Profile.

7.1.5 There is no approved EIA with respect to a golf facility under the EIAO, however, an Environmental Permit (No. EP-189/2004) for the Oriental Golf Club "Golf City" at Kai Tak was issued on 21 April 2004, via direct application under Section 5(1)(b) of the EIAO.

Appendix A

Issues Relating to Decommissioning

A. ISSUES RELATING TO DECOMMISSIONING

A.1 Important Note

A.1.1 Development of an outdoor golf course is a Designated Project (Item O.1) under the "Tourist and Recreational Developments" category of Part 1, Schedule 2 of the Environmental Impact Assessment Ordinance (EIAO).

A.1.2 When the Golf Course land use is replaced by the later expansion of SkyCity, the temporary Golf Course will be decommissioned. Decommissioning of the Golf Course, however, is not a Designated Project in under the EIAO.

A.1.3 Notwithstanding, this Appendix provides a discussion of the environmental issues that relate to the decommissioning of the Golf Course, and is provided for information only.

A.2 Summary

A.2.1 The main decommissioning activities will be the removal of the clubhouse and maintenance buildings and the removal of the artificial lake liner. It may not be necessary to remove the landscaping since some of the (by then) established vegetation could be of value to the landscaping of the subsequent project. All lake water will have been used for irrigation in the run-up to closure of the facility and so there will be no need to "empty" the lakes.

A.2.2 Possible water quality concerns relating to run-off into the marine environment will be addressed through good site practice during decommissioning and through the adoption of de-silting chambers or sedimentation tanks, the designs of which have been proved to be effective. There are unlikely to be any significant impacts during decommissioning in terms of air, noise, waste, ecology, fisheries, landscape and visual or cultural heritage.

A.2.3 In summary, the **environmental impacts anticipated during decommissioning of this Project will not be adverse** and are expected to be negligible. Based on the assessments carried out, the environmental impact of decommissioning the SkyCity Golf Course is considered to fall well within the guidelines and criteria laid down in the EIAO-TM, and that the effectiveness of the mitigation measures has been demonstrated in practice.

A.3 Air Quality Impact

A.3.1 Air quality impacts will include gaseous emissions, dust and odour (from plant exhaust) arising from the decommissioning works. The quantity of plant on site that would generate exhaust emissions will be limited and therefore gaseous emissions will be of minor concern. The Contractor will comply with the mitigation measures specified in the Air Pollution Control (Construction Dust) Regulation of Air Pollution Control Ordinance (APCO).

A.3.2 Dust from decommissioning is could arise from removal of the clubhouse and ancillary buildings, however, since the landscaping will not be removed (it will be reworked as part of the site preparation for the subsequent project) dust from this source is limited. Notwithstanding, any dust can be mitigated by the regular dampening of exposed areas by water spraying. Mitigation measures to be adopted during decommissioning follow those identified for the Construction Phase.

A.3.3 No odour impacts are anticipated and so, therefore, the **air quality impacts anticipated during decommissioning will not be adverse** and are expected to be negligible.

A.4 Noise Impact

A.4.1 The removal of the clubhouse and ancillary buildings is unlikely to cause any significant noise impacts because of the minor nature of the works – the surrounding airport-related users are considered to be noise tolerant.

A.4.2 Existing NSRs in North Lantau New Town are located 2.3km distant from the site and noise is unlikely to be perceived at these NSRs. Mitigation measures to be adopted during decommissioning follow those identified for the Construction Phase.

A.4.3 Overall, **noise impacts anticipated during decommissioning will not be adverse** and are expected to be negligible.

A.5 Water Quality Impact

A.5.1 In the final months of operation, the lake will not be refilled with seawater or borewater and it is anticipated that extraction for irrigation will use up a significant volume of water such that there will be no need to "empty" the lakes prior to decommissioning. However, if rainfall causes the lakes to refill then water will need to be pumped out into Outfall No. 8 – this will only be carried out when EM&A results indicate that water is of an acceptable quality and can therefore be discharged without adverse impact to the environment.

A.5.2 Possible water quality concerns relate to run-off into the marine environment, since the lakes will no longer be functioning during decommissioning. The Contractor will be required to apply for a Discharge Licence under the Water Pollution Control Ordinance (WPCO) and to meet any conditions stipulated in the Licence to protect off-site water quality. Muddy run-off will be prevented through good site practice during decommissioning and through the adoption of de-silting chambers or sedimentation tanks, the designs of which have been proved to be effective. The Contractor will also be required to follow good site practice, such as paragraphs 2 to 9 of *ProPECC PN 1/94*. Mitigation measures to be adopted during decommissioning follow those identified for the Construction Phase.

A.5.3 The removal of the clubhouse and ancillary buildings is unlikely to cause any significant water quality impacts because of the minor nature of the works, and it should be noted that as the landscaping (by then) will comprise established vegetation, it could be of value to the landscaping of the subsequent project and so may be incorporated into site formation works.

A.5.4 There are no off-shore decommissioning activities required and consequently no physical disturbance to the marine environment will be necessary. Therefore, **water quality impacts anticipated during decommissioning are unlikely to be adverse**.

A.6 Waste Impact

A.6.1 Decommissioning will involve the removal of the clubhouse, ancillary buildings, hardstanding and artificial lake liner. Valuable materials (such as ferrous and non-ferrous metals from buildings and plastics from the lake liner) will be separated and likely sold for off-site recycling. The remaining material will likely be disposed of to landfill if it cannot be economically recycled. Given the relatively small volumes of waste material requiring disposal, no adverse impact is anticipated to the disposal capacity of the landfills (or other waste treatment facilities which may be available at that time).

A.6.2 Solid waste generated will be transported to NLRTS for processing before it is disposed of at the WENT landfill. All current procedures for disposal of solid waste from the Airport to NLRTS will be followed. Mitigation measures to be adopted during decommissioning follow those identified for the Construction Phase.

A.6.3 The general practices by Contractor and waste collector for the collection and management of waste within a construction site and the transportation and disposal of waste to landfill/public fill will be followed in accordance with the Waste Disposal Ordinance. Therefore, **waste impacts anticipated during decommissioning are unlikely to be adverse** and are expected to be negligible.

A.7 Ecological Impact

A.7.1 Possible water quality concerns relate to run-off into the marine environment, since the lakes will no longer be functioning during decommissioning. The Contractor will be required to apply for a Discharge Licence under the Water Pollution Control Ordinance (WPCO) and to meet any conditions stipulated in the Licence to protect off-site water quality. Muddy run-off will be prevented through good site practice during decommissioning and through the adoption of de-silting chambers or sedimentation tanks, the designs of which have been proved to be effective. The Contractor will also be required to follow good site practice, such as paragraphs 2 to 9 of *ProPECC PN 1/94*. Mitigation measures to be adopted during decommissioning follow those identified for the Construction Phase.

A.7.2 There are no off-shore decommissioning activities required and consequently no physical disturbance to the marine environment will be necessary. Therefore, **terrestrial or marine ecological impacts anticipated during decommissioning will not be adverse** and are expected to be negligible.

A.8 Fisheries Impact

A.8.1 There are no fish nursery grounds or mariculture zones in the vicinity although there is a fish spawning ground to the north of the Airport Island. This will not be directly affected by the Project because no significant water quality impacts are anticipated during the decommissioning phase. No additional environmental protection measures are considered necessary during decommissioning. Therefore, **fisheries impacts anticipated during decommissioning will not be adverse** and are expected to be negligible.

