DOCUMENT CONTROL			Proposed Extension of Public Golf Course at Kau Sai Chau Island, Sai Kung – Environmental Impact Assessment	No. 382210.REP
AMENDMENT RECORD				Prepared by: Esther Tong
Turfgrass Management Guidelines			Client: HKJC	Initials: ET
				Date: July 2005
Pages:	**Date:**	**Issue No.**	**Description:**	**Initials:**
All	July 05	1	Issue 1	ET
	Aug 05	2	Section 2.10	ET
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			Section 2.12.7	ET

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SECTION 1 BACKGROUND

1.1 The Jockey Club Kau Sai Chau Public Golf Course opened its first 18 golf holes to the public on the 27th December 1995, with the second 18 holes opened for play on the 28th of September 1996. The official opening ceremony was carried out on the 13th of November 1996.

1.2 The Golf Course Superintendent (GCS) has been responsible for implementing the Turfgrass Management Plan (TMP) since the beginning of golf course turf establishment at Kau Sai Chau in 1995. The TMP has been in operation for over ten years and is implemented by the GCS and his team of trained and experienced staff. The TMP has been complied with to ensure that the procedures for chemical applications and course development are followed in an environmentally acceptable manner. Where necessary, the TMP has been updated according to site specific experience gained by the Superintendent and his Team, and changes in legislation affecting the management of chemicals.

1.3 The management of the course requires experience and knowledge in turfgrass cultivars, disease control and prevention, pest management, soil chemistry and biology and local knowledge of weather patterns. The TMP team is based at the maintenance area on the course where, in addition to the office facilities, there are a dedicated chemical store room; a washroom area for plant and machinery from which washwater drains to the sewage treatment plant and is subsequently recycled on the course; and a workshop area for the repair and maintenance of plant and machinery.

1.4 The TMP is particularly linked to the results of water quality monitoring which is covered in Section 3.

1.5 The GCS understands that the successful implementation of the TMP to achieve its environmental objectives requires a close two-way consultation process between his team and external parties, including consultants, professional authorities and relevant Government departments. Consultation regarding the TMP therefore has been on-going since the opening of the golf courses.

1.6 The attached document is an amended TMP specifically intended for the management of the proposed third golf course. Changes to the document have been made to reflect both the improved construction specification for the third golf course and differences in the management approaches for the maintenance of Seashore Paspalum turf grass. This is reflected in the document through reduced requirements for Nitrogenous fertilizers, and the addition of some biological products for the treatment of turf grass pests.

SECTION 2 TURF GRASS MANAGEMENT

2.1 INTRODUCTION

2.1.1 This Turf Management Plan (TMP) is designed to assure that the Golf Course management is fully aware of the Golf Course Superintendent's (GCS) programmes and the ways in which these programmes are planned. The TMP is important to establish objectives for the conservation of water and nutrients, and minimization of chemical usage on the golf courses. The integration of these areas is essential in developing an effective TMP which helps the GCS manage the courses effectively.

2.1.2 The thresholds which prompt action in the TMP programme are based on pest populations, turfgrass/soil nutrient tests, soil water conditions, soil and thatch physical properties, turfgrass playing conditions and environmental conditions. These threshold periods have been comprehensively developed and fine-tuned over the past ten years of operation of the existing golf courses. The same principles will be applied to the third golf course TMP whilst catering for the different turf management strategies required for Paspalum, which is the turf selected for use on the third golf course. Constant monitoring will help determine if threshold values are met and whether any action is required.

2.1.3 The performance of the TMP is assessed in terms of the quality of turf produced in time with the stated objectives of water and nutrient conservation and chemical minimisation. This monitoring will be facilitated by the excellent green construction and the complex drainage system with a fully integrated irrigation regime. The success of the TMP depends on regular and frequent monitoring and evaluation. The evaluation results will be used to modify the programme to respond to changing environmental, cultural, and pest conditions within the stated objectives.

2.2 SELECTION OF TURFGRASS SPECIES AND CULTIVARS

2.2.1 General

The turf grass proposed for the third golf course at Kau Sai Chau is Paspalum “Sea Isle 2000” for greens and Paspalum Vaginatum for fairways, tees, and roughs. Since the selection of Bermuda as the turf for the existing courses in 1994, Paspalum has emerged as an alternative choice with similar texture and quality as Bermudagrass but with better environmental qualities and has been selected with the following criteria in mind:

- Multiple environmental stress tolerances
- Improved nutrient uptake and utilization efficiency (requires judicious applications of fertilizers)
- More stable disease and insect resistance (requires minimal pesticides)
- Capability to tolerate a wide range of alternative water resources
- Good playing surface quality
- Good aesthetic appeal with low maintenance approach

2.2.2 Greens

The grass selected for use on the greens, "Sea-isle 2000" Seashore Paspalum, generates excellent growth while providing a strong tight knit playing surface. It has a darker green color than Bermuda grass and performs well at lower mowing heights. Greens planted with "Sea-isle 2000" Seashore Paspalum have lower nitrogen requirements, particularly during establishment, and are more resistant to a wide range of pests meaning minimal pesticide requirements. Used in conjunction with good cultural maintenance practices, "Sea-isle 2000" Seashore Paspalum provides an excellent putting surface. "Sea-isle 2000" has better low light intensity tolerance, traffic tolerance, and cold tolerance, which make this turf well suited to handle difficult growing conditions between January and April in Hong Kong.

Greens will be established from stolons which will be certified and tested for purity to save management control efforts in the long term. Optimum mowing heights for Paspalum "Sea-isle 2000" greens are in the range of 3-5 mm. Colour and density of Paspalum greens mown at this height will usually be darker green and more dense than the Tifdwarf Bermuda greens on the existing course mown at the same height. Reel mower maintenance will be increased as wear and tear on bed knives and reels are expected to be greater from Paspalum greens.

2.2.3 Fairways

The fairways will be planted with Paspalum Vaginatum. Except for "Sea-isle 2000" use on greens, this will be the only turf species used for planting of the golf course to avoid any cross contamination which would require subsequent management and control actions. As for greens, the turf planted on fairways would be certified, and tested for purity, to save management control efforts in the long term. Greens surrounds, bunker surrounds, and sloped areas would be sod planted for quick establishment and protection against soil erosion. Other areas would be planted by traditional sprig planting methods.

Optimum mowing heights for Paspalum fairways vary between 13-16mm depending on the time of year. Heights should be raised to the higher end of this scale going in to winter to improve carbohydrate load in the crown region and in the rhizomes and to enhance winter hardiness.

2.2.4 Tees

Tees on public golf courses tend to suffer from extensive wear, especially on Par 3 holes where divots are more frequently removed from the surface. The tees designed for the third golf course are much larger than tees on the existing course to enable better traffic rotation and thereby reduce man made stress levels on the turf. The tee size on the third golf course would be sufficient to handle traffic through the winter period without over seeding with a Perennial Ryegrass. This will conserve water and nutrients that would be required to grow in over seeded turf on the tees on an annual basis. Large tees would also minimize extensive exposure of the soil and reduced the likelihood of disease.

