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GOLF CLUB

Manawatu Golf Course

Golf Course Environmental Sustainability Report

March 2022

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Contents

1.0 Executive Summary

Context

Manawatu Golf Club (MGC) recognises the need to protect and, where possible, enhance the provision and quality of the golf courses greenspace assets. This commitment will result in MGC becoming a more attractive golf and recreational destination that will have tangible benefits to the Club, the region and the wider perception of the golf sector in New Zealand.

With the on-going intensification of our city spaces, golf courses provide both land development value and areas of important ecological value. In addition, these spaces offer a level of protection for the diversity of local flora and fauna that could otherwise be lost to on-going intensification.

Assessment of the environmental sustainability of Manawatu GC.

Will Bowden of New Zealand Turf Management Solutions (NZTMS) works as an independent industry expert and is New Zealand's only environmentally qualified and experienced golf course specialist advisor.

Environmental scoring system

An appendix of the NZTMS Environmental Report System (ERS) has been included in Appendix 1. Will Bowden developed the ERS and Dr Mark Bellingham (previously Forest & Bird) to provide golf clubs and greenspaces with a robust and scientifically objective measure of current environmental performance and golf course sustainability. The key factors considered within the report system are:

<u>Key ecological value factors</u>

1. Ecology
2. Landscape and Cultural Heritage
3. Energy Consumption and Waste Reduction
4. Water Resource
5. Climate Change
6. Pollution Prevention.

Recognition of criteria

These six key ecological values were based upon the Golf Environment Organisation (GEO) certification scheme (‘*OnCourse*’) for golf courses. The Royal & Ancient has endorsed this internationally recognised certification programme. In addition, it is the only golfcourse-specific environmental programme to have gained International Social and Environmental Accreditation and Labelling Alliance (ISEAL) endorsement.

1.1 Observational strengths and weaknesses

This report provides a range of objective and subjective data pertaining to the current ecological value of MGC.

The following strengths and weaknesses were observed:

Strengths:

- During the site visit, all relevant Club stakeholders we communicated with and exhibited an excellent awareness and 'buy-in' regarding environmental issues affecting the golf course.
- The majority of the Club demonstrates a good (and increasing) level of operational sustainability.
- A relatively high level of expertise exists within the club personnel, i.e. qualified staff and professional development pathways.
- The Club has demonstrated a willingness to participate in environmental initiatives.
- A good appreciation of the precise value of what golf courses offer regards 'protecting' the local diversity of flora and fauna was exhibited.
- The Club is a welcoming and accessible venue to a wide range of people (including non-golfers). There was excellent diversity in Club operations, e.g. the café and restaurant, driving range and function hire etc.

Weaknesses:

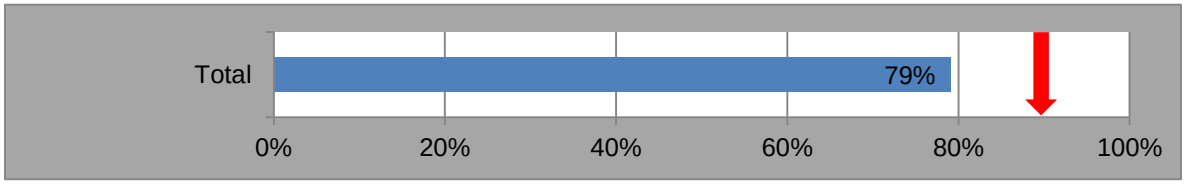
- Some work is needed to optimise the connection of habitats on the course to wider 'green corridors. Introducing these would add significant environmental value to the site.
- Limited diversity of natural habitat options around the site. The site is predominantly parkland with no significant riparian habitats or wetlands to add additional biodiversity.
- Due to the existing cool-season turfgrass species that dominate the site, there is a reasonably high reliance upon pesticide (fungicide) applications to successfully manage the finer turf surfaces at MGC.

1.2 Calculated environmental sustainability of the golf course

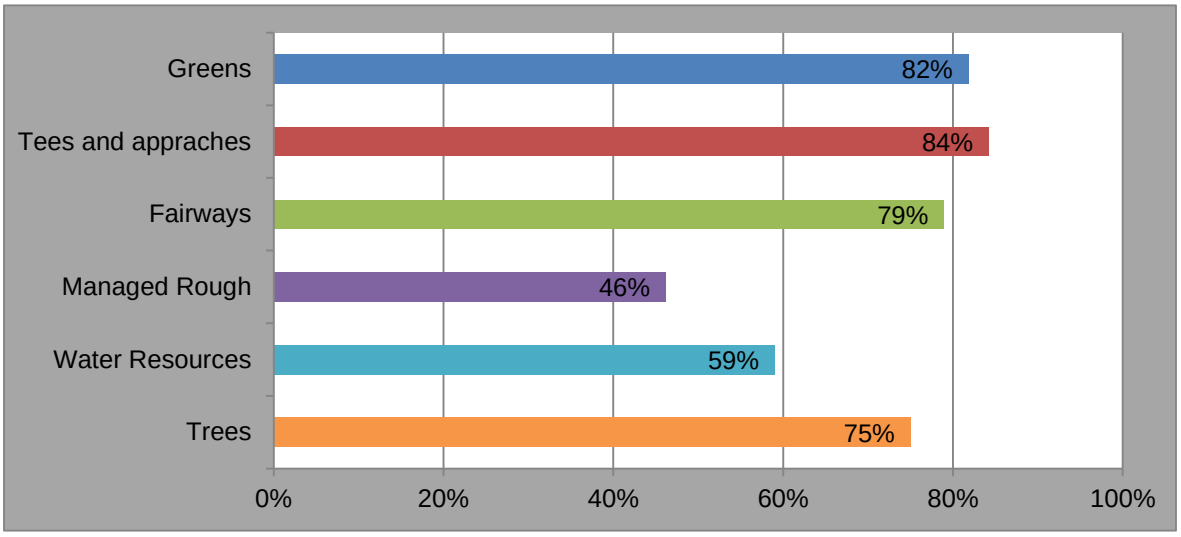
The environmental sustainability of the golf course was measured using our ERS reporting system. A breakdown of how each key golf course area scored and weighted this programme has been provided below.

The red arrow on the 'Total score' section indicates where we feel a realistic target (i.e. a site-specific 100%) should be for MGC.

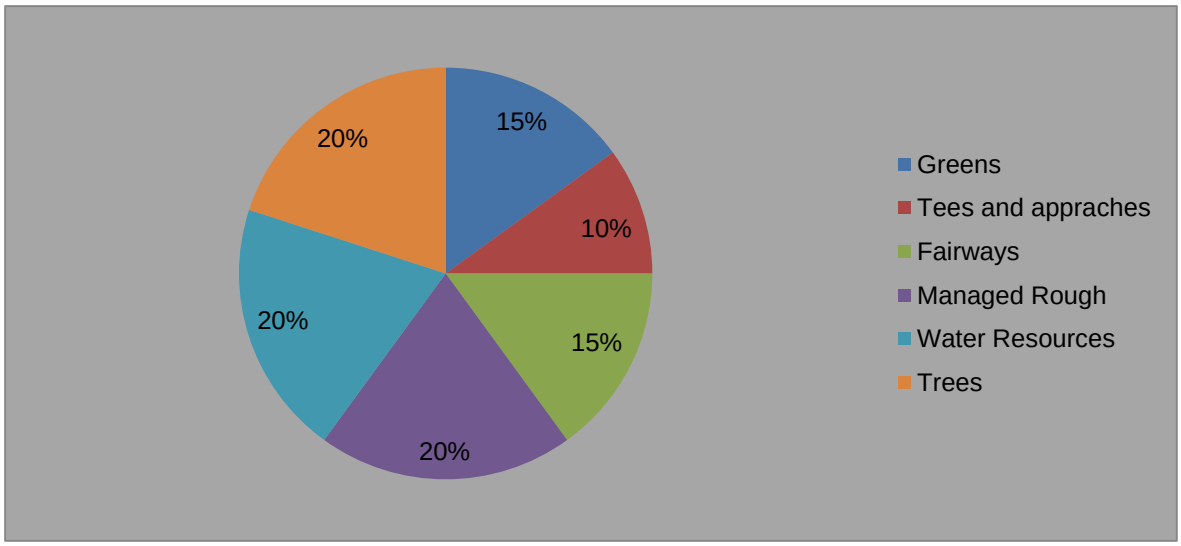
Total Score



Individual Scores



Individual Score Weighting on Total Score



2.0 Introduction

This report provides MGC with a summary of the critical environmental and associated operational factors influencing the management and sustainability of the golf course.

The key findings of this report have been captured in the following ways:

1. A site visit
2. Completion of a sustainability audit.
3. Interpretation and recommendations based upon outcomes from items (1) and (2)

The sustainability audit provided a snapshot of the current ecological value of the site whilst also generating a set of recommendations (priorities) for enhancing the potential environmental and operational sustainability of the golf course. This data has been presented as a '*Current Sustainability Score'* and '*Target.*'

Note: All of our recommendations have been based upon a consideration of site-specific limiting factors such as; availability of resources, on-site expertise and other economic considerations. The outcome of this report should not be compared with other facilities.