A.9 Landscape and Visual Impact

A.9.1 The visually sensitive receivers previously identified above are located at some distance from the Project. Views from receivers on the Airport island will be partially blocked by the Airport Railway station and other airport facilities. Views of decommissioning activities from the North Lantau New Town are insignificant due to the distance involved. Mitigation measures to be adopted during decommissioning follow those identified for the Construction Phase. Therefore, **landscape and visual impacts anticipated during decommissioning will not be adverse** and are expected to be negligible.

A.10 Cultural Heritage Impact

A.10.1 Other than the Ha Law Wan Archaeological Site on Scenic Hill, there are no cultural heritage sensitive receivers on the Airport Island, and Ha Law Wan will not be affected by the Project. Sensitive receivers on Lantau are unlikely to be affected, either directly or indirectly, by the Project. No additional environmental protection measures are considered necessary during decommissioning. Therefore, **cultural heritage impacts anticipated during decommissioning will not be adverse** and are expected to be negligible.

A.11 Land Contamination

A.11.1 In terms of land contamination, the only opportunity for this to occur would be from a build-up of chemicals within the site. The only route for such a build-up would be the accumulation of nutrient-containing sediments within the lakes. However, since the lakes will be formed using an impermeable liner, there is no possibility for sediment to escape from the confines of the lakes. The contamination of the surrounding land cannot therefore occur.

A.11.2 However, the lakes act as sediment traps and so sediment will build-up within the lakes. Although the irrigation (recirculation) of lake water provides a natural and efficient means to remove nutrients from the water, nutrients may nevertheless accumulate in the lake sediment.

A.11.3 During decommissioning, sediment will be pumped out from the empty lakes and collected in tanks for appropriate off-site disposal. The sediment testing parameters stipulated under *Environment, Transport and Works Bureau Technical Circular (Works) No. 34/2002* will not apply to SkyCity Golf Course because the quantity of sediment will fall below the quantities stipulated in the Circular.

A.11.4 Once the sediment has been removed, the impermeable liners will be removed and disposed of or recycled as appropriate. The remaining depression within the ground will then be worked over as part of the site formations works for the subsequent project. No contamination of the surrounding ground will have occurred. No additional environmental protection measures are considered necessary for the decommissioning phase

A.11.5 Therefore, **land contamination anticipated during decommissioning will not be adverse** and is expected to be negligible.

Appendix B

Outline Turfgrass Management Plan

B. OUTLINE TURFGRASS MANAGEMENT PLAN

B.1 General

B.1.1 This outline Turfgrass Management Plan (TMP) is provided only for reference. A Project-specific TMP will be prepared and submitted to the appropriate authority for review and approval prior to the commencement of the establishment period for the turfgrass, and will broadly follow the outline presented herein.

B.1.2 It is proposed to use *Paspalum* as the predominant turfgrass species. *Paspalum* is a highly salt tolerant grass with a reduced need for nutrients and reduced susceptibility to pests. *Paspalum* has been used on two other golf courses in Hong Kong (Shek O Country Club and OGC Golf City, Kai Tak) and at two golf centres in Shenzhen (Sand River Golf Club and Shenzhen Golf Club). It has proved to be both very playable and also environmentally friendly.

B.1.3 The use of *Paspalum* will enable saline water to be used for irrigation, thus minimising the use of fresh water, and also enhancing weed control, since most weeds do not tolerate saline water.

B.1.4 A summary of the maintenance practices for *Paspalum* is shown in Table B.1, below. The Contractor should modify this outline TMP to take into account his detailed design of the Golf Course, and any requirements of *Paspalum* variants (e.g. SeaIsle2000, SeaIsle1, etc.).

Table B.1 : Summary of Cultural Practices Used on *Paspalum* Turf

Activities	Greens		Tees & Fairways		Roughs	
	Winter	Summer	Winter	Summer	Winter	Summer
Mowing height/mm	4	4	14	12	50	50
Cutting Freq/week	4	6	2	4	monthly	fortnightly
Verti cutting/month	1	2		2		
Topdressing/month	1	2	1	1		
Slicing		2	1	2		2
Coring		1		2		
Irrigation/week	3	2	3	1		

B.2 Nutrient Requirements for Establishment

B.2.1 During establishment and maintenance of the Golf Course, artificial chemical fertilisers will not be used. This will avoid any possibility of leaching (Total) Inorganic Nitrogen (TIN), which is of concern in the waters surrounding the Airport Island – organic nutrients do not contain TIN. There are a number of organic nutrients available in Hong Kong, including "Milorganite", "Nu-Gro", "Indusol", "Alaska fish fertilizer" and "Nutri-smart".

Objectives

B.2.2 The objective of the TMP is to optimise applications of nutrients as far as possible. At certain times of the year, nutrients will be applied in a programme suited to the particular turfgrass species. Nitrogen and potassium can be applied at a ratio of 1:1 or 1:2. Iron applications will also be made since this will increase chlorophyll content and also harden plant cells increasing resistance to trampling. Micro-nutrients will only be applied if soil test results indicate deficiencies. None of the nitrogen, phosphate, potassium (N•P•K) organic nutrients should contain trace elements, as this can lead to an imbalance in nutrients.

B.2.3 *Paspalum* grass requires its own specialized management techniques. Healthier growth rates are achieved when nutrients are not over-applied and when the grass is not over watered. A balanced nutrient and watering programme would allow the grass to stand up to wear and develop disease resistance.

Establishment

Table B.2 : Summary of Nutrient Requirements for Establishing *Paspalum* Turf

Weeks	Nutrient Applied*	Rate (Kg/ha)	KgN/ha Applied
1	18•10•9	275	50
2	3•1.6•1.6	1,000	30
3	18•10•9	275	50
4	19•0•16	260	50
5	3•1.6•1.6	1,000	30
6	19•0•16	130	25

Note : * Organic N•P•K ratio.

B.3 Nutrient Requirements for Maintenance

Nutrient Status

B.3.1 Nutrient status will be monitored every 6 months , e.g. through the aid of soil and leaf tissue tests. This helps integrate the nutritional programmes for the turfgrass with the nutrient requirements found to be necessary through the laboratory tests. Tests help determine the optimum nutrient provisions for turfgrass. To help maintain an even balance of nutrient supply that is not greatly affected by environmental conditions, slow release and organic nutrients is preferred. This gradual slow release action helps to minimise the amount of nitrate leached from the soil.

B.3.2 As a general rule, high nitrate nutrients, such as those mixed in liquid nutrient form (which are prone to leaching) are not used. The only area where this form of nutrient will be used is on the greens. However, the quantities of actual nitrogen applied to greens in this form are extremely low e.g. 10kgN/ha and significant leaching is not likely because of rapid foliar uptake. Such applications will not be made when it is raining, when rain is expected or when a Rainstorm Warning or a Typhoon Signal No. 3 or above is issued. This will prevent the application from being needlessly washed off and thereby will maintain the water quality in the lakes.

Nitrogen

B.3.3 The nitrogen source used should be in slow release organic form. With the correct management practices and the use of slow release organic nutrients, losses of nitrogen (to the lakes) will be minimal. Only mini pill fertilisers will be used as this will also minimise run-off as the nutrient granules become fixed within the turfgrass canopy.

Phosphorous

B.3.4 Turfgrass does not require large amounts of phosphorous after establishment. This is incorporated into the programme through an N•P•K blended nutrient. Before the planting of any turfgrass, phosphorous should be applied at 30kg/ha. As phosphorous will only be applied in small quantities during regular maintenance, the chance of any significant run-off following application is small.