2.2.5 Bunkers

The bunkering of the third golf course will provide a distinct feature of the Golf Course. Paspalum will also be used as the turf for bunker surrounds. Bunker faces will primarily receive foliar feeding for areas that rotary fertilizer spreaders could not access.

2.2.6 Roughs or non Fairway Areas

Roughs next to fairways are part of the golf course, but are kept on a low maintenance regime. Same as the fairways, they will be planted with Paspalum Vaginatum.

Peripheral areas will be reinstated to their former natural habitat, either through landscaping with indigenous species or natural progression. These areas will be treated as low maintenance areas with no fertilizer or pesticide applications.

2.3 SOIL MANAGEMENT PRACTICES

Construction specifications for golf course formation have been clearly defined and follow the latest United States Golf Association (USGA) specifications

During construction, special attention will be paid to the soil types on Kau Sai Chau. The top soil will be used to cap the outer margins of the Golf Course to provide suitable growing medium for their eventual revegetation. Imported growing medium has been selected for the Tees, Greens and Fairways. In conjunction with drainage and irrigation, the imported medium will provide ideal conditions for good soil management.

Greens have been constructed to U.S.G.A. Specifications. An extensive sub-surface drainage system is installed to dispel groundwater. The golf course runoff is collected by a series of catchpits and sub-soil drainage that discharge to the closed low flow drainage system. The sub-soil drainage will be constructed both in fairways and greens. The sub-surface drainage spacing of 12 meters will be sufficient to ensure that all soils are free draining, and there would be no standing water with its associated turf maintenance problems. The greens and tee surfaces have also been graded to avoid the accumulation of surplus surface water. The U.S.G.A. green construction method is based on creating a perched water table. This allows the root zone to hold moisture which helps to reduce irrigation requirements. The root zone medium for the greens consists of 85% sand and 15% peat moss mixture.

The tees and fairways will consist of a clay sub-base covered with 200 mm of inert river sand. In addition to the extensive sub-soil drainage, cultural practices such as coring and spiking will ensure that greens, tees, and fairways would remain free draining.

It is essential to control and minimize traffic on the Golf Course. Excessive traffic from machinery and golfer's trolleys will cause compaction and wear, which is potentially damaging to the soil structure. As golf buggies will be used on the proposed third golf course both golfer’s carts and maintenance machinery would utilize the cart track to be built adjacent to the fairways and thereby limit compaction to the soil from golf carts and machinery. Aeration of all sand surfaces will be carried out twice yearly or when warranted. This practice will relieve compaction, aerate the sand profile and assist in the free drainage of the sand. Aeration will take place during the months of May and September for all tees, greens and fairways.

Soil testing for nutrient status would be carried out a minimum of 3 times per year. Results of soil tests are an important element of the Turf Management Plan, and would provide important feedback to the GCS on the success of fertility programs in place. Conducted at the above frequency, soil testing would provide ample warning to the GCS on the requirement to amend applications to maintain the turf in optimum condition.

2.4 CULTURAL PRACTICES

The best defence against pest invasion is the provision of a dense, healthy, competitive turf. This is achieved after establishment by providing cultural practices which favour turf growth over pest occurrence. Important cultural practices in IPM programs include proper irrigation, fertilization, mowing aerification, verticutting, and top dressing. Prolonged use of incorrect cultural practices and lack of understanding of the inter relationships between these practices weakens the turf, encourages pest activity or invasion, and excessive thatch development. Thatch harbours many insect and disease pathogens. It also binds pesticides and reduces the efficiency of an irrigation program.

Cultural Practice Reference Table – Greens

Cultural Practice	**Turf Area**	**How Often**	**Time of Year**	**Rate** (pounds/1000 sq. ft.)
Topdressing	Greens	Every 2-3 weeks & follow with verticutting	All year	
Aerification	Greens	10-12 weeks	Spring, Fall	N/A
Verticutting	Greens	biweekly	All year	N/A
Plant Growth Regulator	---			---
Overseeding	---			
Fans	---			N/A
Other:	Hydroject	monthly	Late Fall & Winter	---

Cultural Practice Reference Table – Tees

Cultural Practice	**Turf Area**	**How Often**	**Time of Year**	**Rate** (pounds/1000 sq. ft.)
Topdressing	Tees	6-8 weeks	Spring, Summer	Light dusting
Aerification	Tees	Once a year	Early Spring	N/A
Verticutting	Tees	6-8 weeks	Spring, Summer	N/A
Plant Growth Regulator	---			---
Overseeding	Tees	Once 2 year	Early Fall	
Fans				N/A
Other:				

Cultural Practice Reference Table – Fairways

Cultural Practice	**Turf Area**	**How Often**	**Time of Year**	**Rate** (pounds/1000 sq. ft.)
Topdressing	Fairways	Follow aeration	Late Spring	Light dusting
Aerification	Fairways	Once a year	Late Spring	N/A
Verticutting				N/A
Plant Growth Regulator	Fairways	5-6 weeks	Late Spring, Mid Summer	830 ml/ha - prims
Overseeding				
Fans				N/A
Other:				

2.5 IRRIGATION MANAGEMENT

Irrigation is one of the most important aspects of the TMP. Poor or excessive irrigation practices can result in nutrient loss, disease and insect susceptibility. To combat this potential risk, watering schedules will be initiated and closely monitored by the GCS.

Watering will generally take place overnight and as close to the early morning as practicable. This practice minimizes 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 infrequent watering cycles are the key to strong Paspalum grass development on a sand based turf. Irrigation rates are adjusted by the GCS according to assessment of requirements. Watering requirements will be determined through the use of soil probes and turf inspection on a daily basis. Weather forecasts and predictions are also part of the decision to irrigate or not.

Watering is carried out in cycles to eliminate water runoff. Emphasis will be placed upon preventing the soil and thatch from becoming hydrophobic. Watering in the early evening 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 will only be directed at target areas which will reduce water runoff and wastage.

Irrigation is an important tool for the GCS as it helps to stabilize soils and prevent wind erosion in bunkers. As for the existing courses all irrigation practices will be documented in terms of watering time and millimetres of water applied to an area.

In order to maintain optimum efficiency of the irrigation system, a regular preventative maintenance program will be strictly adhered to. This will include checks to all major components of the system including lightning protection. All irrigation pumps will be serviced through an annual preventative maintenance contract with system inspection and testing on a quarterly basis.

2.6 FERTILIZER REQUIREMENTS

2.6.1 Objectives

The objective of the TMP with respect to fertilization is to minimize application as far as possible. At certain times of a year, nitrogenous fertilizers will be applied to a programme suited to Paspalum turf and the prevailing soil conditions that will be determined through soil testing. Relative to other turf grass, Paspalum has a lower requirement for Nitrogenous fertilizer. Paspalum fertilization requirements differ substantially from Bermuda grass requirements with a Nitrogen to Potassium ratio of 1:2 or 1:3, depending on prevalent soil conditions. 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, and Potassium (NPK) based fertilizers will contain trace elements as this can lead to an imbalance in nutrients.