As a landowner, MGC recognises its responsibilities to actively promote the on-going enhancement, ecological diversity, and operational sustainability of the golf course. Accordingly, the ERS score takes into account key data from the following designated areas:

I. Ecology
II. Landscape and Cultural Heritage
III. Energy Consumption and Waste Reduction
IV. Water Resources
V. Climate Change
VI. Pollution Prevention

3.0 Methodology & Qualification of the author

Will Bowden (Manager of NZTMS) is an independent industry expert in designing and administering the environmental sustainability scoring system as a robust and objective tool for measuring a golf course's environmental performance and potential.

3.1 Methodology

The methodology employed to capture and deliver the information provided to MGC within this report was stagedas follows:

1. Issuing of initial '*Environmental Questionnaire'* aimed at capturing site-specific data such as the size of the area(s), number of holes, membership size, general agronomic principles, an understanding of environmental practices and associated concepts, etc.

2. A site visit by NZTMS to visually audit each venue (using an objective Environmental Sustainability Review System [ESR]) and liaise with club stakeholders.

3. Provision of a recommendations report

Note: These 'scores' and 'targets' have been generated from the initial Environmental Review System [ERS] that objectively measured each site's current and potential environmental and operational sustainability.

To ensure maximum objectivity was achieved, the percentage weightings of each key area, i.e. naturalised areas, soils, trees, water resources, managed rough, fairways, tees, approaches, and greens, have been calibrated to take into account any significant or site-specific limiting factors and overriding environmental characteristics

3.2 Qualifications of the author

Will Bowden is an experienced (independent) golf course agronomist and ecologist. With over 25 years of experience in the industry as a practitioner and consultant. Bowden founded NZTMS in April of 2019 and has established the group as an innovative, research-led and sustainability-focused organisation.

Table 1 provides an overview of Bowden's experience and qualifications focussed explicitly upon the golf course and the environment.

Table 1: Experience and qualifications of the author.

Academic qualification	Experience
B. Env. Sc (Hons) Environmental management in New Zealand	In 2011 Will Bowden introduced GEO Environmental accreditation for the golf courses to New Zealand and became New Zealand's first GEOSA. Originally introducing GEO to the golf sector in New Zealand.
HND (Golf course management & agronomy)	Contributions and publications to industry conferences and journals in NZ and Internationally on the subject of golf course sustainability
Dip. Env. Sc Environmental management in New Zealand	Developed the first golf course dedicated environmental sustainability audit programme in New Zealand with input from Forest & Bird
Cert. Environmental management (UK)	Ecological Manager for a golf course construction in the UK
Practitioner experience	Golf Course Superintendent (2004 – 2009) in the UK and NZ

4.0 Interpretation of Key Environmental Issues

This section interprets the critical environmental issues considered during the site visit. In addition to considering these critical factors, a current and target sustainability (%) score has been provided at the start of the report.

The key environmental issues addressed within this report are:

1) Ecology:

Ecological factors are those that deal with the relationship between organisms and their surrounding physical environment. Key considerations in this area shall include:

- Establishment of ecological plantings and native vegetation regeneration programmes.
- Designation of no-spray areas/buffer zones around fragile habitats.
- Whether or not a specific focus has been placed upon promoting the protection and introduction of New Zealand native species of flora and fauna across the site.

2) Landscape & Cultural Heritage:

Landscape & Cultural Heritage reflect the interaction between human and nature over centuries. These factors contribute to the unique character of a nation, specific region and locality and include:

- Features of archaeological, historical and cultural heritage value.
- Consideration of the natural surrounding landscape and any key features. Ensuring wherever possible that future landscaping is sympathetic and appropriate to key landscape elements.
- Physical landscape features should reflect those naturally occurring within the wider historical, environmental and cultural landscape.

3) *Energy Consumption & Waste Reduction:*

A long-term commitment to reducing the consumption of energy services and the promotion of increased environmental quality, and financial security. Seeking to identify and establish efficiencies regarding operational management and in turn minimising the consumption of energy and reduction of waste.

- Optimisation of staff and resources to achieve maximum output and minimise waste.
- A schedule to reduce the scope of managed turfgrass areas (i.e. mown rough and banks etc)this will in turn reduce energy resources, as well as fertiliser and water demands.
- Planned initiatives to drive recycling and adopt (where possible) best practices for wastemanagement and greater energy efficiency.

4) *Water Resources:*

Acknowledging the value of water as a finite resource and developing a strategy and plan to utilise this resource appropriately. Balancing the commercial expectations of the end-user with sectorrecognised best practice management of the resource.

- The club seeks to minimise and/or eliminate the unnecessary use of irrigation water.
- Where required, water shall be applied following recognised best practice guidelines andefficient system design.
- The site manages overland water flows and protects surrounding catchments from the risksassociated with the rapid and uncontrolled discharge of excessive Stormwater.
- The club manages resources in a way that the potential for groundwater contamination tooccur is minimised and the maximum uptake of added inputs achieved.

5) *Climate Change:*

- The consensus of scientific evidence points towards the accelerated warming of the Earth as aconsequence of the increased release of greenhouse gases (by humans) into the atmosphere.
- Wherever possible efforts should be made to mitigate unnecessary emissions of Carbon dioxide andstrive to find alternatives to the use of inefficient fuel and energy sources…

- Where applicable: the design and layout of the golf course should recognise the effects of climate change i.e. rising sea levels and increased intensification of storm events and other such associated meteorological/environmental factors.

- Each facility should aim to consider the purchase of alternative machinery i.e. electric or hybrid when replacing or updating existing fossil fuel driven machines.

- The very nature of golf course as a provision of recreational green space should be viewed as an asset in terms of mitigating the 'over-heating' of urban and suburban environments.

6) Pollution Prevention:

A school of thought exists that golf courses significantly contribute to the pollution of wider catchments and associated assets such as water quality, air quality and noise pollution etc. Although much of this belief is built upon anecdotal evidence, it should be the responsibility of any golf course facility to proactively mitigate any potential to harm, pollute or contaminate the natural environment in any way.

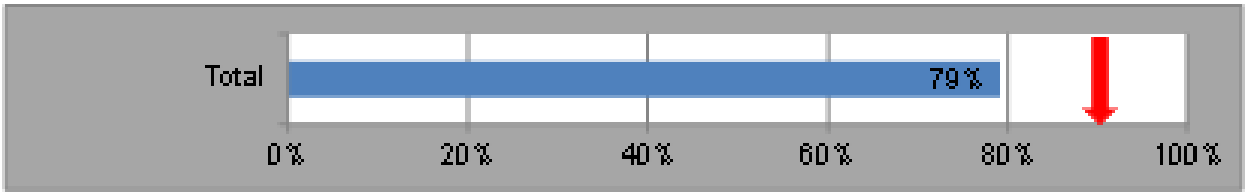
- Principally, all drainage systems associated with the golf course site should offer sustainable solutions and seek to minimise the effects of potential run-off and leachate leaving the site.

- The establishment of 'set-aside' areas such a vegetative buffer zones around riparian habitats and other ecologically sensitive areas is recommended.

- Turfgrass species selection should reflect the naturally occurring limitations of the site and also the level of resource available to maintain the site.

5.0 Site Specific Sustainability Audits

The overall environmental sustainability score for the Manawatu golf course is:



key factors contributing to this score include:

- A good range of native tree and shrub species have been established in plantations around the site.
- Some limitations in terms of habitat diversity (to some extent, this has been factored as a 'site limitation').
- Excellent agronomic philosophies relating to the management of turf surfaces.
- Increased establishment of naturalised (grassland) habitats since the 2011 visits.
- Plantings consider the benefit of inter-connecting with the more comprehensive green network beyond the golf course boundary.

5.1.1 Ecology

Since 2011 we have noticed significant enhancements to many of the site's previously 'sparse/open' areas.

However, across the site, there is still a general need to increase the density of planting in sparse areas (many of which were identified in our 2011 report) alongside the selective thinning out of more densely planted copses of trees and shrubs (such as the left side of the 10th fairway) – specifically referred to later within this report.

Refer to figures 1 and 2 for examples of this.

Figure 1: Existing plantation on the left side of the 10th fairway that requires selective thinning out.

There is potential to harvest shrubs and younger native trees from within this plantation (and others) for transplant to other areas of the site. For this to be successful, the timing and aftercare of each specimen will be critical.

Early autumn is the optimum time to transplant trees. This is when most trees will be in a semi-dormant state. It is critical to provide a water source and vertical growth support for the first 1-2 years of developing the tree in a new position. We also recommend inoculating each transplanted root mass with liquid mycorrhizae brew immediately before planting in the ground.

Figure 2: Showing highlighted areas where additional planting should be added to enhance the sparse (existing) tree planting.

The rest of this section of the report will focus on the ecological value of each site area on a hole-by-hole basis. For ease of reading and context, recommendations to enhance the environmental value of each area of the course have been provided throughout this section of the report, rather than separately at the end.

