

Golf Course Assessment

September 2023



Ballarat Golf Club

Course Assessment

Sam Myott



Making great sport happen

1. Introduction

STRI Australia was commissioned by the Golf Club to undertake an assessment of various aspects of the golf course at Ballarat Golf Club.

The golf course was assessed on September 1st, 2023 and involved:

- Assessing various agronomic criteria and the general condition of the playing surfaces.
- Taking profile cores on 6 greens, surrounds, tees & fairways to assess thatch and root growth.
- Assessment of Club Documents:
 - o BGC Master Plan
 - o BGC Cart Rules
 - o 2021 AGCSA Couch Report
 - o 2021 Couch Fairway Discussion Report
 - o 2017 Thomson Perret Course Review
 - o 2012 POA Report
 - o BGC Course Maintenance and Cultural/Capital Program

2. Assessment of Turf Playing Surfaces

2.1 Course Condition & Agronomy

Observations of the condition and agronomy of the playing surfaces are summarised in Table 1 & detailed in Appendix 1.

Table 1: General Observations of the Playing Surfaces

Playing Surface	Comments
Greens	• Good to very good condition • Full & consistent grass cover (100% cover) • Bentgrass / <i>Poa annua</i> composition (average 50/50, <i>Poa</i> ranges from 30 to 60%) • Good health / vigour • Minimal wear & ball marks • Sand profile, average 200mm+ depth • Some black layer • No disease, no disease scarring • Green's performance testing was not conducted
Greens Surrounds	• Even/consistent grass coverage • Excessive thatch levels 60-70mm
Tees	• Variable condition (very poor to very good) • Average 80% cover (50 to 100%) • Dormant couchgrass – very high <i>Poa annua</i> incidence (average 80%) • Sand profile, average 167mm (150 to 200mm) depth • No disease • Generally, operate with 2-grass-plan – Santa an Couchgrass & <i>Poa annua</i> • In general par 3 tees are too small for general golf play and need to be able to accommodate sufficient play from May to Sept. • Generally, level without significant level deviation. • Divot debris located on some tees.
Fairways	• Variable condition (very poor to good) • Average 75% cover (50 to 100%) • Dormant couchgrass – very high <i>Poa annua</i> incidence (average 50%) • Sand profile, average 150mm (100 to 200mm) depth • Profile sand depth generally consistent • No disease present or scarring • Excess thatch 60-70mm • <i>Poa annua</i> in decline – Glyphosate app • Cart use is excessive, isolated to through the playing surface & main play areas. Design features direct traffic through certain course areas • Drainage system is unknown or limiting – as based upon historical Nearmap images. • Insufficient positive and negative contours generate flat fairway areas, tending to hold moisture. • Insufficient drainage catchment pits to collect and remove surface water, tending to hold moisture in the fairway surface before it reaches the drainage pits. • Fairway access and exit paths generating surface water & silt onto fairways/approaches areas without being appropriately collected through the drainage system. • Due to dormancy, appearance and discolouration is seen as poor. Colourants are recommended.

Other	• Greens/Tees/Fairways/Green surround's are irrigated – Not Rough • 100+ Golf carts are active year-round. • 70+ Medical cart users • Carts have no access to rough • Golf cart access, singular entry and exit points, is from the start of the fairway to the green's approach • Further assessment of the irrigation system is required due to the age of the irrigation system and water quality.
-------	--

2.2 Thatch Levels & Root Growth

Table 2 summarises the average thatch and root growth of the turf surfaces and full results are detailed in Appendix 2.

Table 2: Average Thatch & Root Growth of the Playing Surfaces*

Playing Surface	Thatch Depth (mm)	Effective Root Depth (mm)	Max. Root Depth (mm)	Visual Root Density	Visual Root Health
Greens	30	63	79	3.5	3.7
Surrounds	72	80	100	2.8	3.0
Tees	38	58	125	3.2	3.7
Fairways	61	75	112	3.2	3.5

**Average of 6 holes*

Effective Root Depth: depth at where majority of roots reside (mm)

Root Density & Health: 1 (very poor) to 5 (very good)

- a) Thatch is the intermingled layer of living and dead grass stems, roots and other organic material that is found between the soil surface and the leaf blades.
- **Greens:** Although some thatch is desirable, excessive thatch levels leads to increased surface moisture retention, softer putting surfaces that are prone to pitch marking, slower putting surfaces, increased disease & insect activity, increased susceptibility to dry patch, reduced oxygen exchange and root decline. A thatch layer begins to become undesirable when it exceeds a depth of 12 – 20 mm.