Potassium

B.3.5 Potassium is the third most important element for turfgrass. Potassium is important in resistance to disease, drought, heat stress, cold and wear. Losses of potassium into the water system occur under similar conditions to that of nitrogen. Potassium will be applied in conjunction with nitrogen (N•K) at a 1:1 and 1:2 ratio over a monthly cycle.

Micro-nutrients

B.3.6 Micro nutrient requirements for elements such as magnesium, boron and calcium are determined by soil tests. Iron will be applied according to a plan involving six applications per year on tees, greens and fairways. This is necessary for the reasons stated above.

B.3.7 Turf Managers consider sulphur to be the most important micro-nutrient as it generates strong and hardy plants cells as well as providing fungal control. Calcium and magnesium levels will need to be monitored through soil testing because the sands in Hong Kong easily become deficient of these two elements.

Estimated Nutrient Usage

B.3.8 It is not possible to state the precise amount of nutrient which will be used, bearing in mind the changing weather and soil conditions. The following serves only as a guide to applications, and is summarised in Table B.3. For the purposes of this TMP, the winter months are October to March (6 months) and the summer months are April to September.

Table B.3 : Summary of Fertiliser Requirements for Established Turf

Location	Period	Product	Rate (kg/ha/app)	No. Applications	Total kgN/ha Applied
Greens	Winter	14•0•26 4•2•8 Ferrous Sulphate	408 500 30	4 3 4	57 20 30*
	Summer	14•0•26 19•2•19	250 184	6 6	35 35
Fairways and Tees	Winter	5•2•10 Ferrous Sulphate	285 30	2 4	14 30*
	Summer	19•0•16	260	4	50
Roughs	Summer	16•0•16	187	1	30

Note : * 30kg/ha applies to Sulphur only.

Greens

B.3.9 During the winter months, nutrients will be applied to the greens at 4-week intervals. During this period 14•0•26 will be used. This has a high potassium ratio to help protect against cold stress. The nitrogen form is slow release, therefore creating an even release of nitrogen over a long period. Every 4 weeks 14•0•26 will be applied at a rate of 408kg/ha to generate 57kgN/ha per application. This will be supplemented by 3 applications of 4•2•8 nutrient at a rate of 500kg/ha. This will generate 20kgN/ha per application. Phosphorous will be applied in trace quantities with 4•2•8. Ferrous sulphate will be applied on a 4 week programme at a rate of 30kg/ha.

B.3.10 During the summer months, nutrient applications will be made at 3-week intervals. 14•0•26 in conjunction with 19•2•19 will be applied alternately. Both nutrients will be used to achieve 35kgN/ha. Phosphorous will be applied in trace quantities with 19•2•19. Nutrients with higher phosphorous quantities (such as 19•25•5) will only be applied in response to deficiencies detected in soil tests.

Fairways & Tees

B.3.11 During the winter months, two applications of 5•2•10 will be applied at a rate of 14kgN/ha. Ferrous sulphate will be applied to fairways at a rate of 30kg/ha at 28-day intervals.

B.3.12 During the summer months, 19•0•16 will be applied at 260kg/ha on 56-day cycle (every 8 weeks) to supply 50kgN/ha. Minimal phosphorous will be required for maintenance of turfgrass on fairways and tees and it will only be applied in response to soil test results. However, total phosphorous application should not exceed 100kg/year. Ferrous sulphate will be applied to fairways at a rate of 30kg/ha at 28-day intervals.

Rough Areas

B.3.13 Rough areas form an integral part of the Golf Course. Roughs that come into play are provided with nutrients on an as-needed basis. A nutrient such as 16•0•16 with 50% of the nitrogen source in a slow release form will be used. Before this is applied all rough areas will be sliced to ensure maximum penetration of the nutrients into the soil and therefore reducing potential nutrient run-off.

B.4 Integrated Pest Management Requirements

B.4.1 It is proposed to follow the Agriculture, Fisheries and Conservation Department (AFCD) Integrated Pest Management (IPM) approach to control pests through cultural and biological means.

B.4.2 During establishment and maintenance of the Golf Course, artificial chemical pesticides will not be used. As part of adopting the IPM approach, only biological pest control will be used. AFCD have registered a number of biological organisms for use in Hong Kong, and it is proposed that these form part of the IPM. Biological pest control uses naturally occurring organisms and so avoids problems associated with artificial chemical pesticides, which can bio-accumulate within the ecosystem. Biological pest control is non-toxic and an environmentally safe alternative to artificial chemical pesticides.

Weed Control

B.4.3 Weed outbreaks should mainly be controlled through cultural mowing practices. 80% of weed species are smothered by the dense *Paspalum* turfgrass covering. The density of the grass is created through a close and frequent mowing schedule.

B.4.4 Mechanical methods of removing turfgrass weeds are used whenever practicable. Broad leaved weeds should be removed mechanically by the facility maintenance staff. The proposed usage of salt water for irrigation purposes will restrict the establishment of weeds.

B.4.5 It is the objective to avoid weeds becoming established through good management and cultural practices and to avoid the use of herbicides, even biological ones, wherever possible.

B.4.6 As the turfgrass is able to tolerate high salt concentration, saline water will be used on the basis that terrestrial weeds normally do not grow in saltwater or in an environment with high salinity content.

Disease Control

General

B.4.7 *Paspalum* grasses are noted as some of the most disease resistance varieties available that are adaptable to the Hong Kong environment. Hong Kong's weather is conducive to fungal attacks at certain times of the year. Disease prevention through cultural methods and a well-developed maintenance regime will provide conditions which limit grass susceptibility to fungal attack.

B.4.8 The Golf Course is a very open area with low vegetation and constant air movement. This air movement will reduce the amount of moisture surrounding the leaf surface thereby discouraging dew formation which is one of the major causes of fungal infection. With free draining sand fairways, the soil profiles are not expected to become saturated, which has proved to contribute to disease outbreaks. Landscaping will be kept low around green areas to reduce shading of the turfgrass, as direct sunlight is critical in disease prevention.

B.4.9 Thus, three major contributors to turfgrass diseases in Hong Kong should be minimised by cultural methods under IPM, i.e., good design, well ventilated location and direct sunlight. Disease attacks should therefore be minimal and easily contained. Disease resistance can be controlled in most cases through a balanced nutritional programme in association with cultural and irrigation practices and the minimal use of biological pest control.

Diseases Found in Hong Kong

B.4.10 The most common fungal pathogens that affect grasses of Hong Kong are *Pythium* (blight) and *Helminthosporium* (leaf spot).

- *Pythium* blight causal agent – *Pythium aphanidermatum*/*Pythium splendens*. This disease causes most concern because of the short time span for the disease to reach epidemic proportions. During warm to hot, humid weather, purplish, water soaked spots appear on the grass which later turn tan or brown. In early morning, spots appear dark and if the humidity has been high, white fungal mycelium can be seen on the dead, matted leaves of the spot. Large areas become blighted in wet conditions in such cases whole greens may be lost in a matter of days.
- *Helminthosporium* (leaf spot) Causal Agent – *Bipolaris cynodontis*. Initial spots start as a pin-point, purplish water soaked spot, which becomes dead in the centre, turns brown and later grey. Fungal spores need high humidity and a fine film of water on the leaf surface in order to germinate and infect.

B.4.11 Any unidentified infestations will be referred to a plant pathologist for disease identification. After reviewing the results carefully the management should plan the appropriate actions to be taken. Identification of areas most prone to disease attack due to course and soil microclimate will enable the course manager to keep a close watch for diseases if particularly susceptible areas are encountered.