Hole-by-hole ecological enhancement opportunities

Hole No.1:

As mentioned in the 2011 report, Phoenix palms (*Phoenix*; L) offer no ecological value to this course area. The solid structural presence of these trees supports the definition of holes (between fairways). From an ecological perspective, these exotic tree species are significantly more damaging to the local flora and fauna than beneficial.

Phoenix palms commonly harbour vermin such as rats and non-native bird species, i.e. Mynas. These ‘pest’ species invade the habitats of our native bird and mammal species.

If the Club wishes to retain the palms, we strongly recommend installing belts (see figure 3) and clinching these around each tree approx. 10 ft up from the base. This will help mitigate the potential for rodents to ravel up the trunks and nest in the fronds.

Figure 3: Metal belt clinched around the trunk of an exotic palm.

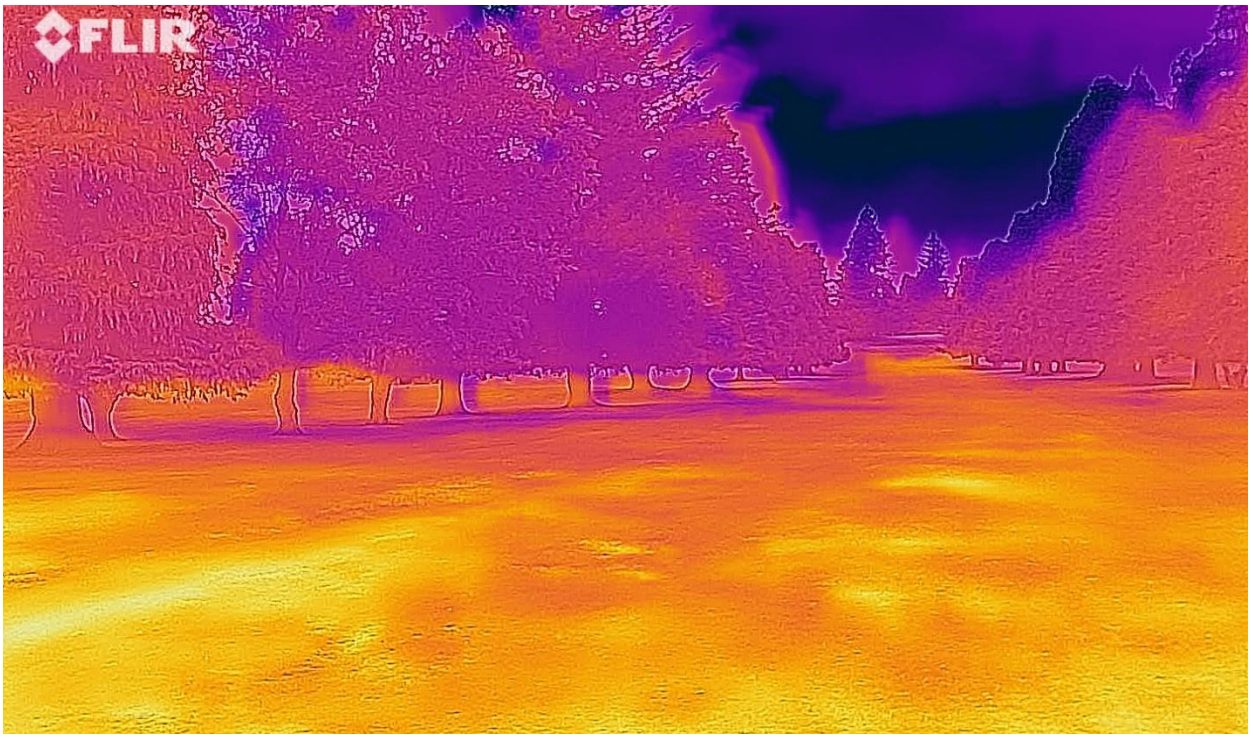
Ideally, these tree species would be removed and replaced with native varieties such as Kahikatea (*Dacrycarpus dacrydioides*) and Totara *(Podocarpus totara*).

A plantation on the right side of the fairway (figure 4) should be viewed as an excellent (existing) example of a good native plantation for MGC. There is excellent diversity of species within this plantation and a good selection of canopy heights, densities and foliage.

Figure 4: Native tree/shrub plantation on the 1st hole.

Maintaining a healthy population of larger tree species on the course will not only 'conserve' the current landscape value of the course and preserve the 'parkland' characteristic of the site but also help to buffer extremes in temperature (in particular in summer) with the cooling effect that established trees at a variety of canopy heights can offer (refer to the example of this in figure 5).

Figure 5 shows images taken with a Thermal Imaging camera during the NZTMS site visit. Clearly showing the benefits trees have regarding temperature buffering compared to just turf on the soil.



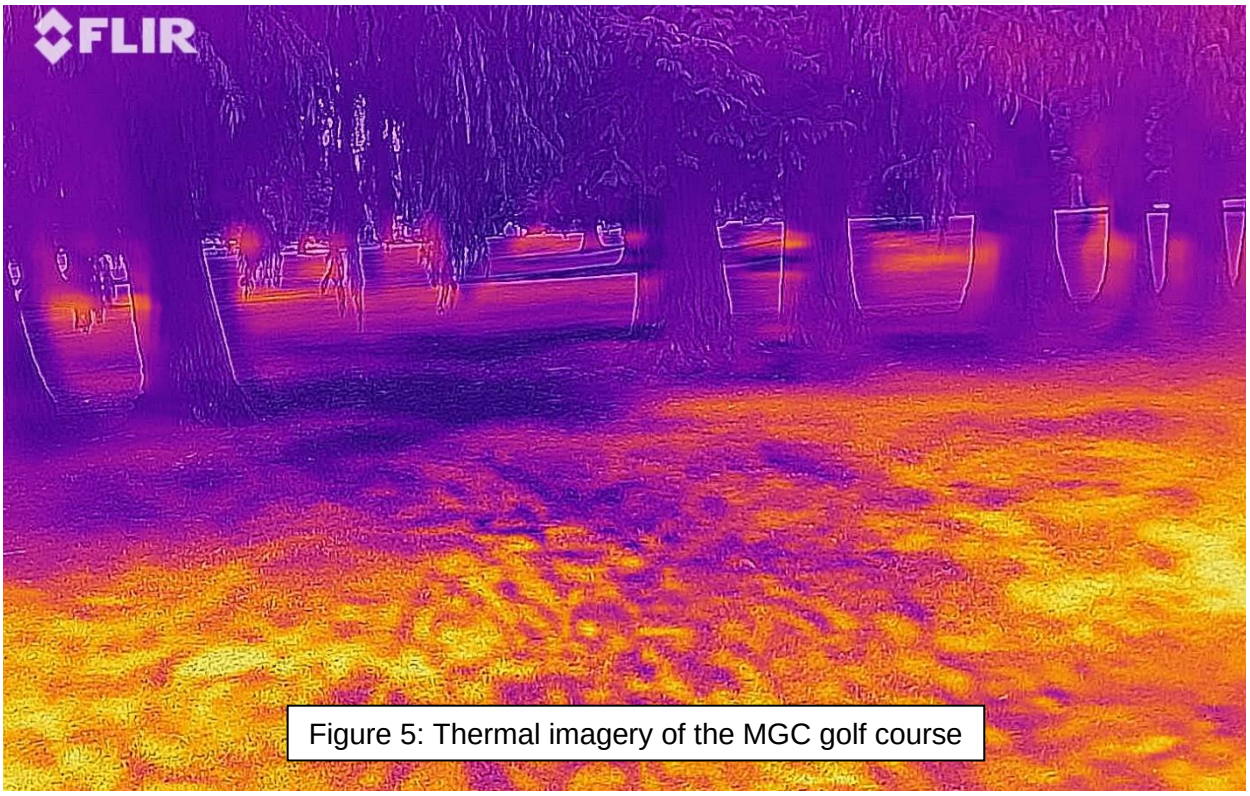


Figure 5: Thermal imagery of the MGC golf course

15-18˚C	>18 - 22c	>22-30c

In some instances, trees can provide up to 50% reductions in ambient temperatures. This is an often-overlooked benefit for having large trees (and smaller shrub stock) across a golf course landscape.

Several trees are behind the green, including golden totara (*Podocarpus totara Aurea*). The fescue rough can be encouraged around these trees to add further habitat biodiversity and aesthetical interests to this part of the golf course. This will also support insects, birds and small shade seeking mammals.

Figure 6: View looking towards green in the distance.

Diversity of species and canopy height is an important factor for golf courses to consider when establishing and managing plantations. In particular, on a site like MGC where there is a limited range of naturally occurring habitats, i.e. no nearby coastline, dunes, large watercourses or open grassland. It is important to maximise the ecological value of the habitat areas present.

Figure 7 qualifies the value of a diverse vegetation habitat at MGC and provides an applied representation of how this looks.

As is shown in the diagrams, there need be no adverse impact upon the playability of the golf course as a direct result of establishing highly complex tree habitats compared to low-quality areas that may be perceived to look 'tidier'.