Excessive thatch layer in the greens (average 30 mm)
 - **Greens Surrounds, Tees & Fairways:** Excessive thatch can form a “sponge” layer over the soil impeding water and fertiliser movement into the soil profile and ideally thatch levels should be less than 20mm.

Excessive thatch layer in the greens surrounds (average 72 mm), Tees (average 38 mm) & Fairways (average 61 mm)
- b) The main functions of a plant's root system are to absorb water and nutrients and provide anchorage and ideally root depth needs to be greater than 100mm. A poor and shallow root system will impact on irrigation scheduling and make the plant is less able to tolerate stresses (heat, moisture, disease).

- **Greens:** The effective rooting depth of the tested greens (63 mm) was less than ideal and both root health and density was moderate to good.
- **Surrounds:** The effective rooting depth of the tested greens (63 mm) was less than ideal and both root health and density was moderate.
- **Tees & Fairways:** The effective rooting depth in the tested tees (58 mm) & fairways (75 mm) was less than ideal and both root health and density were moderate to good.

Key Findings

Greens

- The greens were in good health and vigour on the day of assessment, without signs of disease scarring
- Bentgrass / Poa annua composition (average 50/50, Poa ranges from 30 to 60%)
- Limited or minimal ball marks were observed
- Excessive thatch levels, appropriate management practices need to be applied
- Less than ideal root growth, appropriate management practices need to be applied
- Putting green performance for trueness and smoothness were not tested on the day of assessment

Greens Surrounds

- The green surrounds were in good health on the day of assessment, without signs of disease scarring, and no significant weed intrusion
- Low areas were holding excessive moisture within thatch / rootzone profile
- Excessive thatch levels are affecting playability, appropriate management practices need to be applied
- Less than ideal root growth, appropriate management practices need to be applied

Tees

- The primary turfgrass species is couchgrass, which is in dormancy. Very high poa annua incidence
- Generally, the tees operate with 2-Grass program – couch & Poa annua. The practice needs to be more deliberate, maintain a 2-Grass program and provide a desired playing surface or maintain a pure couchgrass surface
- Excessive thatch levels, appropriate management practices need to be applied.
- Less than ideal root growth, appropriate management practices need to be applied.
- Generally, par 3 tees are too small for general golf play and need to be able to accommodate sufficient play from May to September.
- Generally, tees are level without significant level deviation

Fairways

- *The primary turfgrass species is couchgrass, which is in dormancy. Very high poa annua incidence*
- *Excessive thatch levels are impacting healthy turf grass growth and development, holding or impeding surface water movement and impacting playing surface expectations, appropriate management practices need to be applied.*
- *High level of golf cart use across the playing surface & main areas impacting playing surface expectations. Design features direct traffic through narrow course areas increasing wear and turfgrass decline*
- *Golf cart access is limited to a singular entry and exit points, from the start of the fairway to the green's approach*
- *Drainage system is unknown or limiting – as based upon a review of Nearmaps and historical images. As a general rule, 2000 metres of sub surface drainage is required per Hectare for a sand capped playing surface*
- *Insufficient positive and negative contours generate flat fairway areas, tending to hold moisture*
- *Insufficient drainage catchment pits to collect and remove surface water, tending to the playing surface to absorb moisture before it reaches the next drainage pit*
- *Due to dormancy, appearance and discolouration is seen as poor. Colourants are recommended.*
- *Fairway access and exit paths generating surface water & silt on to fairways/approaches without being appropriately collected through the drainage system*

4. Hydraulic Conductivity Testing Of Course Sand Materials

Hydraulic Conductivity testing measures the flow of water through the sand material. Collective samples were taken across several greens to form a composite sample. The 2nd fairway was selected to measure the performance of the fairway sand material. The Course top dressing sand material was sampled and tested. Results are summarised in Table 3.