Application of Biological Pest Control for Fungal Infections

B.4.12 Biological pest control should only be applied on greens. Damage to fairways and tees as a result of disease is perceived to be acceptable and consistent with the desired goal of minimising even biological pest control, wherever possible.

B.4.13 IPM will be adhered to throughout the year, for example, if past experience and documented reports indicate that *Helminosporium* outbreaks occur after the first morning fog in March, where the mornings have a thick cover of fog, high humidity with little sunlight and air movement, then a preventative application of biological pest control at low rates will be applied. This is a sensible approach since it will result in less application than would be needed to eradicate an established infestation.

B.4.14 It becomes more expensive and labour intensive to control disease once established. At this point, loss of a suitable playing surface or putting green may occur. Early detection and prompt control of disease during known susceptible periods is the most efficient way of controlling fungal attacks.

Insect Control

General

B.4.15 The most common invertebrate pests likely to be found on golf courses in Hong Kong are, Army Worms, Mole Crickets and White Grubs (family *Scarabaeidae*). White Grubs and Army Worms are usually detected by the feeding habits of the local Magpie *Pica pica*. Mole Crickets push mounds of soil above the turfgrass and destroy roots and tear plants from their growing places. Insect invasions will be most prevalent during the turfgrass establishment stage when the roots and stems of the plant are at a young and immature stage.

B.4.16 By understanding the lifecycle of insects, the most sensitive point in their life cycle when they can be effectively controlled can be determined and appropriate biological control introduced.

Mole Crickets

B.4.17 Mole Crickets lay eggs at a peak rate during May and June. Eggs will hatch approximately 2 weeks later. The nymphs will then grow rapidly while feeding constantly and it is at this stage that treatment for mole crickets is most effective.

White Grub

B.4.18 The white grubs' life cycle begins between spring and mid-summer when the female beetle lays her eggs. When this is complete the beetle comes to the surface. Eggs start to hatch in 10 to 12 days and the new born larvae begin feeding on roots immediately. It is at this stage of the life cycle that treatment is most effective. It is important to apply appropriate biological pest control at this point because during the winter, the grubs burrow deep into the soil becoming more sedentary and difficult to control. They are significantly harder to detect at this stage in their life cycle therefore applications would be ineffective, and optimum control may not be achieved. As the soil warms again, they resume eating for a short time.

Army Worm

B.4.19 The larval stage or caterpillar damages the turfgrass by feeding on the blade, crown and stem. Damaged areas take on a brown, dried up appearance. Active infestations are characterised by having a sharply defined advancing front between defoliated and green undamaged turf. Although turfgrass damage can be severe, recovery is quick and therefore biological control for Army Worm is not always warranted.

Observations

B.4.20 The down-side of relying only on biological pest control is that not all attacks on vegetation can be prevented, as they could by using artificial chemical pesticides. As artificial chemical pesticides will not be used on the Golf Course then, on occasion, it may be necessary to excavated and dispose of individual plants or areas of turfgrass to prevent the spread of disease. New plants or turfgrass would need to be planted as replacements. While this may be considered wasteful, it is one of the consequences of relying only on biological pest control.

B.5 Irrigation Requirements

B.5.1 Irrigation is one of the most important aspects of managing a golf facility. Poor or excessive irrigation practices can result in nutrient loss, disease and insect susceptibility.

B.5.2 Watering will generally take place in the morning as this practice minimises evaporation loss and allows the leaf surface to dry during the day. Morning dew that can encourage diseases will therefore also be eliminated. Deeply penetrating watering cycles are the key to strong *Paspalum* grass development on a sand based turf.

B.5.3 Irrigation rates are adjusted according to this assessment of requirements. Evaporation rates are calculated using soil tensometers. Weather forecasts and predictions are also part of the decision to irrigate or not.

B.5.4 Watering is carried out in cycles to eliminate water run-off. Emphasis is placed upon preventing the soil and thatch from becoming hydrophobic. Watering at night is not encouraged as the grass remains wet for long periods creating an ideal micro climate for disease pathogens on the leaves. Irrigation sprinkler heads are only aimed at target areas which reduce water run-off and wastage. Greens should have double sprinkler heads, one head facing in towards the green and the other covering the surrounds of the green. This allows the greens to be watered separately.

B.5.5 Irrigation is an important tool as it helps to stabilise soils and prevent wind erosion in bunkers. All irrigation practices are documented in terms of watering time and millimetres of water applied to an area.

Appendix C

Water Quality Standards, Monitoring and Calculations

Table C.1 : Standards for Effluent Discharge into the Inshore Waters of NWWCZ

Flow Rate (m^3/day) / Determinant	≤10	>10 & ≤100	>200 & ≤400	>400 & ≤600	>600 & ≤800	>800 & ≤1000	>1,000 & ≤1,500	>1,500 & ≤2,000	>2,000 & ≤3,000	>3,000 & ≤4,000	>4,000 & ≤5,000	>5,000 & ≤6,000
pH	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temp(°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour*	1	1	1	1	1	1	1	1	1	1	1	1
SS	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other Toxic Metals	1	1	0.8	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total Toxic Metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Residual Chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total Nitrogen	100	100	80	80	80	80	50	50	50	50	50	30
Total Phosphorous	10	10	8	8	8	8	5	5	5	5	5	5
Total Surfactants	20	15	15	15	15	15	10	10	10	10	10	10
E.coli (per100ml)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Notes : All units in mg/ unless otherwise stated.

* Colour in lovibond units (25mm cell length).

Shaded column indicated most stringent standard (albeit with a greater flow rate).

Source : *Technical Memorandum – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*, Table 10a, WPCO (Cap 358AK).

Table C.2 : Water Quality Objectives for the NWWCZ

Water Quality Parameters	Water Quality Objectives (WQOs)
Aesthetic Appearance	(a) Waste discharges shall cause no objectionable odours or discolouration of the water. (b) Tarry residues, floating wood, articles made zone of glass, plastic, rubber or of any other substances should be absent. (c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam. (d) There should be no recognisable sewage-derived debris. (e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent. (f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.
Dissolved Oxygen (mg/)	> 4mg/
PH	6.5 – 8.5
Temperature (°C)	< 2°C change of natural daily temperature range
Salinity	< 10% variation of the natural ambient salinity level
Suspended Solids (mg/)	(a) < 30% raise of natural ambient level; or (b) Give rise to accumulation of suspended solids which may adversely affect aquatic communities
Unionised Ammoniacal Nitrogen	< 0.021mg/
Total Inorganic Nitrogen (TIN)	< 0.50mg/
Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants; or (b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).
5-day Chemical Oxygen Demand (BOD_5)	< 3mg/ BOD_5
Chemical Oxygen Demand (COD)	< 15mg/ COD
Toxins	(a) Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other. (b) Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.