Paspalum grass requires its own specialized management techniques. Healthier growth rates are achieved when the grass is not over fertilized or over watered. A balanced fertilizer and watering programme would allow the grass to stand up to wear and develop disease resistance.

2.6.2 Nutrient Status

Nutrient status will be monitored every 3 months of the year through soil testing to determine the nutrient status and overall health of the soil. This helps integrate the GCS nutritional programmes for the grass with the nutrient requirements found to be necessary through the laboratory tests. Tests help determine the optimum nutrient provisions for turf grass. To help maintain an even balance of nutrient supply that is not greatly affected by environmental conditions, slow release fertilizers will be used, together with spoon feeding through foliar applications. This practice will ensure that there would be no nutrient loading within the soil and efficient turf nutrient uptake, minimizing potential for nutrient loss from the soil.

2.6.3 Nitrogen

The Nitrogen (N) source used on Kau Sai Chau will be in slow release form. With the correct Management Practices and the use of slow release fertilizer, losses of nitrogenous fertilizer will be negligible. Only mini prill fertilizers will be used as this will also minimize runoff as the fertilizer granules become fixed within the turf canopy. As shown in section 2.6.7, the estimated use of Nitrogen on Paspalum will be lower than the current requirements for maintenance of Bermuda grass.

2.6.4 Phosphorous

Turf Grass does not require large amounts of Phosphorous. This will be incorporated into the fertilizer program through an NPK blended fertilizer. The Phosphorous source will be derived from Mono Ammonium Phosphate after establishment.

2.6.5 Potassium

Potassium fertilization is very important for Paspalum. Although Paspalum has the capability to extract and accumulate appreciable K in leaf tissues in adverse environments, K additions must be included in the management program. Sufficient K must be applied on a regular schedule to prevent “mining” of the soil K to very low levels, and to provide adequate K for uptake and use in stress tolerance mechanisms. Potassium is important in resistance to disease, drought, heat stress, and cold and wear tolerance. Potassium will be applied in conjunction with nitrogen at a (N:K) 1:2 or 1:3 ratio. The Potassium source is most likely to be derived from Potassium Sulfate or Potassium nitrate.

2.6.6 Micro Nutrients

Micro nutrient requirements for elements such as Magnesium (Mg), Boron (B), and Calcium (Ca) will be 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 in 2.6.1.

Sufficient Sulfur is generally applied, when Potassium fertilizer such as Potassium Sulfate is used as the major source of Potassium, therefore avoiding the need for Sulphur Supplements.

Sufficient Lime will be applied to adjust or maintain the surface 200mm to pH >6.0, and would be applied based on soil test results. It is likely that two applications per year would be required in Spring and Autumn.

2.6.7 Estimated Fertilizer Usage

It is not possible to state the precise amount of fertilizer which will be used, especially bearing in mind the changing weather and soil conditions. The following serves as a guide to applications.

Greens

The total approximate area of greens is 1.12 hectares. The fertilizer programme for greens is divided into 2 periods, winter (November – March) and summer (April – October):

(a) Winter Period

During the winter period, the greens will be fertilized at 8-week intervals. During this period 12.0.24 (or equivalent) will be used. This has a high potassium ratio to help protect the turf against cold stress. The nitrogen form is slow release, therefore creating an even release of N over a long period. Every 8 weeks (3 applications over winter period) 12.0.24 will be applied at a rate of 408 kg/hectare. This will generate 49 kg N/hectare per application (the N value in the fertilizer is 12%). This will be supplemented by 2 applications of 4:2:8 organic fertilizers at a rate of 500 kg/ hectare. This will generate 20 kg N/hectare per application (the N value in this fertilizer is 4%).

(b) Summer Period

During the summer months fertilizer applications will be made at 6-7 week intervals. 15:2:30 slow release fertilizer or similar product would be used. Each application (5 total) would supply 40 kg/N per hectare. Based on 40 kg/N per hectare, 272 kg of 15:2:30 will be used per application.

Phosphorous will be applied in trace quantities within 15:2:30 in summer and 4.2.8 organic in winter, (2% Phosphorous). Fertilizers with higher Phosphorous quantities will only be applied in response to deficiencies detected in soil tests.

With the relatively low quantity of fertilizer applied to the greens it is important to maintain the right nutrient balance within the soil and this would be done through foliar "spoon feeding" which would ensure low quantity but readily available nutrients to the plant. This would be done through monthly application of 13:0:46 Potassium Nitrate or similar product, at a rate of 6.5kg N/ per hectare. Ferrous sulfate will be applied during the winter months on a 4 week programme at a rate of 30 kg per hectare. Ferrous Sulfate helps maintain the green appearance of the turf and also serves to harden plant cells for improved cold and traffic stress tolerances.

From the above programme an approximate calculation is given below on the amount of nutrients (N:P:K) applied to the greens of the proposed third golf course at Kau Sai Chau per year.

- Nitrogen 4.65 kg/ 100m2
- Potassium 10.5 kg/ 100m2
- Phosphorous 0.472 kg/ 100m2 (subject to soil test results)

Fairways and Tees

The total area of Fairways and Tees at the proposed third golf course on Kau Sai Chau is 18.1 hectares. Fairways and tees will receive four granular applications per year with 19:2:19 or similar product being applied in Spring and Autumn and an organic 5:2:10 or similar product being applied twice during the winter. This will be supplemented with foliar spoon feeding with 13:0:46 Potassium Nitrate and Ferrous Sulphate at intervals of 4-8 weeks depending on the time of year.

(a) Winter Period

During the period from November through to February, two applications of organic fertilizer 5.2.10 will be applied at a rate of 40 kg N/hectare. To achieve 40 kg/N per hectare per application, 800 kg 5.2.10 will be applied per hectare.

(b) Summer Period

During the warmer months (growing season) from March through to October, two granular applications of 19.2.19 will be applied at a rate of 50 kg N/hectare. To achieve 50 kg N/hectare per application, 260 kg of 19:2.19, or similar product will be applied per hectare.

Minimal Phosphorous will be required for maintenance of turf on fairways and tees and it will only be applied as part of a general N:P:K application as shown above (2%). Additional Phosphorous applications will not be applied unless soil test results show a deficiency requiring amendment.

13:0:46 will be applied to fairways and tees at a rate of 6.5 kg N/hectare. This will be done as a foliar “spoon feed” which would include low quantity yet readily available nutrients to the plant. Ferrous sulfate will be included with this foliar feed at a rate of 30 kg/hectare. This foliar feed would be done at 4-6 week intervals depending on turf conditions and the time of year.