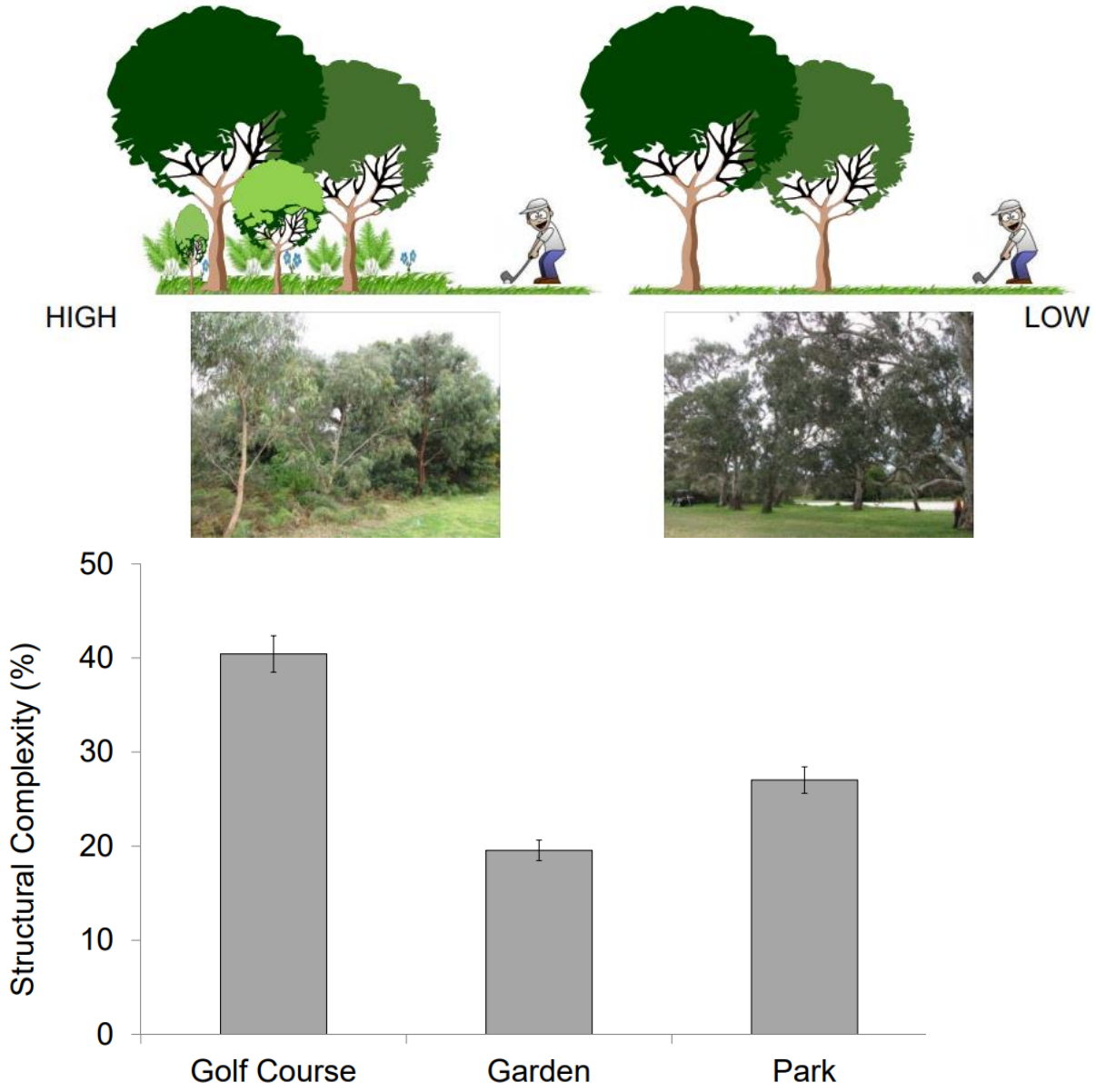


Figure 7: An example of the structural complexity of a vegetative habitat, plus a graph to show the value of these habitats on golf courses versus other green space use.

In a recent study conducted by The University of Melbourne, the vegetative habitat areas on representatively sampled golf courses around the city offered> 10% higher structural complexity than parks. Golf courses inherently provide more potential to foster vegetative density and complexity when compared to the relative monoculture of turf or formalised sports field facility.

Hole No.2:

The hole is named after the dominant landscape feature: 'The Pines'. There is a stand of pine trees that would benefit from some selective thinning to improve the structure of some of the healthier trees. We also recommend incorporating some lower canopy species in this area to complement the aesthetical appearance of the plantation. Figure (s)5 shows that pine trees offer significant temperature buffering during summer.

Figure 8: Stand of mature pine trees on the 2nd hole

A list of suitable trees specie that could be selected to plant within this existing stand of pines are:

- Tī kōuka (*Cordyline australis*)
- Kānuka (*Kunzea ericoides*)
- Mānuka (*Leptospermum scoparium*)
- Karamū (*Coprosma robusta*)
- Kōhūhū (*Pittosporum tenuifolium*)
- Tarata (*Pittosporum eugenioides*)
- Koromiko (*Hebe stricta*)
- Mānatu (*Plagianthus regius*)
- Houhere (*Hoheria sextylosa*)

Some fairway areas had suffered from melting out due to a period of prolonged wet weather suddenly turning hot and dry in the weeks leading up to the site visit. These areas on fairways would benefit from renovation in the early autumn. Therefore, our recommendation (refer to Table 1) is to carry out the following steps to enhance turf quality on 'high spots and fairway areas prone to seasonal environmental stress.

Table 1: Recommended actions for successful localised turf renovation on fairways

Action	Reason
1. Scarify and aerate	Scarify to remove dead (thatch) material. Aerate to create core channels to accept amendments
2. Add amendments – biochar, gypsum and manure	Dress over cored areas and brush in. The amendment should be One third/one third/one-third blend.
3. Dimple seed	Dimple seed with a combination of hard fescue and browntop bent c. 25g/m² rate
4. Manage soil moisture	Ensure areas are not allowed to dry out, and that soil moisture in the top 70 mm is maintained at around 20-25% until successful turf establishment.
5. Apply a light granular fertiliser (high P)	Nominal rate 10g/m²

Figure 9: Localised turf loss on high and low spots of the 2nd fairway.

Hole No.3:

On the left side of the fairway, a naturalised area of tall fescue (*Festuca arundinaceous*) offers an excellent example of how a well-managed mature pine and naturalised grassland habitat can look. This area adds character and aesthetical appeal to the course and offers significant habitat opportunities for insects, reptiles and small birds.

As detailed on the 2nd hole, inter-planting with selective native tree and shrub species in this area would add further ecological value.

Figure 10: Tall fescue grassland habitat under pine trees.

Hole No.4:

There is an excellent grassland habitat along the right side of the hole. This area would benefit from being selectively 'cleaned out' through Haloxyfop. It may also be feasible to incorporate some areas of native wildflower seed in areas of rough closer to the green. This will add greater aesthetical appeal and give the impression that the area is 'cared for' and proactively managed, rather than just 'left wild'.

Figure 11: Artistic impression of how the hole could look with increased naturalised rough.

Alongside the area around the green complex, there is also an opportunity to decrease the mow able rough around the tee complex – refer to figure 12.

Figure 12: Additional naturalised areas around the 4th tee complex could be added.

On this hole, we also recommend that the existing stan of Leylandii behind the green are removed and replaced with a more 'open' plantation of short to medium height native species. These will complement the long-term vision of the course and allow for an enhanced vista behind the 4th green.

Figure 13:

Suggested removal and replacement of the Leylandii behind the 4th green

Holes No.5 & 6:

There has been some additional tree planting between holes 5 & 6 since the 2011 report. As a result, many plantations flourish and serve well as a corridor to interlink each end of the hole.

We recommend additional planting between the last pine trees on the left side of hole 5 and the existing native bush plantation to further enhance this course area. Species such as

- Pittosporum (kōhūhū or *Pittosporum tenuifolium*)
- Lemonwood (*Pittosporum eugenioides*)
- 5-finger (*pseudopanax-arboreus*)

Figure 14: Additional low to mid-canopy (native) tree and shrub planting to infill between pine plantation and established native area.

The area along the right side of the 6th green could be developed into a fine fescue habitat that would lead into the native plantation behind the 4th green (once the Leylandii have been removed).

Figure 15: Potential to incorporate additional naturalisation of fine fescue rough in this area of the site. (A) with, (B) without.

Hole No.7:

As per our previous report, we recommend establishing fescue rough along the length of the embankment that runs parallel to the right side of the 7th hole. Establishing a naturalised area here would offer several benefits. Key to these would be:

1. Reduced labour input – mowing.
2. Improved H&S outcome – mitigation of the risks associated with mowing and maintaining a steep bank.
3. Aesthetical value.
4. Habitat/ecological value – establishing naturalised fescue in this course area would provide an excellent continuation of the theme from the 4th hole.

Figure 16: An artistic impression of how the right side of the 7th hole would look if it were naturalised.

Figure 17 shows how this fescue rough could be incorporated around the tee complex and create a seamless effect of golden fescue in this area of the course.