Source : Table 1.1, *Marine Water Quality in Hong Kong in 2003*, EPD, November 2004

Table C.3 : Historical WQO Compliance at EPD's Marine Water Quality Monitoring Stations

Monitoring Station	Depth Averaged Annual Arithmetic Means				
	Dissolved Oxygen (mg/)	pH	Unionised Ammoniacal Nitrogen (mg/)	Total Inorganic Nitrogen (mg/)	5-day Biochemical Oxygen Demand (mg/)
2003 Results[1]					
NM1 Lantau Island (North)	5.5 ✓	8.1 ✓	0.004 ✓	0.35 ✓	0.9 ✓
NM2 Pearl Island	5.8 ✓	8.1 ✓	0.005 ✓	0.48 ✓	1.0 ✓
NM3 Pillar Point	5.6 ✓	8.1 ✓	0.005 ✓	0.44 ✓	1.0 ✓
NM5 Urmston Road	5.6 ✓	8.1 ✓	0.006 ✓	**0.53** **X**[a]	1.1 ✓
NM6 CLK (North)	5.7 ✓	8.1 ✓	0.005 ✓	**0.57** **X**[b]	1.2 ✓
NM8 CLK (West)	5.9 ✓	8.2 ✓	0.002 ✓	0.42 ✓	1.0 ✓
2002 Results[2]					
NM1 Lantau Island (North)	5.9 ✓	7.9 ✓	0.004 ✓	0.34 ✓	0.7 ✓
NM2 Pearl Island	6.5 ✓	8.0 ✓	0.004 ✓	0.42 ✓	0.9 ✓
NM3 Pillar Point	6.2 ✓	8.0 ✓	0.004 ✓	0.41 ✓	0.9 ✓
NM5 Urmston Road	5.9 ✓	8.0 ✓	0.006 (	0.56 Xc	0.9 (
NM6 CLK (North)	6.8 (	8.1 (	0.004 (	0.50 (	1.2 (
NM8 CLK (West)	6.8 (	8.1 (	0.002 (	0.32 (	1.1 (
2001 Results3					
NM1 Lantau Island (North)	5.8 (	8.1 (	0.006 (	0.39 (	0.6 (
NM2 Pearl Island	5.7 ✓	8.1 ✓	0.006 ✓	0.45 ✓	0.5 ✓
NM3 Pillar Point	5.7 ✓	8.1 ✓	0.007 ✓	0.45 ✓	0.6 ✓
NM5 Urmston Road	5.7 ✓	8.1 ✓	0.008 ✓	**0.56** **X**[d]	0.8 ✓
NM6 CLK (North)	6.2 ✓	8.1 ✓	0.006 ✓	**0.56** **X**[e]	0.7 ✓
NM8 CLK (West)	6.0 ✓	8.1 ✓	0.002 ✓	0.41 ✓	0.6 ✓
2000 Results[4]					
NM1 Lantau Island (North)	5.9 ✓	7.9 ✓	0.004 ✓	0.34 ✓	0.8 ✓
NM2 Pearl Island	5.8 ✓	7.9 ✓	0.004 ✓	0.36 ✓	0.6 ✓
NM3 Pillar Point	5.9 ✓	7.9 ✓	0.004 ✓	0.35 ✓	0.6 ✓
NM5 Urmston Road	6.0 ✓	7.9 ✓	0.005 ✓	**0.51** **X**[f]	0.8 ✓
NM6 CLK (North)	6.2 ✓	8.0 ✓	0.004 ✓	0.45 ✓	0.6 ✓
NM8 CLK (West)	6.3 ✓	8.0 ✓	0.002 ✓	0.31 ✓	0.6 ✓

Notes : ✓ Compliance with WQO (see Table C.2)
X Non-compliance with WQO (see Table C.2)

a. Maximum TIN exceedance = 1.00mg/
b. Maximum TIN exceedance = 1.61mg/
c. Maximum TIN exceedance = 0.78mg/
d. Maximum TIN exceedance = 0.93mg/
e. Maximum TIN exceedance = 1.27mg/
f. Maximum TIN exceedance = 0.99mg/

Source : 1. Table 8.1, *Marine Water Quality in Hong Kong in 2003*, EPD, November 2004
2. Table D10, *Marine Water Quality in Hong Kong in 2002*, EPD, November 2003
3. Table D10, *Marine Water Quality in Hong Kong in 2001*, EPD, November 2002
4. Table D10, *Marine Water Quality in Hong Kong in 2000*, EPD, November 2001

Table C.4 : Summary of Water Quality Data from Airport Authority's Non-statutory Marine Environmental Monitoring Programme (Contract 194)