From the above programme an approximate calculation is given below on the amount of nutrients (N:P:K) applied to the tees and fairways of the proposed third golf course at Kau Sai Chau per year.

- Nitrogen 2.58 kg/ 100m2
- Potassium 5.36 kg/ 100m2
- Phosphorous 0.42 kg/ 100m2 (subject to soil test results)

Rough Areas

Rough areas form an integral part of the course design strategy. Roughs that come into play on the Golf Course will be on a low maintenance regime and fertilized on an as needed basis. Based on the existing practice they would receive approximately 50% of the volume of fertilizer of fairway and tee areas on the same ratio of 1:2 (N:K.)

Peripheral, or out of play roughs, initially established with Paspalum will be reinstated to their formal natural habitat, either by landscaping with indigenous species or natural progression. Many examples of this can be seen on the existing courses. These areas will be treated as low

maintenance with no fertilizer or pesticide applications.

An N:P:K slow release fertilizer will be used for areas of rough that are maintained. Before this is applied all rough areas will be spiked. This will ensure maximum penetration of the nutrients into the soil and therefore reducing potential nutrient runoff.

Establishment and grow-in

Normal grow-in time from sprig planting to full coverage for Paspalum is between 2-3 months depending on volume of sprigs planted, water quality and quantity, and temperature/ time of year. At Kau Sai Chau it is expected that grow-in would take 2 months in peak growing season and 3 months through winter

1st Month

Paspalum absorbs limited amounts of Nitrogen in the first month of establishment. Instead the turf prioritizes root development and therefore higher levels of Phoshorous and Potassium will be required. In the first month of establishment, slow release fertilizers with N:P:K ratio of 1:2:3 are adequate when applied at 0.25kg N per 100m2 on a bi-weekly basis (maximum 2 applications). When stolon growth is first observed emphasis should be shifted to higher N sources.

2nd and 3rd Months

Approximately 4 weeks after planting, and after stolon growth is first observed, a slow release N:P:K fertilizer of 12:12:24 formulation will be applied at a rate of 0.5 Kg N per 100 m2, and repeated at 3 week intervals, with a maximum of 3 applications anticipated for full grow-in.

In addition to the above applications a dual-phase approach to enhance stolon/ rhizome/ shoot growth will be adopted with light verti-cutting on a weekly/ biweekly basis followed by spoon feeding low rates of Calcium Nitrate at 0.075 Kg N per 100 m2. A maximum of 6 applications of Calcium Nitrate would be made during the grow-in period.

For areas planted with sod, fertilization would follow the schedule shown for the first month establishment above, and thereafter a mature turf program would be adopted. Whether the turf is established by sod or stolons, N fertilization rates should be reduced to that of a mature turf program as quickly as possible.

From the above programme an approximate calculation is given below on the amount of nutrients (N:P:K) required for establishment and grow-in of Paspalum for the proposed third golf course at Kau Sai Chau.

- Nitrogen 2.45 kg/ 100m2
- Potassium 4.5 kg/ 100m2
- Phosphorous 2.5 kg/ 100m2

2.7 WEED CONTROL AND HERBICIDE REQUIREMENTS

2.7.1 Introduction

Close Paspalum mowing heights provides a tight dense canopy that deters aggressive growth in most weeds. With good cultural mowing practices, it is estimated that 90% of weed species would be smothered by the dense Paspalum grass covering. The density of the grass is created through a close and frequent mowing schedule. All turf supplied for planting of the proposed third golf course will be certified and tested. Tight quality control measures will ensure a mono stand of pure turf from the beginning to reduce any requirement for Herbicide control on an ongoing basis.

Mechanical methods (hand pulling) of removing turfgrass weeds will be the primary means of control. Broad leaved weeds will be removed mechanically by the course maintenance staff. Paspalum has been used widely on salt-affected sites due its high tolerance for saline water. In such cases most weeds are suppressed or eradicated by the high salinity. The use of salt water will be explored as a means of weed control management through spot spraying, and should be sufficient to eradicate most annual grass and broadleaf weed problems. An additional weed control strategy will be the use of rock salt in the form of spot application to problem weeds, followed by light irrigation (too much water will dilute the salt-enhanced stress and diminish weed control effectiveness).

Herbicides will only be used under extreme cases when any persistent weeds need to be removed. These will be controlled by means of chemical applications. (Normally one application or at most a second light application will suffice. This is sufficient to remove unwanted weeds.) Herbicide will only be applied in select areas on dry days with very little air movement to reduce the risk of spray drift to non-targeted areas. It is the objective of the GCS to avoid weeds becoming established through good management and cultural practices and to avoid the use of herbicides wherever possible.

A single application of the pre-emergent herbicide Ronstar would be made at time of planting. This would greatly reduce infestation of weeds during establishment and would reduce long term weed control requirements by ensuring a pure mono stand of Paspalum from the beginning. Other than this single application, herbicides would not be used during the turf establishment period. This is because the immature Paspalum would have a low tolerance to other herbicides during the initial stages, and the combination of a pre-emergent treatment of Ronstar and hand weeding would be sufficient to maintain optimum quality in the early stages.

2.7.2 Quantification of Herbicides

The herbicides to be used on the proposed third golf course at Kau Sai Chau are all products registered with the Hong Kong Agricultural, Fisheries and Conservation Department (AFCD) under the Pesticides Ordinance. Herbicides will only be applied as spot applications where cultural maintenance, mowing practices, and salt/ salt water treatments have failed. The main weed varieties expected to effect the proposed third golf course are *Axonopus* (Carpet Grass), Sedges, Torpedo grass, and Crab grass. These weeds can be controlled through the use of salt water; however, in severe cases control using a contact Herbicide may be required. The main Herbicides that will be used on Kau Sai Chau will be the following 5 products.

Ronstar Active Constituent 2% Oxadiazon

Granular Ronstar is recommended for selective preemergent control of grass weeds and will be used on Paspalum grass for the control of Crabgrass, Goosegrass, Poa, and winter broadleaves.

It will be applied at a rate of 1.8 kg per 100 m2, by rotary spreader. The product would not be used if it is raining or windy or if these conditions are forecast.

Image Active Constituent 17.3% Imazaquin

Image is recommended for the selective control of grass weeds and will be used on Paspalum primarily for eradication of sedges. It will be applied at a rate of 3 L/hectare, and will be boom sprayed in 600 L of water. The product will not be used if it is raining or windy or if these conditions are forecast.

2,4D/Mecoprop (Emulsifiable concentrate 25/50 % weight by volume)

2,4-D/Mecoprop is a selective, hormone type phenoxy herbicide. It is applied post emergence and is used on sports turf for selective control of creeping broadleaf weeds. Mecoprop is absorbed by plant leaves and translocated to the roots. It affects enzyme activity and plant growth. It acts relatively slowly requiring three to four weeks for control.