Figure 17: Incorporating additional fescue rough into areas around the tee complex.

Hole No.8:

The citrus tree plantation between holes 7 and 8 provides a good link from the course to the wider green network. This plantation will add to the value of this area.

It was positive to see that clover and hawkesbit had been allowed to establish in the out-of-play roughs in this area of the course (refer to figure 18). Allowing broadleaf weed species to establish discreet areas saves time and money on resources and chemicals and adds valuable bee and insect habitats.

Figure 18: A discreet area where broadleaf weed species had been established.

Hole No.9:

The pathway from the 8th green to the 9th tees is an area where ground cover specie such as Muehlenbeckia (*Muehlenbeckia australis*) and/or *Coprosma* sp. could be planted to infill existing bare areas (figure 19) and offer cover and shelter for reptiles such as skinks as well as insects.

Figure 19: Illustrating how existing bare ground can be enhanced for reptiles.

Along the right side of the hole (bordering the residential sections) would be an excellent place to embark upon a formal pest/predator control programme.

Perhaps it would be possible to gain support and buy-in from some residents along this side of the hole who could monitor traps. The ‘Good nature’ traps operate autonomously and are monitored via Bluetooth. This might provide a good opportunity for the Club to engage with the local community and establish a pest trapping programme in an easily accessible and otherwise low-value habitat area.

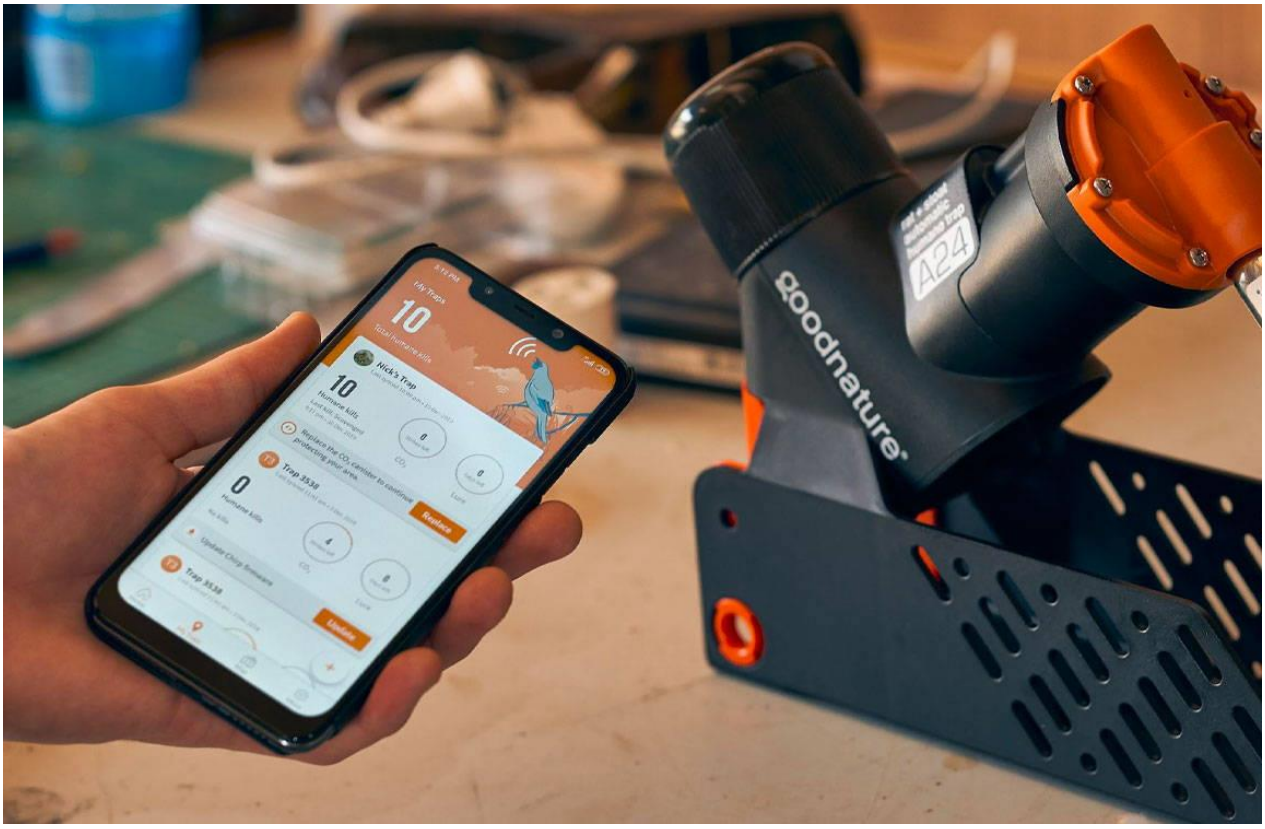


Figure 20: A ‘Good nature’ trap with Bluetooth interface.

Hole No.10:

Along the right side of the fairway, the existing tree line could be significantly enhanced with some selective understorey planting (similar to the concept shown in figure 7). This would provide a far more natural and ‘soft’ graded woodland edge to the habitat and enhance this course area for small, insect-feeding birds such as fantails, grey warblers, etc.

On the left side of the hole, increased planting (between 10 and 12) to bolster the existing trees (refer to figure 21).

Figure 21: The area on the left side of the 10th hole would benefit from increased native tree and shrub density.

Our previous report discussed the need to thin out and selectively remove trees from the plantation on the left side of the fairway (figure 22).

There are too many trees planted too close together in this plantation, and the negative effect of this is that the area becomes difficult to manage. Species such as Pittosporum, Lemonwood etc., could be selectively removed and carefully transplanted to the area further up the hole between the 10th green and 12th tees. This work would need to be carefully undertaken and at the right time of the year (i.e. early autumn).

Figure 22: Existing (overcrowded) plantation/copse needs thinning out.

As a general rule for small to medium-sized shrubs and trees, a planting spacing of 1-2 m is ideal, with 3-10 m suitable for large podocarp species such as Kauri and Totara. This allows the natural canopy of each species to establish sufficient airflow and light to penetrate the plantation and reduce the likelihood of pest and disease infestations.

An area between the 10th green and the 12th tees has been identified as somewhere that would benefit from plating up with a native tree and shrub scheme. This area offers little visual interest and can become ecologically valuable as a native plantation.

Further to adding value to the golf course, planting up in this area of the course will also improve the connectivity between the golf course and the wider green urban network (beyond the boundary of the MGC).

Figure 23: Potential for a significant native plantation exists in an out-of-play area (between the 10th and 12th holes).

We recommend that the majority of planted species should be of medium height. One or two larger podocarps, such as Totara or Kahikatea (*Dacrycarpus dacrydioides*). However, the majority of species should be medium canopy height, such as:

- Kanuka (*Kunzea ericoides*)
- Pittosporum sp.
- Five-fingers (*Pseudopanax arboreus*)
- Manuka (*Leptospermum scoparium*)
- Rimu (*Dacrydium cupressinum*)
- Ribbonwood (*Plagianthus regius*), Mānatu

The total area for planting is approximately 2,400 sq. m, representing a significant opportunity for the Club.

The following is a wider-ranging list extracted from - The *Restoration Planting from Taranaki to Manawatū–Whanganui: A guide to the Manawatū Plains Ecological District*

1.Trees

- godley's kōwhai
- hīnau
- horoekakaikōmako
- kamahi
- kōhūhū
- kotukutuku
- long-leaved lacebark
- māhoe
- makomako
- mātai
- lacebark
- pigeonwood
- puka
- titoki
- tawa
- white maire

2. Shrubs

- *Coprosma rhamnoides*
- hangehange
- heketara
- hinau
- kanono
- kawakawa
- māpou
- pate
- ramarama
- rangiora
- round-leaved coprosma

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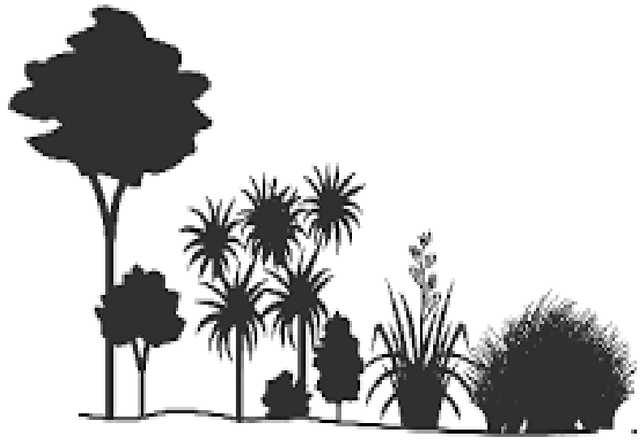

The image above provides a good example of the 'ideal edge' design we are trying to achieve in this area (or with any significant plantation). The graded edge is extremely important as it maximises the habitat for the widest possible range of insects, birds and mammals.

Although the recommended spacings for native plants are quite large the theory is that this spacing will allow each specimen to develop and mature in its own space, without having to compete for light and moisture.