Table 3: Drainage Rates of Golf Course Sand Materials

	BGC Greens	BGC #2 Fwy	BGC top dressing Sand
Hydraulic Conductivity (mm/hr) Drainage (after ASTM F1815 method)	44	97	3

In general,

- The BGC Greens root zone material has a slow to moderate drainage rate
- The BGC #2 Fwy root zone material has a moderate drainage rate
- The BGC top dressing sand has a very slow drainage rate

Topdressing Material

The greens topdressing sand has a significantly slow drainage rate. The use of this sand material on greens will result in the sealing of the playing surface and lead to the migration of fine sand materials into the greens rootzone profile. Resulting in the impact in the drainage performance the greens' putting surface, a in softer putting surface which is directly responsible for the trueness and smoothness performance of the putting surface. The putting surface will be more incline to disease, and the development of Black Layer within the root zone profile.

Key Findings

- *Sand profile material drains at adequate rate and is suitable for use on the respective green and fairway profiles.*
- *The top-dressing sand material is inappropriate for maintenance and cultural program use on all playing surfaces. Continued use of this top-dressing sand material will reduce the playing surface infiltration / drainage rate to 3mm/Hr. This effectively seals the playing surface profile, in particular greens which will lead to a decline in putting surface performance.*
- *The present use of this sand material needs to cease, and an alternant sand material needs to be sourced that it is compatible with the host sand material.*

5. Nutrient Results Assessment

The Soil Nutrient Report – AGCSA Tech, Dated March 22nd, 2022. The interpretation of the Report is provided below.

In general, the nutrient results for Greens;

- The pH is strongly alkaline, due to the high pH level of the irrigation source. pH level needs to be managed to alleviate alkaline creep which will reduce the availability of nutrients to the turfgrass plant
- Total salts are moderate to elevated and need to be managed
- Phosphorus and Calcium levels are inadequate.
- Calcium / Magnesium ratio levels are low
- Sodium levels are high and need to be managed
- Micronutrient levels are generally adequate

Nutrient Sampling was conducted on the day of assessment on the 6th Tee, 16th Tee, 7th Fairway and 13th Fairway:

Summary of results are below:

- pH levels are slightly alkaline which is not of a major concern.
- EC levels are adequate.
- CEC is low in all samples, indicating poor nutrient retention
- Phosphorus: Adequate in the 13th Fairway sample while being low in all other samples.
- Potassium and Calcium are low in all samples and will benefit from increase.
- Magnesium: Slightly low in both Fairway samples but adequate in both Tee samples.
- Sodium (%): Adequate in all samples and of no concern to the soil structure.
- Micronutrients are generally adequate.
- Chloride levels are low and of non-concern.

Key Findings

- *Greens health on the day of the assessment was observed as strong vigour and healthy, and reflects the present maintenance program.*
- *Greens' nutrient results indicate a strong alkaline pH and high level of salt, both will impact turfgrass health performance. This is associated with the quality of the irrigation supply and reflect a period without flushing rainfall. Note: Testing was undertaken at the end of the irrigation season in March.*
- *Nutrient levels on fairways and tees need to increase to meet playing surface expectations, and to support golf cart traffic on fairways. Note: Testing was undertaken outside the irrigation season in September.*
- *CEC levels need to increase on fairways and tees to aid in nutrient retention and support turfgrass health and reduce the need to large quantities of amendments.*

6. Irrigation Water Quality

The Water Analysis Report – AGCSA Tech, Dated March 18th, 2022. The interpretation of the Report is provided below.

In general,

- The pH is moderately alkaline and has the potential to cause alkalinisation of soil profiles receiving this water as primary irrigation.
- Total salts are indicated as high and have the potential to accumulate within the soil profile (sand-based profiles such as these are more likely to adequately leach salts from the profile so long as the profiles are not excessively compacted and the sand itself adequately drains).
- General macro & micro elements are acceptable and can be supplemented to the turf through soil or foliar applications where deemed necessary. The indicated concentration of some macro elements, such as Calcium, is not likely to excessively result in removal of other plant essential nutrients (ie Potassium) from the profile as a result of use.
- The water hardness is higher than desired and has the potential to not only impact chemical efficacy, but also may cause rapid deterioration of irrigation systems & spray units.
- While the sample is high in total salts & Sodium, these are unlikely to be an issue in sand-based profiles, sand profiles which have adequate drainage capabilities and are not overly compact are generally able to adequately leach salts from the profile making it no major concern (unless young or susceptible turf species are being established in which case saline water should be avoided).
- The use of cool season turf grass on fairways is inappropriate, given the large area size of the playing surface, drought stress during warmer periods of the year (particularly when grown in sand-based soils) and their preferred growing conditions (i.e. ~20°C). Understanding cool season turf undergoes this abiotic type of stress, the increasingly high pH of the immediate rootzone system will limit the plant available nutrients, in turn reducing the ability for the turf to withstand environmental stresses, which will also be further exacerbated due to the wear stress caused through golf cart traffic and machinery traffic.