Roundup® Active Constitute 41% Glyphosate

Roundup® is a broad-spectrum herbicide which may also eradicate turf grasses as well as the targeted weeds. Roundup® will not be used routinely. Spot spraying of areas with weed infestation will only take place when there is a need to eliminate all grasses in a given area. The spraying will be undertaken with a knapsack sprayer containing a 2% Roundup® solution, and will not be used if it is raining or windy or if these conditions are forecast.

Spot Spraying

Whilst boom applications will be required, as far as possible emphasis would be on spot spraying, for reduced chemical usage and increased product efficiency.

Establishment and grow-in

Except for a single application of Ronstar during turf establishment, herbicides would not be applied to Paspalum during establishment and grow-in. Emphasis will be on quality control of stolons and sod delivered to site so that minimal weeds would be encountered within the turf stand. Weeds that become evident during establishment would be hand pulled as herbicides use at this early stage would injure the immature turf.

2.8 DISEASE CONTROL AND FUNGICIDES

2.8.1 General

Seashore Paspalum does not have a wide variety of pathogen problems that tend to effect other warn season grasses, probably due to the fact that it evolved in a wet, humid ecosystem with multiple disease exposure where surviving ecotypres have developed resistance.

The Paspalum grasses chosen for the proposed third golf course at Kau Sai Chau 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. Conditions on the proposed third golf course will be open with low vegetation and good 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 the U.S.G.A. Golf Green Construction method and free draining sand fairways, the soil profiles are not expected to become saturated. Saturated soil profiles have been proven to contribute to disease outbreaks. Thus both the two major contributors to turf grass diseases in Hong Kong will have been minimized by excellent construction methods and a well ventilated location. 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 fungicides. The use of salt water will also be explored as a bio control for disease treatment.

2.8.2 Diseases Found in Hong Kong

The most common fungal pathogens that affect grasses of Hong Kong are *Rhizoctonia* (brown patch), *Pythium* (blight), *Helminthosporium* (leaf spot), and *Dollar Spot*.

Brown Patch (*Rhizoctonia* blight) Causal Agent – *Rhizoctonia solani* and other *Rhizoctonia* spp. Outbreaks of Brown Patch typically occur during hot, humid weather. Patches or rings of grass die out suddenly, these ranges in size from a few inches to several feet in diameter. Prolonged periods of leaf wetness are necessary for severe damage to occur.

Pythium blight Causal Agent – *Pythium aphanidermatum/P: splendens*. This disease causes most concern to GCS 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 turns 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.

Dollar Spot Causal Agent – Sclerotinia homeocarpa. Outbreaks of Dollar Spot from Spring through Autumn, and is most active during moist periods of warm days, and cool nights in the Spring, early Summer, and Autumn. The disease is spread from one area to another by water,

mowers, other equipment, and shoes. The disease appears as round, brown to straw-colored sunken spots approximately the size of a silver dollar. Cobweb like mycelium can be seen growing on effected areas in the early morning

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

2.8.3 Application of Fungicides

As for the existing courses, it is anticipated that fungicides will only be required for application to the greens. Damage to fairways and tees as a result of disease is perceived to be acceptable damage and consistent with the desired goal of minimizing fungicide applications. The main fungicides that will be used to combat and eradicate the above diseases will be chosen from the following products: Iprodione (a.i. 25%), Chlorothalonil (a.i. 75%), Mancozeb (a.i. 80%), and Aluminium tris (a.i. 80%). Other fungicides would be used on a limited basis as required and would all be registered products with the Hong Kong Government under the Pesticides Ordinance. All of these products become strongly bound to the soil, minimizing the chance of runoff.

An integrated pest management system will be adhered to throughout the year with main emphasis on maintaining healthy soil and plant profiles. If past experience and documented reports indicate that “Brown Patch” outbreaks occur after the first morning dues in November, where the mornings are cold and days warm, then a preventative application of fungicide at low rates will be applied. This is a sensible approach as it will result in less fungicide being applied than would be needed to eradicate an established infestation.

Pythium outbreaks occur during the months of April and May when there is a thick cover of fog, and high humidity with little sunlight and air movement. During these months it would be wise to implement a preventative spray programme of 3 applications during the 2-month period. This will also help prevent *Helminthosporium* leaf spot during April and May when it is most likely to attack Paspalum turf. A total of four preventative applications of fungicides are justifiable if sustained conditions are conducive to disease.

It becomes more expensive (more products required) and labor 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. All fungicides to be used will be registered with the Hong Kong Government under the Pesticides Ordinance, Cap. 133.

2.8.4 Quantification

The Fungicides to be used on the proposed third golf course at Kau Sai Chau are all products registered with the Hong Kong Agricultural, Fisheries and Conservation Department (AFCD) under the Pesticides Ordinance. The following products will be used for disease control requirements for fungicide storage is based on 2 hectares of Greens:

Daconil – 750 g/kg chlorothalonil wettable powder
Daconil controls Brown Patch and Dollar Spot diseases. At a preventative rate, 12 kg will be used per hectare. For curative purposes, 20 kg will be applied per hectare with a water application rate of 300 L/hectare. Daconil is a contact fungicide. After applying Daconil, mowing and irrigation will cease for 24 hours. 80 kg of Daconil will be stored.

Mancozeb – 750 g/kg Mancozeb wettable powder
Mancozeb is another contact fungicide that controls Winter *Fusarium*, Brown Patch and *Helminthosporium*. Mancozeb is applied at a rate of 25 kg/hectare. It needs to be applied in sufficient water to give an even coverage. 50 kg of Mancozeb will be stored.

Rovral – 500 g/kg Iprodione wettable powder
Rovral is most effective when it is applied on a monthly basis as a preventative measure against the diseases: Brown Patch, Dollar Spot: Winter *Fusarium, Helminthosporium,* Spring Dead Spot and *Curvularia*. Rovral will be used as an emergency tool applied at a rate of 10 kg per hectare. 40 kg of Rovral will be stored at Kau Sai Chau.

Aliette – 800g/kg Fosetyl Aluminium tris
Alliete is a systemic fungicide for control of Pythium diseases and can also be tank mixed with Mancozeb for control of Rhizoctonia diseases. Alliete will be applied at a rate of between 12-18kg depending on severity of disease, and would be applied with 400-800 litres of water/hectare. Lighter rates would be applied if the disease is used as a preventative application when conditions first favour disease.

2.9 INSECT CONTROL AND INSECTICIDE APPLICATIONS

2.9.1 General

The most common invertebrate pests likely to be found on Kau Sai Chau are Armyworm, Cut Worms and Sod Webworm, 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 turf and destroy roots and tear plants from their growing places. Insect invasions will be most prevalent during the turf establishment stage when the roots and stems of the plant are at a young and immature stage. Whilst chemical control is considered an important component in controlling insect populations, it forms only part of an integrated pest management approach and will only be used as a last resort.

By understanding the lifecycle of insects, the most sensitive point in their life cycle when they can be effectively controlled can be determined.