Basic husbandry in terms of weed control (I recommend 'Eco Gard' products https://www.ecogard.co.nz/) will be necessary.

- Podocarp sp. 3 m spacing
- Podocarp /Broadleaved 3-1 m spacings
- Broadleaved and Shrub 1 m spacings

Notes:

Each coloured 'dot' does not represent a single plant. The dots represent where each species (based upon canopy height) should be planted in the plantation space.

The following numbers provide a guide for the area available between the 10th and 12th :

Large Podocarps = 15-20

Medium trees (Podocarps and broadleaved) = 40-50

Smaller shrubs (broadleaves and myrtles) = 100-110

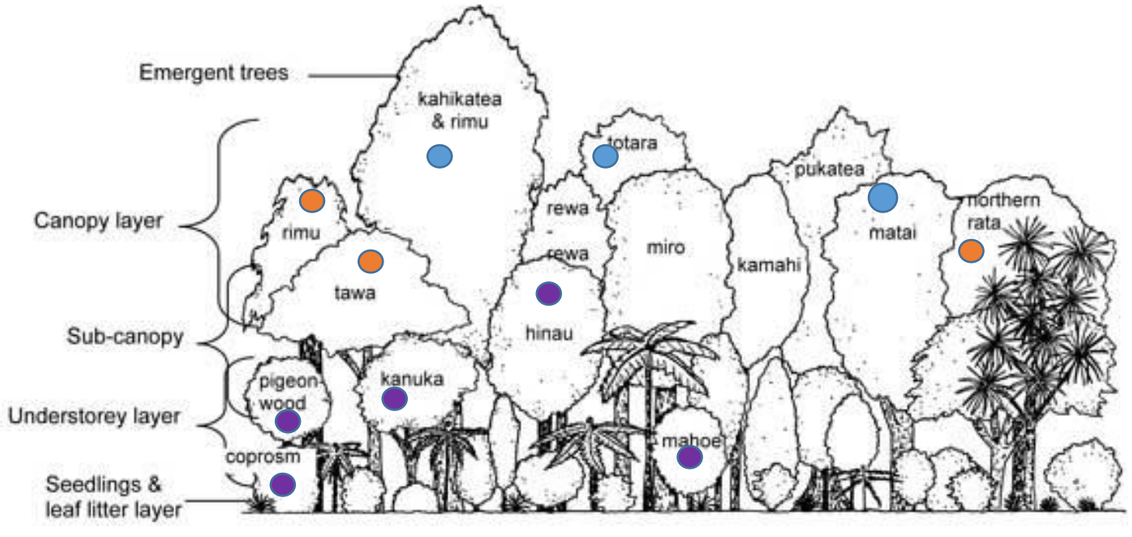

Figure 24: shows how enhancing the plantation between 10 and 12th holes will also enhance the diversity of the existing (wider) green corridor(s) around the course and beyond.

Hole No.11:

There is potential to create a fescue habitat up to the hole along the right side of the fairway/approach.

This area would be ideal as a pollinator reserve, with species to encourage insects and butterflies included in pockets of the fescue rough.

Figure 25: Potential to establish an area of fine fescue rough that follows the right side of the hole up to the green.

The fescue area could then ‘blend’ into a pollinator habitat in the area behind the green (refer to figure 26), which would complement the fescue as well as maximise the benefit from the existing residential planting behind the hole (i.e. between the golf course boundary and new build houses).

Figure 26: Pollinator zone between the back of the green and housing development.

Hole No.12:

There is an underutilised area to the right of the 12th tee complex (see figure 27). This passive area could be transformed relatively easily into a passive recreational/wildlife zone that golfers and residents could enjoy.

However, due to the proximity of this area to the neighbouring houses, a level of compromise will be required in terms of the extent of 'naturalisation'. We appreciate that property bordering a residential development needs to look 'well kept'. It is possible to enhance this area to benefit golfers, neighbours, and wildlife.

The Club could consider the selective planting of one or two specimen trees (for long-term shade) and establish well-maintained fescue roughs that have corridors and picnic areas mowed out from them. During the pandemic, many public parks worldwide started to establish passive recreational areas. They offered the public a way to connect with nature in a socially distanced way. A concept of this is shown in figure 27.

Figure 27: Walkways and private areas mowed out from long grass habitats

Figure 28: An artistic impression (Image A) of how this area could look

Hole 13:

Towards the start of the hole, the area feels comparatively ‘open’ and sparse of plantings. The character of this part of the course could benefit from some increased planting along the right side of the hole before reaching the white tee. Additionally, this area runs parallel to the 14th fairway.

Adding some specimen natives (i.e. Totara and Kahikatea) would help to enhance the character and definition of these holes and H&S benefits in the longer term.

Figure 29: Sparse (relatively open) area at the start of the 13th hole.

Figure 30: Some selective planting of specimen native trees would benefit the delineation between holes.

Along with the left side of the hole is a line of Pittosporum trees that would benefit from fescue rough being allowed to establish in front of them and then graduating down to the managed rough height (see figure 31).

Figure 31: Fescue border to existing Pittosporum hedge.

We recommend the removal of the existing conifer stand on the left side of the fairway and replacing this with a native planting similar to that shown in figure 30.

Hole 14:

The existing copse of trees on the left side of the hole (predominantly silver birch and broadleaf) could be planted with an additional 7-10 mid-size transplanted trees such as Pittosporum, lemonwood and kahikatea to increase the planting density and aesthetical value of this part of the hole. This additional planting could also work to inter-link with the plantation by the 13th green (figure 30).

Figure 32: Increase the density of plants within this area of the course.

On the left side of the fairway, there is an excellent example of a suitable planting for MGC. Species such as; Totara, sweetgum (*Liquidambar styraciflua*), magnolia (Magnolia; L), plum (*Prunus domestica*) and manuka have all been planted.

Whilst this is not exclusively a 'naïve' plantation, the variety of heights, vegetation, colour and fruit-bearing of these species in combination, makes this plantation both ecologically and aesthetically valuable.

Figure 33: Existing plantation on the left side of the 14th hole.

As per the plantation on the 10th hole, this area requires selective thinning out to ensure each species has the best opportunity to thrive.

An area beside the green backs onto the neighbouring residential development (refer to figure 34). This area has the potential to be another fescue-naturalised area that would enhance the character and environmental value of this corner of the course as it interfaces with the wider green network.

Figure 34: Opportunity to establish fescue zone where the course interfaces with the residential boundary.

Hole 15:

Bring the fescue around the orange tee to avoid summer turf loss by melting out of managed rough. This will also marry in with fescue rough on the embankment leading up to the teeing ground.

Figure 35: Introducing naturalised areas to steep or ‘hard to manage’ areas of mown turf.

Planting mid-height canopy trees and shrubs along the right side of the hole to soften the interface between the existing mature tree stand and the new sub-division

Figure 36: Additional planting of mid-canopy species in the area between the fairway and the new residential building zone.

Hole 16:

The grassland habitat along the right side of the 16th is excellent. There is an opportunity to extend this through to the 4th hole

Figure 37: The long rough area along the right side of the hole (from the tee end) offers excellent habitat for small insects and butterflies.

The area to the right of the tee complex, adjacent to the cart path, will be restored to native bush upon completion of the bulk earthworks currently underway to develop the housing estate. (Refer to figure 38). This area will interface with the fescue around the 16th hole once it is completed and established.

We recommend establishing fescue areas around the cart path side of the blue and red tees, as there is a dedicated pathway and steps up to the teeing ground. This would mitigate seasonal turf loss through melting out a drought and reduce the mowing resource.

Figure 38: Area adjacent to new housing development. This area will be planted upon the completion of bulk earthworks.

Figure 39: Tee complex with fescue around it.

Along the right side of the hole, the existing tree-line requires inclusion into a tree management policy for the Club. There is a need to remove exotic trees from this copse that selectively reach the end of their viable lifespan. As with all of our recommendations regarding planning a new plantation, we recommend a mix of Podocarp and broadleaved species and canopy heights for optimised habitat biodiversity.

Hole 17:

The area to the left side of the 17th green could be naturalised or planted up with native trees and shrubs. This area appears to have previously been naturalised and returned to a more '*managed*' rough. A move to a less formal and '*less managed'* look to this area will allow the adjoining corridors between the 17th and 3rd holes to interface with the area, and in turn, this will benefit the wider green corridor network in this area of the site.

Figure 40: This front area of the hole would lend itself to naturalisation.

The dying conifers on the right side of the hole should be retained (as long as the Club can tolerate their visual look). These trees offer perching posts and opportunities for wild birds to congregate safely. Tui and Kaka were frequently observed on this tree on the day of the audit.

Figure 41: Dying conifer on the 17th hole is home to several native bird species.

Also on the right side is a line of three reasonably young trees (privet, poplar, and silver birch). These need to be added to increase the planting density in this area. We recommend adding 4-6 large trees to improve the aesthetics and ecological value of this plantation.

Figure 42: Sparse plantation of silver birch, privet and poplar trees.