Key Findings

- *While the water sample is high in Total Salts & Sodium, these are unlikely to be an issue in sand-based profiles, unless the sand profile is impacted by compaction or doesn't drain adequately or is impacted by excessive thatch levels*
- *pH is moderately alkaline and has the potential to cause alkalinisation of soil profiles*
- *Undertake maintenance/capital programs to relieve compaction and reduce thatch levels to ensure there is no water holding areas. Water holding areas will accumulate Salts and Sodium.*
- *Maintain adequate Calcium & Magnesium levels to help facilitate natural leaching of salts and Chloride from the profile*
- *Water quality is inappropriate for large area cool season playing surfaces use, due to related drought stress in the summer months, sand profile, thatch levels, elevate cart traffic levels and high salts and sodium levels of the water source. Unless appropriately resourced and budgeted*

7. Golf Carts and Usage

Golf Cart use is a prominent activity at Ballarat Golf Club, with an estimated 100 plus active cart users per year, with 70 medical certificate users per year or during the winter season months.

Assessment of the golf course indicated excess wear and traffic associated with cart movement directly through the main play corridors of play on the fairways. This was particularly impactful around narrow course design corridors that limits the spread of wear, such as bunkers or golf hole entry and exit points.

Cart damage is defined as turf wear that includes – turf and soil compaction due to the weight of the golf carts. Abrasion and wear caused by repeated and concentrated traction including stopping, starting and driving.

Compaction damage limits turf grass growth, limits water infiltration or the ability of the playing surface to drain and limits nutrient uptake. Therefore, the golfing performance of the fairway playing surface is impacted with flatter and harder playing lies.

Key Findings:

- *Ballarat Golf Club operates with a high level of golf cart users per year, considered similar levels to resort golf cart activity.*
- *With only a singular golf cart entry and exit points on fairways, there's a reduced the ability to rotate or limit golf cart traffic*
- *High level of golf cart activity reduces turfgrass growth and impacts the play ability of the fairway playing surface, providing a flatter surface due to rootzone profile compaction, excessive thatch levels and associated traffic stress. With the further performance of the playing surface further decreasing during periods of stress – i.e.: elevated salt & pH levels in the irrigation water without flushing rainfall, turf plant dormancy and extended periods of wet weather*
- *Golf cart use with a medical certificate does not reduce the impact to the golf course with 70 plus golf cart users. It is considered normal golf cart traffic in relation to the impact to the golf course and its playability, particularly during stress periods.*
- *Where single golf cart use occurs across multiple golfers and cart use, i.e. four carts across a group of four golfers. This further compounds golf cart traffic wear to the fairway playing surface.*

8. Golf Course Assets – Expected Lifespan

Ballarat Golf Course commenced construction in 2007 and was completed in 2009, the golf course is 14-15 years old.

Table 4 references the expected lifespan of golf course playing surfaces and assets, from greens, tees, fairways, drainage, irrigation system and cart paths.

Table 4: Expected lifespan of Golf Course Assets

Course Item	Years
Greens	15 to 30+
Tees	15 to 20
Fairways	15 to 20
Bunker Sand	5 to 7
Bunker Drainage	7 to 10
Fairway / Rough Drainage	20 to 25
Irrigation System	10 to 30
- Irrigation Controller	10 to 15
- Pump Station	15 to 20
- Sprinklers	10 to 15
Cart Paths	15 to 30+

Note: Referenced information is care of the ASGCA

Key Findings:

- Golf course assets (playing surfaces and fixed assets) at Ballarat Golf Club are entering the initial stage of lifespan decline and will require increased capital works and cultural practices, and associated budgets beyond the maintenance program to meet the desired golfing expectations.*