2.9.2 Mole Crickets

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 early nymph stage that treatment for mole crickets is most effective. As Mole Cricket populations would take time to accumulate within the soil, application of insecticides for treatment of Mole Crickets is not expected within the first 6 months after planting.

2.9.3 White Grubs

The white grubs' life cycle begins between spring and mid-summer when the female beetles lay 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 spray 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 insecticide applications would be ineffective, and optimum control may not be achieved. As the soil warms again, they resume eating for a short time. As White Grub populations would take time to accumulate within the soil, application of insecticides for treatment of White Grubs is not expected within the first 6 months after planting.

2.9.4 Army Worm

The larval stage or caterpillar damages the turfgrass by feeding on the blade, crown the stem. Damaged areas take on a brown, dried up appearance. Active infestations are characterized by having a sharply defined advancing front between defoliated and green undamaged turf. Although turfgrass damage can be severe, recovery is quick and therefore chemical control would only be considered in cases of sustained infestation.

As Army Worm is likely to be attracted to the succulent fresh growth during turf grass establishment control action is a likely requirement. It would be important to prevent turf loss due to Army Worm infestation in the initial establishment period as loss of turf in newly planted areas would increase the potential for damages to the course through erosion. In such cases the primary method of control will be biological products such as *Bacillus Thuringiensis*. Chlorpyrifos will only be used to control severe pockets of infestation after initial treatments of the biological products named above have failed to control the infestation.

2.9.5 Cut Worms and Sod Webworm

With multiple generations per year and capacity to damage high profile areas such as greens, Cut Worms and Sod Webworm are often targeted for regular, preventative sprays. Nevertheless, with monitoring and knowledge of Cut Worm and Sod Webworm behaviour, the GCS can maintain high quality turf with reduced amounts of insecticides. Daily monitoring ensures that initial damage is tolerable and only curative applications are required for control of Cut Worm and Sod Webworm. On the existing courses control of Cut Worm and Sod Webworm has only been required on greens and this expected to be the same on the proposed third golf course.

2.9.6 Quantification

Technological advances in pesticide manufacturing in the last 5 years have bought new products to the market with good environmental qualities that have replaced many of the traditional products. Other insecticides would be used on a limited basis as required and would all be registered products with the Hong Kong government under the Pesticides Ordinance.

Chipco Choice® – Active Ingredient 1 g/kg Fipronil

Fipronil is used for control of mole crickets. This is a relatively new product, first registered in Hong Kong in 1999. Fipronil belongs to a new class of insecticides, phenyl pyrazoles. It is systemic when applied as a soil treatment, with long residual control. Its low concentration and

long residual control make this an effective control tool. Chiplo Choice® was last applied for mole crickets in 1999 with no subsequent applications required to this date.

Merit® – Active Ingredient 200 g/L Imidacloprid

Imidacloprid is used for control of White Grubs and Bill Bugs. The product was first registered in Hong Kong in 2001. Imidacloprid is a broad-spectrum, long residual insecticide that is effective at low rates (applied at 2.5 L/hectare), with good environmental qualities.

Bacillus thuringiensis

Bacillus thuringiensis (BT) will be used primarily in the control of Army Worm during the grow-in of the golf course and on an ongoing basis at holes 5 and 6 (part of fairway), which has not been included in the closed drainage system.

Bacillus thuringiensis is a naturally-occurring soil bacterium that produces poisons which cause disease in insects. (BT) is considered ideal for pest management because of its specificity to pests and because of its lack of toxicity to humans or the natural enemies of many turf pests. To be effective, it must be eaten by insects during their feeding stage of development, when they are larvae. It is ineffective against adult insects. When eaten, the spores and crystals of (BT) act as poisons in the target insects, and are therefore referred to as a stomach poison. The crystals dissolve in the intestine of susceptible insect larvae and paralyze the cells in the gut, interfering with normal digestion and triggering the insect to stop feeding on host plants. Spores can then invade other insect tissue, multiplying in the insect's blood, until the insect dies. Death can occur within a few hours to a few weeks of application, depending on the insect species and the amount ingested.

Chlorpyrifos (Emulsifiable Concentrate 40% weight by volume)

Chlorpyrifos is used for control of a wide range of turfgrass pests. Applied at a rate ranging from 700 ml to 4 L/hectare, depending on insect. Chlorpyrifos is predominantly used as a treatment for Cut Worm and Sod Web Worm on greens and therefore used at the lower application rate (700 ml to 1 L/hectare). Chlorpyrifos is also used as a curative treatment for African Black Beetles, Funnel Ant and Grass Grub.

2.10 AESTHETIC AND FUNCTIONAL THRESHOLD TABLE

Threshold levels represent percent of area affected or number of insect/weeds per square foot required prior to any chemical treatment application**.**

Pest	Greens	Tees & Fairways	Roughs	Detection method
Diseases				
Helminthosporum	5%	Untreated	Untreated	Visual inspection / Microscope
Pythium	5%			
Rhizoctonia	5%			
Dollar spot	10%			
Cuvulera	10%			

Pest	Greens	Tees & Fairways	Roughs	Detection method
Insects				
White Grubs	2 nos. / sq. ft.	4 nos. / sq. ft.	6 nos. / sq. ft.	Visual + soil inspect
Mole Crickets	2 nos. / sq. ft.	3 nos. / sq. ft.	6 nos. / sq. ft.	Visual + soap flush
Sod Webworms	4 nos. / sq. ft.	8-10 nos. / sq. ft.	Not required	Visual + soap flush
Armyworms	Not required	4 nos./ sq. ft.	6 nos. / sq. ft.	Visual + soap flush
Cutworms	1 no./ sq. ft.	5 nos./ sq. ft.	Not required	Visual + soap flush
Weeds				
Nutsedge	Hand pulled	2 nos. / sq. ft.	6 nos. / sq. ft.	Visual inspection
Torpedograss	Hand pulled	2 nos. / sq.ft.	4 nos. / sq. ft.	
Broadleave weeds	Hand pulled	2 nos. / sq. ft.	6 nos. / sq. ft.	

2.11 TURF MANAGEMENT MEASURES FOR HOLE 5 & 6

2.11.1 Cultural Practices

The following cultural practices will be performed on holes 5 & 6 to ensure maximum turf health and vigor:

Cultural Practice Reference Table – Greens

Cultural Practice	Turf Area	How Often	Time of Year	Rate (pounds/1000 sq. ft.)
Topdressing	Greens	Every 2 weeks & follow with verticutting	All year	
Aerification	Greens	Every 10 weeks	Spring, Summer, Fall	N/A
Verticutting	Greens	biweekly	All year	N/A
Plant Growth Regulator	---			---
Overseeding	---			
Other:	Hydroject	monthly	All year	---

Cultural Practice Reference Table – Tees

Cultural Practice	Turf Area	How Often	Time of Year	Rate (pounds/1000 sq. ft.)
Topdressing	Tees	6-8 weeks	Spring, Summer	Light dusting
Aerification	Tees	Three times per year	Spring, Summer, Fall	N/A
Verticutting	Tees	6 weeks	Spring, Summer	N/A
Plant Growth Regulator	---			---
Overseeding				
Other:				

Cultural Practice Reference Table – Fairways

Cultural Practice	Turf Area	How Often	Time of Year	Rate (pounds/1000 sq. ft.)
Topdressing	Fairways	Follow aeration	Late Spring	Light dusting
Aerification	Fairways	Once a year	Late Spring	N/A
Verticutting				N/A
Plant Growth Regulator	Fairways	5-6 weeks	Late Spring, Mid Summer	830 ml/ha - prims
Overseeding				
Other:				

2.11.2 Filter system installation to catch pits

A filter system installed to catch pits on hole 5 and part of hole 6 for the removal of surface runoff pollutant is proposed as an effective mitigation measure. The system will be managed and maintained according to manufacturers specifications.