Hole 18:

There is a need for a pine and conifer removal programme. The existing stand of trees on this hole offers minima ecological value, and at some point, these trees will all reach the end of their viable lifespan. The design of this block plantation is high density and was established to offer maximum visual definition of the hole in the shortest possible time. This ‘block’ design is outdated and is less in keeping with the evolving parkland/naïve tree and shrub plantings around the rest of the golf course.

Figure 42: The formalised area behind 18th tees.

The formalised area behind the 18th tees would benefit from an overhaul. This area would fit better with the rest of the course if fescue were encouraged to grow on the embankment behind the tee and remove some of the existing trees (nearest to the teeing ground).

The root systems of the trees being so close to the tee contribute to the dryness and turf loss shown in figure 42.

6.0 General sustainability note

As part of the environmental sustainability audit, we have been asked to consider ways MGC could further reduce any negative impacts current turf management practices have on the environment. Water, fertiliser and pesticide use are the 3 key areas to consider aside from the ecological aspects of the golf course that have been addressed in Section 5.0 of this report.

This section of the report offers some pragmatic recommendations to the Club regarding mitigating the inputs of key turf management elements, beginning with water.

6.1 Mitigating water use on turf

Over the past 2 years, NZTMS has been involved in a range of field trials regarding the potential for different organic amendments to have a positive influence on reducing the amount of water required to maintain healthy turf.

One of the most promising amendments we have tested over this time has been biochar. This is effectively carbon and is a by-product of the timber industry. The biochar is formed from Pylorosis (effectively, this constitutes burning the wood in the absence of oxygen).

The biochar we have tested is supplied by a company called Soilpro Soil Conditioners and has over 50% Carbon content. The feedstock is Radiata pine from Rotorua, and as the wood is untreated, the biochar has been able to gain ‘BioGrow NZ’ certification.

Our research established that a suitable amendment ratio for turf is 15% (by volume). This should be pre-blended into the sand profile at the construction time and ideally placed approximately 100 mm below the finished surface level in a 50 mm band. If using biochar on an existing turf surface, i.e. a green or fairway, we recommend following the methodology below:

1. Core aerate the turf to a minimum depth of 80 mm.
2. Pre-blend the sand topdressing with 6 mm screened biochar at a rate of 15% by volume.
3. Apply as usual (I,e using a drop or spinner dresser).
4. Brush in the blend as best as possible.

We have seen success with following this methodology on New Zealand golf courses. Tara Iti (Northland) has been committed to applying biochar blended topdressing at each renovation of the past few years. The results have been impressive. Figure 43 shows how the profile is becoming amended after just 1 year.

Figure 43: Showing biochar amelioration into the sand profile green following 1 year of treatment (i.e. 2 x core renovations)

One of the key findings from our research in using an amended biochar/sand profile for sports surfaces has been the potential to save water. At 15% by volumes, the amended sand profile retained up to 40% greater soil moisture content than the straight sand profiles. In addition, we were able to measure live data over one year, sing wireless moisture probes set at varying heights within the sand profile.

The benefit of retaining increased moisture deeper within the profile is that this encourages deeper turf root systems and, in turn, increases the resilience of the turf to environmental stress. In addition, we found that infiltration rates were not negatively impacted. The amended sand profiles achieved an infiltration rate above 150 mm/hr (this exceeds USGA recommendations).

Current golf courses in New Zealand that have used or are using biochar as a tool to mitigate water and nutrient loss are:

Waitemata GC

Tieke Golf Estate

Royal Auckland & Grange GC

Tara Iti (Doak course)

Wainui GC

6.2 Organic fertiliser option

An organic compound high in nutrients and offers a slow release of nutrient availability (particularly Phosphorus) is struvite. We have been engaged by watercare to provide independent trials regarding the potential of using struvite as an organic soil enhancer in place of proprietary high P products.

Struvite is a 100% renewable product that is a by-product of the processes used in the treatment of wastewater. Currently, struvite is disposed of in landfills, and consequently, the potential benefits of this compound are being lost.

Globally, countries such as Germany, Holland, and parts of Scandinavia are developing commercially viable methods of producing struvite as their primary Phosphorus sources as part of the desire to operate in a sustainable and circular economy. As a result, the importation of Phosphorus from overseas (predominantly China) is being replaced by a renewable material produced locally in abundance.

One of the excellent benefits of struvite is in its physical characteristic. The product looks like and handles like sand and can be easily dressed out in a sand top dresser.

Struvite has a guaranteed analysis of

12% Phosphorus
5% Nitrogen
10% Magnesium

Figure 44: Struvite sand.

Our recommendation for MGC is to trial the use of struvite as a product to be applied to the greens at renovation time. Once the green is ready for the final topdressing, we recommend blending the struvite to the sand at a rate of 1000 – 1500 Kg/Ha. This will assist in supporting the initial recovery of the turf and where inter-seeding has taken place. In addition, the highly stable Phosphorus component of the compound will support the turfgrass seedlings' early shoot and root growth.

The product has 0% burn potential, causes no phytotoxicity and is 100% safe to handle. Currently, we have overseen the use of struvite on several turf sites in New Zealand. These include:

Yarrow Stadium

Remuera Golf Club

Kaipatiki Sports Park (Auckland)

Birkenhead Memorial Sports Park (Auckland)

7.0 Summing up

Based upon the findings of the site visit, ERS and further site-specific observations, we have complete confidence that MGC is in a strong position to embark upon GEO Accreditation. From our experience of auditing a significant number of golf courses, the percentage score of 79% sits well above the average score for an 18-hole golf course in New Zealand (typically 64%).

MGC is well-placed to enhance its ecological and sustainability value further. The course already performs exceptionally well in many key areas and within whilst site-specific limitations exist (i.e. no large water bodies, extensive grassland habitats, etc.). There is adequate scope on the existing site to significantly enhance the ecological value of the property for the benefit of golf and wildlife.

This report has focussed solely on the golf course component of the site. However, it is designed to be considered in relation to a more operational (Clubhouse) focused report that we believe 'GreenStart NZ' has been engaged to provide.

In addition to the ecological habitat and wildlife enhancement opportunities at MGC, we have also provided some general recommendations that reflect a sustainable turf management philosophy. For example, considering the incorporating organic and circular products such as biochar and struvite into part of the turf management programme at MGC will create an opportunity to improve the sustainable sourcing and use of products that are produced within New Zealand and have a low carbon footprint – as well as being proven to have beneficial influences on turfgrass health and soil conditioning in the mid to long-term.

NZTMS commends MGC on its high level of environmental sustainability and the openness that staff have at the Club to enhance this willingly. We hope that we can support the Club through its GEO journey (If chosen to pursue) and enjoy watching the course thrive due to on-going, sustainable enhancements.

Appendices 1

Interpretation of Environmental **R**eview **S**ystem (**ERS**):

NZTMS Golf Course Sustainability Review for New Zealand Golf Courses

1. Introduction of the review

This review focuses on capturing a broad collection of information regarding the day-to-day maintenance of the golf course. From this data, a condensed overview of operations can be presented to the Club, creating a 'snapshot' of their current levels of sustainability relative to the following golf course elements:

- greens
- tees and approaches
- fairways
- managed rough
- watercourses
- trees
- naturalised areas

It is envisaged that a club would sign up for an initial review and target setting consultation. Then, over the subsequent twelve months, targets are tracked with regular meetings, and a second review at the end of this period will assess progress and highlight savings.

2. Aims of the review

The primary objective of the review is to encourage and monitor sustainability regarding the maintenance and management of the golf course and, in doing so, reduce inputs and generate proven financial savings. This will be achieved in the following ways:

- Highlighting specific target elements to address and creating set goals.
- On-going advice and consultancy to support sustainable progress towards set goals.
- Collection of data to record resource savings and environmental enhancements of the golf course.
- Developing closer bonds between golf clubs and surrounding local communities by altering perceptions about the golf industry and raising broader awareness of the value of golf courses as community green spaces with the potential for multifunctional use.
- Creating a point of difference amongst golf courses by issuing those clubs involved with certification of the scheme.

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3. Carrying out the review

- Club agrees to commit to a minimum one-year programme.
- The initial review is carried out by NZTMS consultant/representative (it will be necessary to visit the Club and speak to the golf course superintendent; also walk the course and make relevant additional notes/comments).
- The completed review and scoring interpretation are handed back to the Club for discussion.
- A date is set to discuss a future strategy, focussing on areas of priority highlighted by the initial review.
- Subsequent meetings are set up to track the progress of these prioritised projects.