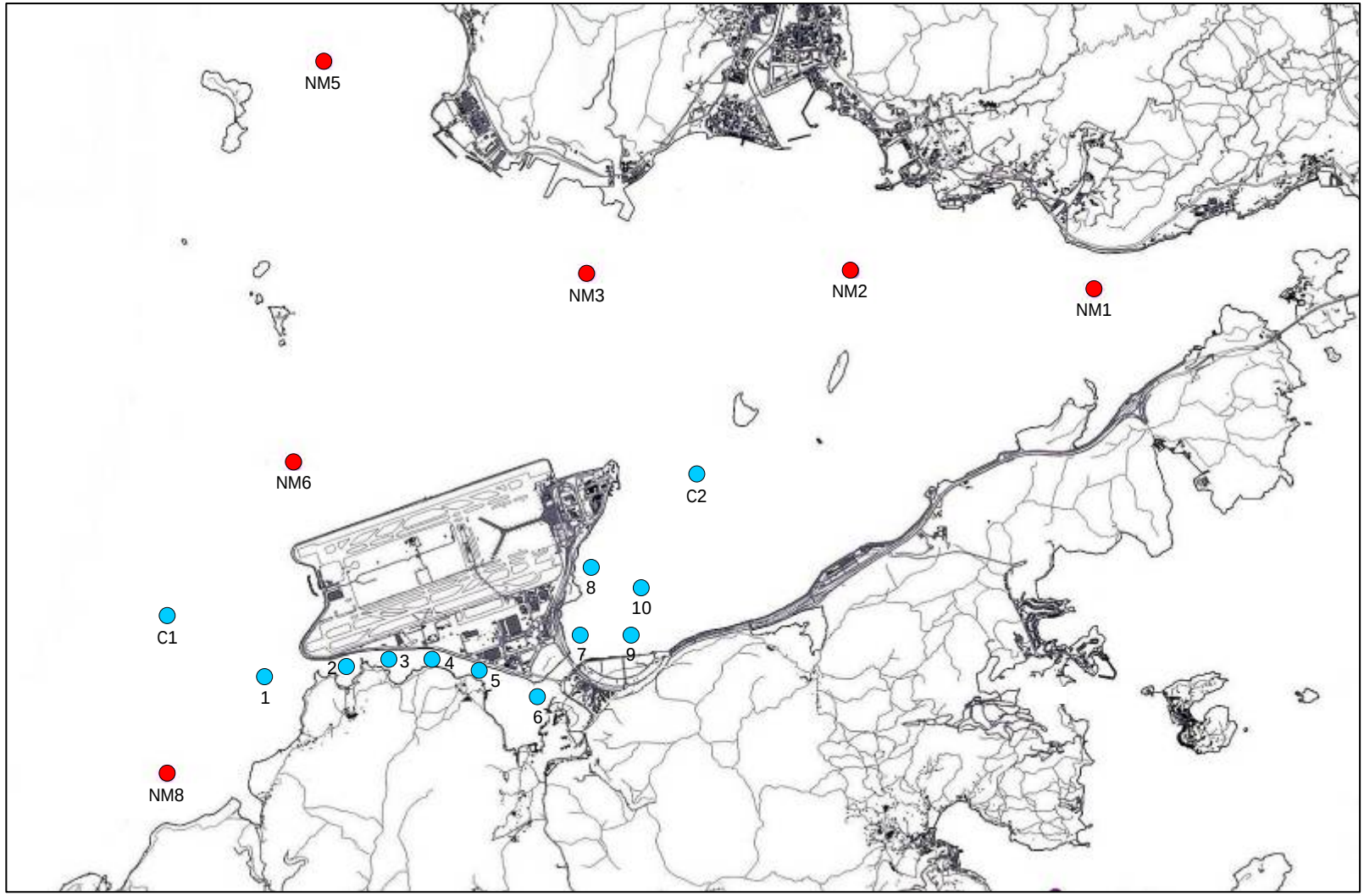
	Item	1	2	3	4	5	6	7	8	9	10	11	12	Yearly Range
	Date	31 Mar 99	30 Apr 99	28 May 99	25 June 99	23 Jul 99	20 Aug 99	24 Sep 99	22 Oct 99	19 Nov 99	17 Dec 99	21 Jan 00	11 Feb 00	
Water Quality Parameters*	Temp (℃)	21.7 (21.1-22.5)	24.7 (24.3-24.9)	26.2 (25.6-26.5)	28.9 (28.2-29.2)	28.9 (27.7-29.9)	29.6 (28.5-30.4)	26.8 (26.3-27.3)	26.3 (26.1-26.5)	22.9 (22.7-23.3)	19.1 (18.8-19.2)	17.0 (16.4-17.4)	17.1 (16.8-17.4)	16.4-30.4
	Salinity (ppt)	33.4 (33.5-34.0)	30.9 (30.0-32.0)	24.8 (21.0-31.0)	14.3 (12.0-16.0)	14.4 (7.8-24.0)	15.0 (8.0-24.0)	28.9 (28.3-29.4)	30.2 (29.2-31.5)	30.4 (30.0-31.9)	30.7 (30.2-31.3)	30.6 (28.9-31.8)	29.5 (28.7-30.4)	7.8-34.0
	Turbidity (NTU)	9.2 (5.2-14.6)	9.0 (3.7-12.2)	11.5 (4.0-18.0)	10.0 (7.2-12.8)	9.8 (7.0-13.0)	10.1 (5.6-13.4)	5.1 (2.8-9.5)	13.0 (8.3-18.0)	7.9 (5.7-12.7)	12.1 (6.0-25.6)	2.2 (0.8-3.3)	4.4 (3.0-6.8)	0.8-25.6
	SS (mg/)	11.5 (7.4-18.0)	14.4 (6.0-24.0)	13.0 (4.3-21.0)	9.0 (6.3-11.0)	10.2 (5.6-16.0)	10.9 (7.7-14.0)	7.2 (3.9-15.0)	19.2 (9.5-32.0)	9.6 (6.0-15.0)	15.0 (8.3-35.0)	5.7 (4.3-6.5)	9.0 (6.7-13.0)	3.9-35.0
	DO (%)	97.3 (92.0-102.0)	101.5 (97.0-109.0)	77.8 (69.0-93.0)	85.8 (71.0-94.0)	103.7 (62.0-160.0)	127.5 (81.0-189.0)	96.3 (92.0-104.0)	93.2 (88.0-98.0)	95.0 (91.0-98.0)	78.5 (72.0-86.0)	96 (87.0-107.0)	100.7 (96.0-107.0)	62.0-189.0
	DO (mg/)	7.0 (6.7-7.5)	7.1 (6.8-7.7)	5.3 (4.7-6.3)	6.1 (5.0-6.7)	7.3 (4.2-11.4)	9.4 (6.2-15.8)	6.5 (5.8-7.0)	6.3 (6.0-6.6)	6.8 (6.5-7.0)	6.1 (5.7-6.8)	7.7 (6.7-8.8)	8.1 (7.7-9.0)	4.2-15.8
	TRC (mg/)	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)	0.02 (<0.01-0.04)	<0.1 (<0.1-<0.1)	0.03 (0.01-0.04)	0.02 (<0.01-0.02)	0.03 (<0.01-0.06)	0.01 (<0.01-0.02)	0.02 (<0.01-0.03)	<0.01 (<0.01-0.02)	<0.01 (<0.01-0.02)	<0.01-0.06
	BOD (mg/)	1.6 (<2.0-2.4)	1.6 (<2.0-2.7)	<2.0 (<2.0-<2.0)	<2.0 (<2.0-<2.0)	<2.0 (<2.0-<2.0)	3.2 (<2.0-5.2)	3.4 (<2.0-11.0)	<2.0 (<2.0-<2.0)	<2.0 (<2.0-<2.0)	<2.0 (<2.0-<2.0)	<2.0 (<2.0-<2.0)	<2.0 (<2.0-3.4)	<0.2-11.0
	TKN	0.2 (0.18-0.27)	0.2 (0.1-0.2)	0.2 (0.1-0.3)	0.2 (0.18-0.28)	0.4 (0.22-0.68)	0.3 (0.07-1.0)	0.2 (0.15-0.31)	0.1 (0.06-0.16)	0.37 (0.2-1.4)	0.2 (0.11-0.23)	0.23 (0.19-0.30)	0.3 (0.17-0.73)	0.06-1.40
Sediment Quality Parameters*	Cadmium (mg/kg)	0.11 (0.03-0.24)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.14 (0.11-0.17)	n/a	0.03-0.24
	Chromium (mg/kg)	32.4 (16.0-41.0)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	29.7 (23.0-38.0)	n/a	16.0-41.0
	Copper (mg/kg)	28.4 (16.0-40.0)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25.1 (12.0-37.0)	n/a	12.0-40.0
	Lead (mg/kg)	39.9 (26.0-52.0)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	39.0 (25.0-49.0)	n/a	25.0-52.0
	Mercury (mg/kg)	0.03 (0.03-0.03)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.03 (0.03-0.03	n/a	0.03-0.03
	Nickel (mg/kg)	37.9 (10.0-189.0)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	20.9 (16.0-27.0)	n/a	10.0-189.0
	Silver (mg/kg)	0.5 (0.5-0.5)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.5 (0.5-0.5)	n/a	0.5-0.5
	Zinc (mg/kg)	101.8 (63.0-130.0)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	103.3 (76.0-130.0)	n/a	63.0-130.0
	Arsenic (mg/kg)	12.8 (6.0-18.0)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14.4 (10.0-19.0)	n/a	6.0-19.0
	p,p' -DDE (mg/kg)	<0.05 (<0.05)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<0.05 (<0.05)	n/a	0.03-0.03
	p,p' -DDT (mg/kg)	<0.05 (<0.05)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<0.05 (<0.05)	n/a	0.03-0.03
	Total PCBs (mg/kg)	0.5 (0.5-0.5)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.5 (0.5-0.5)	n/a	0.5-0.5

Table C.5 : Summary of Water Quality Data from Airport Authority's Non-statutory Marine Environmental Monitoring Programme (Contract M829)