Detailed design of the system and removal characteristics are covered under the Water Quality Chapter of the EIA report.

2.11.3 Primary treatment with biological products

Primary treatment of pests at holes 5 & 6 will be done through the use of biological treatments where products are available for specific pests. There will be no thresholds established for biological treatments as it is preferred to apply such products at an early stage of infestation to give the application the best chance of success. Pesticide applications would only be made in the event that biological treatments fail to control an infestation below the threshold levels set for application of pesticides. The following biological products are recommended for treatment of the following pests:

Pest	Target	Biological products
Insects	Armyworms Sod webworms Cut worms	Neem oil (AFCD Reg. No. 2P262) *Bacillus thuringiensis* (AFCD Reg. No. 2P12) *Spodoptera litura* Nuclear Polyhedrosis Virus (AFCD Reg. No. 2P242)
	Mole Crickets	*Beauveria bassiana* (AFCD Reg. No. 2P239)
Disease	Dollar spot	*Trichoderma harzianum* (AFCD Reg. No. 2P255

2.11.4 Threshold levels for pesticide applications

Threshold levels represent percent of area affected or number of insect/ weeds per square foot required prior to any chemical treatment application**.**

Pest	**Greens**	**Tees & Fairways**	**Roughs**	**Detection method**
Diseases Helminthosporum Pythium Rhizoctonia	 5% 5% 5%	Untreated	Untreated	Visual inspection / Microscope

Pest	Greens	Tees & Fairways	Roughs	Detection method
Dollar spot Cuvulera	10% 10%			
Insects				
White Grubs	2 nos. / sq. ft.	4 nos. / sq. ft.	6 nos. / sq. ft.	Visual + soil inspect
Mole Crickets	2 nos. / sq. ft.	3 nos. / sq. ft.	6 nos. / sq. ft.	Visual + soap flush
Sod Webworms	4 nos. / sq. ft.	8-10 nos. / sq. ft.	Not required	Visual + soap flush
Armyworms	Not required	4 nos./ sq. ft.	6 nos. / sq. ft.	Visual + soap flush
Cutworms	1 nos./ sq. ft.	5 nos./ sq. ft.	Not required	Visual + soap flush
Weeds				
Nutsedge	Hand pulled	2 nos. / sq. ft.	6 nos. / sq. ft.	Visual inspection
Torpedograss	Hand pulled	2 nos. / sq.ft.	4 nos. / sq. ft.	
Broadleave weeds	Hand pulled	2 nos. / sq. ft.	6 nos. / sq. ft.	

The threshold levels set in the TMP have been established with years of experience and would be applied universally across the existing and proposed third golf courses. The important difference between Hole 5 & part of Hole 6 and the remainder of the golf course is that bio-pesticides will be used on first detection of pests or when seasonal conditions indicated pest outbreaks are probable. This is because the bio-pesticides available and proposed are mainly targeting on pests in the immature stage. It takes time to have an effect on pest populations due to their mode of actions are slower than chemical pesticides or ineffective once threshold levels are exceeded. The preventive approach for bio-pesticides is designed to give them the best chance of success.

The threshold levels do not automatically trigger the use of chemical pesticides across the golf courses. The proposed threshold levels is to raise a warning signal to the Golf Course Superintendent (GCS) who could than make a decision on type of treatment and controlling method. There are many factors, pest life cycle, and other maintenance practices that could be assisted to maintain the turfgrass back to acceptable target level. Chemical pesticides application is only one of the practical methods.

2.12 CHEMICAL APPLICATION MANAGEMENT PLAN

2.12.1 Background

The purpose of this management plan is to provide technical records for management review regarding the fertilizers and chemicals being used on the Golf Course and the method of application. It must be understood from the outset that all employees handling chemicals and fertilizers have received initial site training regarding storage, handling, and application, after spraying procedures, and spill control procedures. All chemicals will be stored in a dangerous goods store approved by the Fire Services Department. A chemical and fertilizer foreman and one assistant will be employed responsible for chemical and fertilizer applications. An education syllabus is being developed in conjunction with the AFCD and other Hong Kong Golf Course Superintendents. This has resulted in a draft Code of Practice for Golf Course Chemical Applications. The Code of Practice will provide a basis for training those working with chemicals on golf courses.

2.12.2 Chemical Preparation

Chemical preparations take place in a confined segregated and bunded area where chemical spill contingency plans can be implemented. Storage containers that are well labeled will be used to keep all chemical waste solutions within the bunded area. Any waste product will be removed by a Licensed Contractor.

Pesticide Inventory

The following pesticide inventory has been identified as the initial products that will be used on the proposed third golf course at Kau Sai Chau: -

Fungicides	Herbicides	Insecticides
▪ Aliette	▪ Ronstar	▪ Chlorpyrifos
▪ Rovral	▪ Image	▪ Imidacloprid
▪ Daconil	▪ 2,4D/Mecoprop	▪ Fipronil
▪ Mancozeb	▪ Roundup	▪ *Bacillus thuringiensis*

Records will be kept relating to the purchasing of these products. The records will document the following; -

- Type of pesticide;
- Amount purchased;
- Date purchased;
- Supplied by;
- Date of arrival;
- Received by; and
- Pesticides application

2.12.3 Pesticides Applications

Pesticides will be applied in liquid or granular form. They will be dispersed through the following devices:

- Boom spray applications – A dedicated 900 L spray unit (Toro 5500) will be used for boom spray applications. A 6-metre boom with 11 nozzle outlets will be used to apply between 100-150 L per hectare depending on the product being applied and calibration of the tank. This unit will mostly be used for herbicide applications.

- Spot spray applications – A 400 L polyethylene tank mounted on a 4-wheel utility vehicle attached to a hose line with hand gun nozzle. This will be the preferred method for herbicide applications.

- Hand boom applications – The dedicated spray unit (Toro 5500) will be used for hand boom applications. A 2.5 metre hand boom with 8 nozzle outlets will be used to apply 300 L water solution per hectare. Hand boom (Falcon) nozzles are enclosed by a specially designed polyethylene cover to irradicate drift and increase spray efficiency. This method will be used for fungicide and insecticide treatments to greens.