8. Summary of Key Points

- *Greens, greens surrounds, fairways and tees all have excessive thatch levels and less than ideal root growth*
- *The top dressing sand material is inappropriate for maintenance and cultural program use on the playing surfaces, in particular the greens, and needs to be replaced with a sand that is compatible to the present host sand material.*
- *The pH of the irrigation water is moderately alkaline and has the potential to impact to soil profiles. Total salts are high and have the potential to accumulate within the soil profile without the appropriate maintenance and cultural programs*
- *Water quality is inappropriate for large area cool season playing surfaces use, due to related drought stress in the summer months, sand profile, thatch levels, elevate cart traffic levels and high salts and sodium levels of the water irrigation source. Unless appropriately resourced and budgeted*
- *The performance of the tees playing surface needs to be determined as a 2-Grass plan – couch & Poa annua, and maintained appropriately to the meet golfers expectations.*
- *Par 3 tees are generally too small for general golf play and need to be able to accommodate sufficient play from May to September*
- *The performance of fairway playing surface is accumulatively impacted and compounded by excessive thatch levels, limited nutrient availability and retention, limiting function of the drainage system, design restrictions and the high level of golf cart activity which impacts the Santa ana couchgrass, in particularly during the colder months of Ballarat where dormancy is impacted.*
- *Golf course assets (playing surfaces and fixed assets) at Ballarat Golf Club are entering the initial stage of lifespan decline and will require increased capital works and cultural practices, and associated budgets beyond the maintenance program to meet the desired golfing expectations.*

Appendix 1a: General Condition of Greens

Green	Cover	Health /Vigour	Poa %	Wear / Traffic	General Condition
1	100	Good	50	minimal	good
2	100	Good	60	minimal	very good
3	100	Good	50	minimal	very good
4	100	Good	40	minimal	very good
5	100	Good	40	minimal	very good
6	100	Good	60	minimal	good
7	100	Good	60	minimal	good
8	100	Good	50	minimal	very good
9	100	Good	50	minimal	very good
10	100	Good	40	minimal	very good
11	100	Good	35	minimal	very good
12	100	Good	40	minimal	very good
13	100	Good	40	minimal	very good
14	100	Good	60	minimal	good
15	95	Fair	40	minimal	good
16	100	Good	60	minimal	good
17	100	Good	30	minimal	good
18	100	Good	35	minimal	very good

Appendix 1b: General Condition of Tees

Tee	Cover	Health /Vigour	Poa %	Wear / Traffic	General Condition
1	80	dormant	70	High	Poor
2	100	dormant	70	Low	Good
3	80	dormant	80	Med	Fair
4	80	dormant	80	Med	Fair
5	80	dormant	80	Med	Poor
6	70	dormant	80	High	Fair
7	50	dormant	80	Med	Very poor
8	50	dormant	80	High	Very poor
9	----- Temporary Tee -----				
10	90	dormant	85	Low	Good
11	60	dormant	95	High	Very poor
12	75	dormant	100	High	Poor
13	70	dormant	80	High	Very poor
14	100	dormant	80	Med	Good
15	100	dormant	85	Med	Fair
16	70	dormant	85	High	Very poor
17	80	dormant	90	High	Poor
18	90	dormant	80	Med	Fair

Appendix 1c: General Condition of Fairways

Fairway	Cover	Health /Vigour	Poa %	Wear / Traffic	General Condition
1	50	dormant	50	High	Poor
2	100	dormant	30	High	Poor
3	80	dormant	50	High	Poor
4	80	dormant	50	High	Poor
5	80	dormant	40	Med	Fair
6	80	dormant	40	Low	Fair
7	80	dormant	40	Med	Fair
8	70	dormant	50	Low	Fair
9	95	dormant	60	High	Fair
10	80	dormant	60	High	Very poor
11	90	dormant	40	Low	Very good
12	70	dormant	40	High	Poor
13	90	dormant	30	Med	Fair
14	60	dormant	60	High	Poor
15	80	dormant	60	Med	Poor
16	70	dormant	60	High	Very poor
17	50	dormant	30	Low	Fair
18	80	dormant	40	High	Poor