Item		1	2	3	4	5	6	7	8
Survey Details	Date	13 Nov 02	13 Jan 03	17 Mar 03	12 May 03	12 June 03	16 July 03	11 Aug 03	23 Oct 03
	Weather Conditions	Sunny, moderate northeast winds	Sunny, hazy, light southeast winds	Sunny, good conditions	Sunny	Cloudy with rain and sunny intervals	Sunny with light wind	Sunny and dry	Sunny and dry
	Air Temp (°C)	23	19	26	27	27	32.3	32.0	dtbc
	High Tide (mPD)	1.8	1.4	2.2	1.9	2.1	2.4	2.5	n/a
	Low Tide (mPD)	1.0	1.0	0.4	1.0	0.7	-0.12	0.1	n/a
Water Quality Parameters*	Temp (°C)	23.6 (23.3-23.9)	17.7 (17.4-18.1)	20.7 (20.1-21.5)	25.9 (25.5-26.3)	27.4 (27.2-27.6)	30.0 (28.7-30.9)	29.9 (28.9-30.9)	26.2 (25.8-26.8)
	Salinity (ppt)	31.4 (30.6-32.2)	28.9 (30.6-32.2)	31.7 (31.3-32.2)	26.9 (24.8-29.5)	18.3 (13.3-25.0)	16.6 (15.3-18.1)	21.3 (19.4-23.4)	31.9 31.2-32.5
	Turbidity (NTU)	10.5 (6.9-832.4)	7.1 (4.4-14.5)	13.0 (5.5-18.1)	8.2 (3.4-24.4)	21.0 (5.1-48.6)	31.0 (16.5-76.4)	20.0 (12.1-39.7)	n/a
	SS (mg L^{-1})	14 (6-40)	13 (10-25)	14.1 (7.0-23.0)	14.9 (6.0-29.0)	35.7 (8.0-94.0)	30.6 (5.0 – 131.0)	20.6 (5.0-77.0)	n/a
	DO (%)	87.5 (85.2-90.7)	117.6 (109.8-126.7)	94.1 (89.3-98.5)	108.0 (78.4-127.4)	71.0 (55.4-80.2)	83.5 (61.7-98.8)	81.3 (62.7-103.3)	n/a
	DO (mg L^{-1})	6.2 (6.1-6.4)	9.4 (8.8-10.1)	7.0 (6.7-7.3)	7.5 (5.5-8.9)	5.1 (3.8-5.9)	5.8 (4.3-6.7)	5.6 (4.3-7.0)	n/a
	TRC (mg L^{-1})	0.03 (0.01-0.05)	0.04 (0.03-0.08)	0.10 (0.06-0.17)	0.10 (0.03-0.19)	0.14 (0.05-0.25)	0.14 (0.03-0.60)	0.03 (0.01-0.11)	n/a
	BOD (mg L^{-1})	<2 (<2)	2 (<2-3)	<2 (<2)	<2 (<2)	<2 (<2)	<2 (<2)	<2 (<2)	n/a
	TKN	0.4 (0.3-0.6)	0.5 (0.4-0.6)	0.6 (0.5-0.7)	0.3 (0.3-0.5)	0.3 (0.2-0.4)	0.3 (0.2-0.3)	0.2 (0.1-0.3)	n/a
Sediment Quality Parameters*	Cadmium (mg/kg)	n/a	n/a	n/a	n/a	0.2 (0.13-0.29)	n/a	n/a	n/a
	Chromium (mg/kg)	n/a	n/a	n/a	n/a	45.8 (29-53)	n/a	n/a	n/a
	Copper (mg/kg)	n/a	n/a	n/a	n/a	33.2 (22-41)	n/a	n/a	n/a
	Lead (mg/kg)	n/a	n/a	n/a	n/a	44.5 (32-53)	n/a	n/a	n/a
	Mercury (mg/kg)	n/a	n/a	n/a	n/a	0.1 (0.1-0.21)	n/a	n/a	n/a
	Nickel (mg/kg)	n/a	n/a	n/a	n/a	30.3 (20-36)	n/a	n/a	n/a
	Silver (mg/kg)	n/a	n/a	n/a	n/a	<1 (<1)	n/a	n/a	n/a
	Zinc (mg/kg)	n/a	n/a	n/a	n/a	127.3 (91-157)	n/a	n/a	n/a
	Arsenic (mg/kg)	n/a	n/a	n/a	n/a	18.3 (10.9-24.7)	n/a	n/a	n/a
	p,p' -DDE (mg/kg)	n/a	n/a	n/a	n/a	<0.05 (<0.05)	n/a	n/a	n/a
	p,p' -DDT (mg/kg)	n/a	n/a	n/a	n/a	<0.2 (<0.2)	n/a	n/a	n/a
	Total PCBs (mg/kg)	n/a	n/a	n/a	n/a	0.1 (<0.1-0.4)	n/a	n/a	n/a

Notes : * Data are presented as mean and range (in brackets
n/a not applicable
dtbc data to be collected.

Figure C.1 : Location of Water Quality Monitoring Stations in the NWWCZ



Note : EPD marine water quality monitoring locations are designated NM1, NM2, NM3, NM5, NM6 and NM8
Location of Airport Authority's non-statutory marineenvironmental monitoring programme is indicated by

Table C.6 : Nutrient Application Amounts During Turfgrass Establishment

Composition (%age)			Rate (kg/ha/app)	No. Applications	Total Application (kg/ha)		
N	P	K			N	P	K
18	10	9	275	2	99.0	55.0	49.5
3	1.6	1.6	1,000	2	60.0	32.0	32.0
18	10	9	275	2	99.0	55.0	49.5
19	0	16	260	2	98.8	-	83.2
3	1.6	1.6	1,000	2	60.0	32.0	32.0
19	0	16	130	2	49.4	-	41.6
Total (kg/ha)					**466.2**	**174.0**	**287.8**
Total for 2.8ha of Greens, Fairways and Tees(kg)					**1,305.4**	**487.2**	**805.8**
Average for 3-months (kg/month)					**435.1**	**162.4**	**268.6**

Source : From Table B.2, extended into a 3-month period.

Table C.7 : Nutrient Application Amounts During Golf Course Operation

	Composition (%age)			Rate (kg/ha/app)	No. Applications	Total Winter Application (kg/ha)			Total Summer Application (kg/ha)		
	N	P	K			N	P	K	N	P	K
Greens											
Winter	14	0	26	408	4	228.5	0	424.3			
	4	2	8	500	3	60.0	30.0	120.0			
Summer	14	0	26	250	6				210.0	0	390.0
	19	2	19	184	6				209.8	22.1	209.8
Fairways and Tees											
Winter	5	2	10	285	2	28.5	11.4	57.0			
Summer	19	0	16	260	4				197.6	0	166.4
Total (kg/ha)						**317.0**	**41.4**	**601.3**	**617.4**	**22.1**	**766.2**
Total for 2.8ha of Greens, Fairways and Tees (kg)						**887.5**	**115.9**	**1,683.7**	**1,728.6**	**61.8**	**2,145.2**
Average for 6-month Winter/Summer (kg/month)						**147.9**	**19.3**	**280.6**	**288.1**	**10.3**	**357.5**
Worst Case Application = 2 x Monthly Average (kg/month)						**295.8**	**38.6**	**561.2**	**576.2**	**20.6**	**715.0**

Source : From Table B.3.