- Rotary Spreader – A 20 L rotary spreader will be used for granular applications. This method of application will not be used frequently as there are limited granular pesticides proposed for use on the proposed third golf course at Kau Sai Chau (Fipronil).

2.12.4 Fertilizer Applications

Records keeping

All fertilizer applications will be documented on forms that will record the following: -

- Location of applications;
- Type of fertilizer applied;
- Amount applied in kg per hectare;
- Date of applications; and
- Product applied.

Fertilizers will be applied to maintain a groomed turf area comprising tees, greens and fairways. All fertilizer applications will be undertaken according to the GCS Programmes. Operators dealing with the application of fertilizers will be made fully aware of the importance of an even application rate and the dangers of over usage. Fertilizers will not be applied near waterways or water logged areas or temporary casual water.

It is important that staff understand how chemicals applied to the grass work to help it grow, what controlled fertilization sets out to achieve and how this is achieved. It has already been determined that overfertilizing is detrimental to the health of turf, creates a reduced tolerance to wear, drought and cold, thus creating disease susceptibility and a depleted root structure. It is the aim of the GCS to ensure that employees are fully trained and aware of these factors.

Greens

Fertilizers will be applied to greens and tees using a small (hand operated) broadcast spreader. The spreader output will be calibrated to half the required fertilizer needed. The applicator will apply the fertilizer in two opposite directions. This ensures an even coverage and application of the correct amount of fertilizer.

Fairways

Fertilizers applied to the fairways will be applied using mechanical methods which allow for faster application. A 400-litre broadcast spreader is mounted on the back of a light weight utility vehicle. The utility vehicle speed and broadcast spreader output is calibrated to determine the exact application rate needed. The fertilizer is applied by starting on one side of the fairway and moving up and down the fairway and then across the fairway, each time at 8-10 metre spacings. This way an even application is achieved.

Boom Spray Applications

Ferrous Sulfate will be applied in a liquid form through a boom spray application method. Actual Ferrous Sulfate or the product “Ferro Mac”, a liquid concentration containing Nitrogen and Iron will be applied using this technique.

2.12.5 Safety (Personal Protective Equipment)

All Golf Course personnel involved in the application of pesticides are required to wear suitable spray protection overalls that will be disposed of after every application. Knee length rubber boots will also be worn to protect feet and these will be washed thoroughly after spraying. A double cartridge respirator, charcoal filtered, with half face negative pressure will be used by operators to protect themselves from inhalation of chemicals, as well as protective eye goggles and gloves.

For details of personal protective equipment for individual pesticides product, always refer to

the safety instruction as stipulated on the product label. Washwater that may contain pesticides should be disposed of according to the requirements of the Environmental Protection Department.

2.12.6 Training

All personnel involved in the management and application of chemicals must receive initial site health and safety training regarding the storage, handling, application, decontamination and spill control procedures. Training will be provided for all those involved in the preparation, handling and application of chemicals. All staffs are trained in emergency procedures and in dealing with and reporting spillages. In addition, these staff has attended external Occupational Safety and Health Council courses on the safe handling of chemicals.

Applications on the proposed third golf course will be managed and applied by the same staff currently responsible for the turf programs on the existing courses.

2.12.7 Spillages

Spillages are extremely unlikely events with spraying equipmemt all designed to withstand accidents or rolling and contain pesticides within tanks. During the operation phase of the existing golf courses, no chemical spill has been reported in the past 10 years.

In the event that any spillages occur on the golf courses, the following actions would be taken:

- Make every effort to contain the spillage responsibly and safely;
  - Only person with full personal protective equipment (PPE) will be allowed to enter the spill containment site;
  - For spillage on the golf courses, bunds would be established if required to prevent any flow toward golf course drainage, and sand (at least double the spill volume) would be used to absorb the pesticide spill;
  - After the spill is contained, it would be swept or shoveled up into marked containers or heavy duty plastic bags and placed in a secure area to await disposal;
  - The top 2-3” soil may have to be removed;
  - After the spill is contained and the area is cleaned, it will be treated with hydrated lime or activated charcoal; and
  - All contaminated debris would be disposed only after consultation with EPD.
- Block drainage downstream flows and divert upstream flows where practicable;
  - Sensitive streams and marine water are protected by the proposed closed low flow drainage system and no spraying zone around all freshwater features at the proposed golf course. Golf Course Superintends should also pay attention to prevent pesticide spills from entering the closed system through containment.
- Notify Environmental Protection Department and Fire Services Department;
- Collect samples of downstream water for analysis; i.e. catchbasins and end storage tanks lakes; and
- Continue sampling until the impact of the spillage can no longer be detected.

2.12.8 Buffer Zones

Buffer zones for sensitive streams during the construction and operational phases have been detailed in Chapter 6 Water Quality Impact Assessment and Chapter 8 Ecological Chapter.

SECTION 3 WATER QUALITY MANAGEMENT

3.1 INTRODUCTION

As stated in the Environmental Impact Assessment, the operation of the Golf Course is not anticipated to have any significant impact on the freshwater and marine environment. Turfgrass has been demonstrated to be an effective filter and virtually eliminates surface water runoff (Cohen *et al*., 1990) and it reflects in the past 10 years water quality and ecological monitoring data at the existing golf courses.

This water quality monitoring programme therefore serves to satisfy three objectives:

- To provide the Golf Course Manager with useful data to feedback into the TMP;
- To monitor potential polluting effects at sensitive sites, in terms of potential water quality impacts; and
- To monitor long term trends of water quality during the operational life of the golf course.

The first objective is clearly a priority as it provides a mechanism for implementing preventive environmental controls.

The monitoring programme has been designed with due consideration to the fact that runoff is likely to be minimal. As a consequence, significant impacts are not anticipated in open areas of water. Details information on monitoring locations and frequency during construction and operational phases of the golf courses has provided in the EM&A manual.

3.2 EVENT CONTINGENCY ACTION PLAN

Details of monitoring frequency are provided in the EM&A manual. The results collected will provide valuable information for the GCS's TMP and for management of irrigation water quality. The data will also be evaluated in conjunction with information that the GCS has collected from soil tests etc., and any data collected through routine management practices for the reservoir.

In the event that the guideline levels are exceeded the proposed actions taken will be as follows:

- Inform the GCS immediately and stop chemical application;
- Notify Environmental Protection Department (EPD) and Agricultural, Fisheries and Conservation Department (AFCD).
- Review of application and re-evaluate suitability and availability of alternatives to chemical control etc.;
- Agree remedial measures with GCS and inform EPD/AFCD;
- Implement immediately the agreed remedial measures; and
- Increase monitoring frequency and or locations to demonstrate the efficiency of remedial measures; (for example, if pesticides are detected in marine waters near the island, additional monitoring would be implemented immediately, incorporating addition stations between the proposed station and sensitive receivers).