4. How the review works

- A golf course does not automatically fail if 50% sustainability is not attained. Instead, the review highlights priority areas (or elements) for future enhancement. The initial assessment and scoring system are purely a means of producing this overview. It is not a benchmark of success or failure.
- Scoring can be refined. This refinement or weighting process is illustrated in Fig.1 and Fig.2 below:

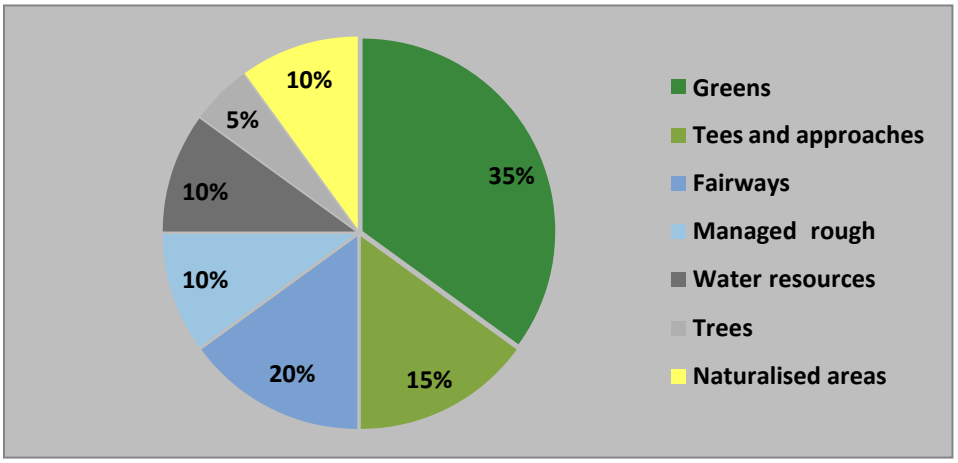

Fig.1: Pie chart illustrating the typical weighting of a Links course (emphasis on greens management

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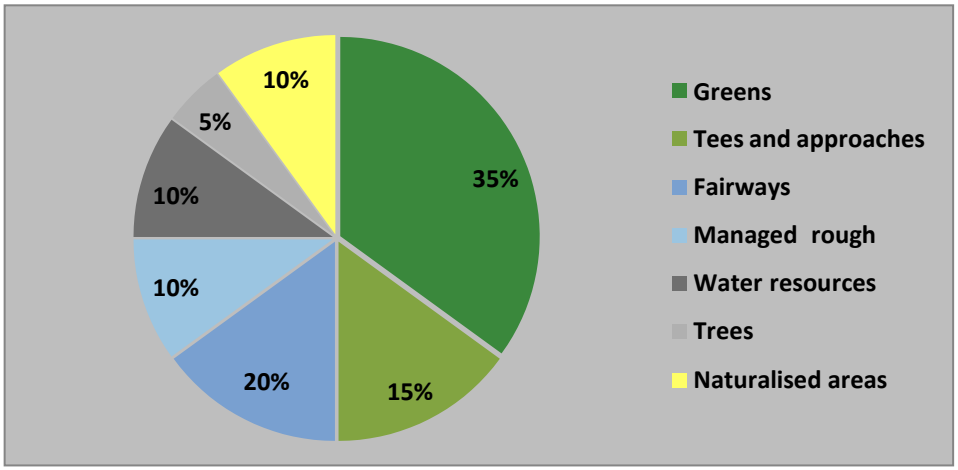

Fig.2: Pie chart illustrating the typical weighting of a Parkland golf course (Heavily tree-lined with a greater emphasis on tree management)

- In most instances, limiting location, resources, budgets, and member expectations will mean a course can't attain 100% sustainability. However, this may remain a theoretical target and can be the long-term goal of every venue.
- The sustainability score is representative of that specific golf course and not a generalised benchmark
- Once the review has been completed, and the sustainability score is set, future goal setting and targets can be prioritised (refer to Fig.3 for Executive Summary of scoring and target setting).

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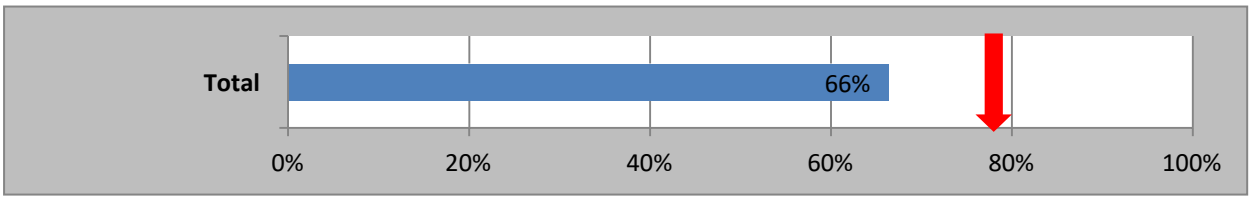
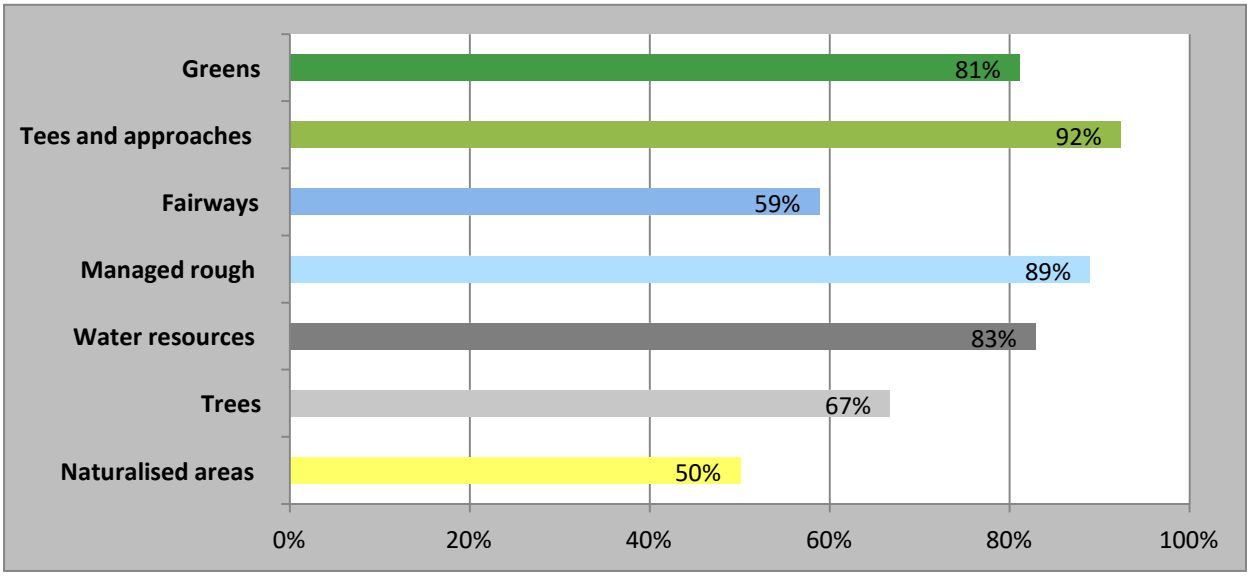
Note: The **red arrow** represents the highest possible sustainability score that the Club could achieve (i.e. '*your site-specific sustainability goal*'). The score takes into account resource and site-specific limiting factors.

The red arrow represents the maximum score possible for your golf course = **78%**

Total score Indicates overall sustainability score



Individual scores



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The individual weighting of scores

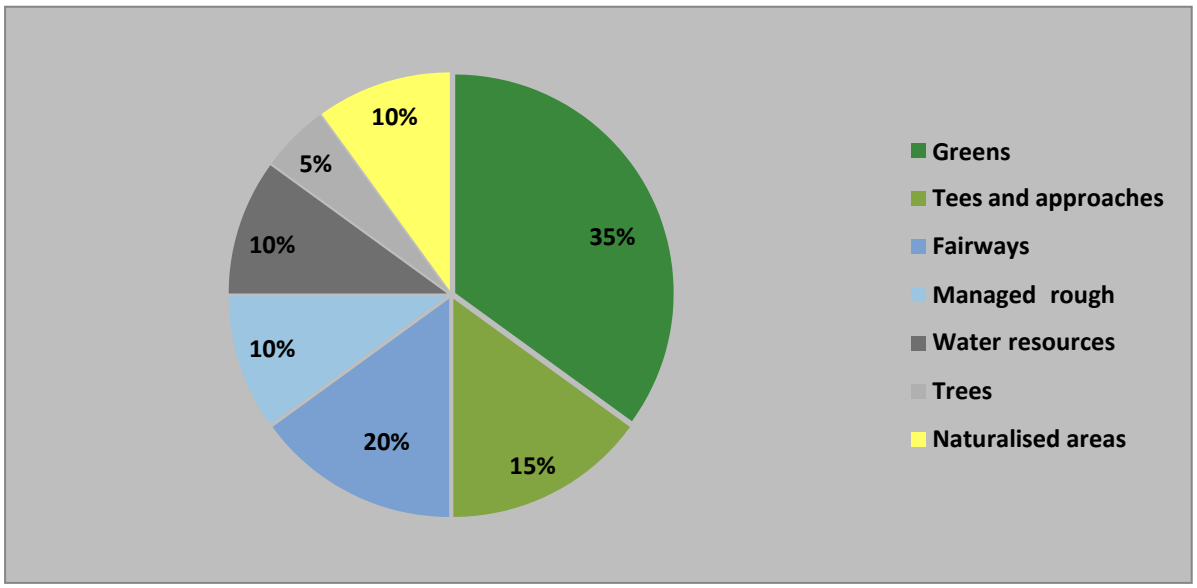

Fig.3: Example executive summary of a sustainability review

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