Table C.8 : Construction Phase Water Balance and Nutrient Loading Calculations

	Dec	Jan	Feb	Mar	Apr	May	Jun
		Main Construction			*Turfgrass Establishment*		
Water Balance Calculations							
Monthly Rainfall (mm)[Note 1]	27.3	23.4	48.0	66.9	161.5	316.7	376.0
Rainfall within 10.5ha Lake Catchment (m^3)	2,867	2,457	5,040	7,025	16,958	33,254	39,480
Monthly Irrigation (mm)[Note 2]					78	109	111
Irrigation to 2.8ha Greens/Fairways/Tees (m^3)					-2,184	-3,038	-3,108
Monthly Evaporation (mm)[Note 1]	116.0	102.7	81.9	95.9	112.5	143.4	147.7
Evaporation from 1.3ha Lakes/Streams (m^3)	-1,508	-1,335	-1,065	-1,247	-1,463	-1,864	-1,920
Rainfall - Irrigation - Evaporation (m^3)	1,359	1,122	3,975	5,778	13,311	28,351	34,452
Max Lake Volume (incl. freeboard) (m^3)	17,500	17,500	17,500	17,500	17,500	17,500	17,500
Net Volume of Lake (m^3)	1,359	2,480	6,456	12,234	25,545	45,851	51,952
Overflow (Net Vol - Max Lake Vol) (m^3)	0	0	0	0	8,045	28,351	34,452
Nutrient Loading Calculations							
Ave Nitrogen Application (kg)[Note 3]					435.1	162.4	268.6
Assume 100% into Net Lake Volume (mg/)					17.0	3.5	5.2
Concentration at Outfall No. 8 (mg/)[Note 4]					4.7	1.0	1.4
%age of WPCO standard (30mg/)[Note 5]					15.7%	3.3%	4.8%
Ave Phosphorous Application (kg)[Note 3]					162.4	268.6	0.0
Assume 100% into Net Lake Volume (mg/)					6.4	5.9	0.0
Concentration at Outfall No. 8 (mg/)[Note 4]					1.8	1.6	0.0
%age of WPCO standard (5mg/)[Note 5]					35.1%	32.4%	0.0%
Ave Potassium Application (kg)[Note 3,5]					268.6	0.0	0.0
Assume 100% into Net Lake Volume (mg/)					10.5	0.0	0.0
Concentration at Outfall No. 8 (mg/)[Note 4]					2.9	0.0	0.0

Notes :
1. Monthly rainfall and evaporation rates from Hong Kong Observatory historical data, from 1960 onwards and represents average monthly data (including extreme events).
2. Irrigation rates based on typical irrigation rates for similar turfgrasses. In terms of water balance, whether turfgrass receives water from irrigation or rainfall makes no difference to net volumes.
3. Nutrient application rates based on Table C.6 for 2.8ha of Greens, Fairways and Tees.
4. Overflow from lake represents 10.5ha of the 38ha catchment of Outfall No. 8. Therefore, overflow from the Golf Course is diluted by 10.5/38 in the flow from Outfall No. 8 (during rainstorms).
5. There is no WPCO standard for potassium. Standards for Nitrogen and Potassium based on most stringent requirements (shaded column in Table C.1).

Table C.9 : Operation Phase Water Balance and Nutrient Loading Calculations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter / Dry Season					*Summer / Wet Season*				*Winter / Dry Season*		
Water Balance Calculations												
Monthly Rainfall (mm)[Note 1]	23.4	48.0	66.9	161.5	316.7	376.0	323.5	391.4	299.0	144.8	35.0	27.3
Rainfall within 10.5ha Lake Catchment (m^3)	2,457	5,040	7,025	16,958	33,254	39,480	33,968	41,097	31,395	15,204	3,675	2,867
Monthly Irrigation (mm)[Note 2]	78	62	71	78	109	111	130	121	117	121	102	87
Irrigation to 2.8ha Greens/Fairways/Tees (m^3)	-2,170	-1,725	-1,996	-2,184	-3,038	-3,108	-3,646	-3,385	-3,276	-3,385	-2,856	-2,430
Monthly Evaporation (mm)[Note 1]	102.7	81.9	95.9	112.5	143.4	147.7	175.0	161.0	156.0	159.0	135.0	116.0
Evaporation from 1.3ha Lakes/Streams (m^3)	-1,335	-1,065	-1,247	-1,463	-1,864	-1,920	-2,275	-2,093	-2,028	-2,067	-1,755	-1,508
Rainfall - Irrigation - Evaporation (m^3)	-1,048	2,251	3,781	13,311	28,351	34,452	28,047	35,619	26,091	9,752	-936	-1,072
Max Lake Volume (incl. freeboard) (m^3)	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500
Net Volume of Lake (m^3)	16,452	19,751	21,281	30,811	45,851	51,952	45,547	53,119	43,591	27,252	16,564	16,428
Overflow (Net Vol - Max Lake Vol) (m^3)	0	2,251	3,781	13,311	28,351	34,452	28,047	35,619	26,091	9,752	0	0
Nutrient Loading Calculations												
2 x Ave Nitrogen Application (kg)[Note 3]	295.8	295.8	295.8	576.2	576.2	576.2	576.2	576.2	576.2	295.8	295.8	295.8
Assume 100% into Net Lake Volume (mg/)	18.0	18.0	13.9	18.7	12.6	11.1	12.7	10.8	13.2	10.9	17.9	18.0
Concentration at Outfall No. 8 (mg/)[Note 4]	0.0	5.0	3.8	5.2	3.5	3.1	3.5	3.0	3.7	3.0	0.0	0.0
%age of WPCO standard (30mg/)[Note 5]	0.0%	16.6%	12.8%	17.2%	11.6%	10.2%	11.7%	10.0%	12.2%	10.0%	0.0%	0.0%
2 x Ave Phosphorous Application (kg)[Note 3]	38.6	38.6	38.6	20.6	20.6	20.6	20.6	20.6	20.6	38.6	38.6	38.6
Assume 100% into Net Lake Volume (mg/)	2.3	2.0	1.8	0.7	0.4	0.4	0.5	0.4	0.5	1.4	2.3	2.4
Concentration at Outfall No. 8 (mg/)[Note 4]	0.0	0.5	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.4	0.0	0.0
%age of WPCO standard (5mg/)[Note 5]	0.0%	10.8%	10.0%	3.7%	2.5%	2.2%	2.5%	2.1%	2.6%	7.8%	0.0%	0.0%
2 x Ave Potassium Application (kg)[Note 3,5]	561.2	561.2	561.2	715.1	715.1	715.1	715.1	715.1	715.1	561.2	561.2	561.2
Assume 100% into Net Lake Volume (mg/)	34.1	28.4	26.4	23.2	15.6	13.8	15.7	13.5	16.4	20.6	33.9	34.2
Concentration at Outfall No. 8 (mg/)[Note 4]	0.0	7.9	7.3	6.4	4.3	3.8	4.3	3.7	4.5	5.7	0.0	0.0

Notes :
1. Monthly rainfall and evaporation rates from Hong Kong Observatory historical data, from 1960 onwards and represents average monthly data (including extreme events).
2. Irrigation rates based on typical irrigation rates for similar turfgrasses. In terms of water balance, whether turfgrass receives water from irrigation or rainfall makes no difference to net volumes.
3. Nutrient application rates based on Table C.7 for 2.8ha of Greens, Fairways and Tees.
4. Overflow from lake represents 10.5ha of the 38ha catchment of Outfall No. 8. Therefore, overflow from the Golf Course is diluted by 10.5/38 in the flow from Outfall No. 8 (during rainstorms).
5. There is no WPCO standard for potassium. Standards for Nitrogen and Potassium based on most stringent requirements (shaded column in Table C.1).

Appendix D

Sewage Generation Rate at SkyCity Golf Course

Table D.1 : Calculations for Sewage Generation Rate

1. Golf Facility			
1a. Total number of golfers	=	464	persons
1b. Design flow - guest	=	50	litre/person/day
1c. Assumed number of employees	=	50	persons
1d. Design flow - employee	=	60	litre/person/day
1e. Sewage generation rate	=	26	m^3/day
2. Other Facilities			
2a. Retail area	=	113	m^2
2b. Assumed floor area per person	=	15	m^2 usable floor area per person
2c. Design flow	=	290	litre/person/day
2d. Area of kitchen in restaurants	=	79	m^2
2e. Design flow - kitchen	=	500	litre/m^2 kitchen area/day
2f. Sewage Generation rate	=	42	m^3/day
Total Flow	**=**	**68**	**m^3/day**