Appendix 2: Turf Health, Root Growth & Thatch Levels

Playing Surface	Thatch Depth (mm)	Effective Root Depth (mm)	Max. Root Depth (mm)	Visual Root Density	Visual Root Health	Soil Texture	Profile Depth	Comments
Greens								
01	30	70	12	4.0	5.0	sand	200	black layer
04	30	80	90	4.0	4.0	sand	200	black layer
08	30	60	110	3.0	3.0	sand	200	black layer
10	30	60	70	3.0	3.0	sand	200	
12	30	60	90	3.0	3.0	sand	200	
16	30	50	100	4.0	4.0	sand	200	
Average	30	63	79	4	4	-	200	-
Greens Surrounds								
01	70	70	70	2.0	3.0	sand	150	black layer
04	60	80	90	3.0	3.0	clay	150	
08	80	100	140	3.0	4.0	sand	100	
10	80	80	90	3.0	2.0	sand	150	
12	80	90	150	4.0	4.0	sand	100	
16	60	60	60	2.0	2.0	sand	100	
Average	72	80	100	3	3	-	113	-
Tees								
01	25	50	70	3.0	5.0	sand	200	clay sod
04	40	60	150	4.0	4.0	sand	200	
08	40	80	150	4.0	4.0	sand	150	
10	50	60	110	3.0	3.0	sand	150	
12	55	60	120	3.0	2.0	sand	150	
16	20	40	150	2.0	4.0	sand	150	
Average	38	58	125	3	4	-	167	-
Fairways								
01	70	80	100	4.0	5.0	sand	100	
04	60	80	120	3.0	4.0	sand	200	
08	55	60	110	3.0	3.0	sand	150	
10	60	80	120	3.0	3.0	sand	150	
12	60	80	110	3.0	3.0	sand	150	
16	60	70	110	3.0	3.0	sand	150	
Average	61	75	112	3.2	3.5	-	150	-

Effective Root Depth: depth at where majority of roots reside (mm)

Root Density & Health: 1 (very poor) to 5 (very good)

Ballarat Golf Club

October 2023

*Report prepared by
Adrian Knapping, Sportsturf Agronomist*



Making great sport happen

Comments

- pH: All samples are slightly alkaline which is not of major concern currently.
- EC: Adequate in all samples and of no concern currently.
- CEC: Low in all samples indicating poor nutrient retention and will benefit from increase.
- OM: -
- Phosphorus: Adequate in the 13th Fairway sample while being low in all other samples.
- Potassium: Low in all samples and will benefit from increase.
- Calcium: Low in all samples and will benefit from increase.
- Magnesium: Slightly low in both Fairway samples but adequate in both Tee samples.
- Sodium (%): Adequate in all samples and of no concern to the soil structure.
- Trace Elements: Copper is low and will benefit from increase while all other trace elements are generally adequate and of no concern.
- Chloride: Low and of no concern in all samples.
- Other Comments: -

Recommendations

- Recommendations to raise soil nutrient levels, restore soil balances and for on going maintenance are detailed in the following table(s).

Recommendations

Ballarat Golf Club

9 October 2023

MATERIALS (/ha)	6th Tee	16th Tee	7th FWY	13th FWY					
Apply at renovation ideally following deep aeration									
Granular NPK 16-11-10 or similar	100kg	150kg	200kg	-					
Slow Release Potassium Sulphate	200kg	200kg	200kg	200kg					
Gypsum	1 tonne	1.5 tonne	1.5 tonne	1.5 tonne					
Pelletised organic material	Label Rate	Label Rate	Label Rate	Label Rate					
Copper Sulphate	2kg	2kg	2kg	2kg					
Maintenance Program									
Granular NPK of 15-5-15 or similar at 200kg/ha every 8-10 weeks or as deemed necessary.	✓	✓	✓	✓					
Liquid Calcium applied every 4-6 weeks depending on rainfall at label rate.	✓	✓	✓	✓					
Liquid Magnesium applied every 4-6 weeks depending on rainfall at label rate.	✓	✓	✓	✓					
Liquid Organics applied every 4-6 weeks depending on rainfall at label rate.	✓	✓	✓	✓					

Multiple applications of a product should be separated by 4 to 6 weeks.
Ensure all products are well watered in or applied prior to rainfall.
NPK/NK frequency may vary depending on rainfall & nutrient retention demands.



STRI Australia

Unit 112 / 45 Gilby Road Mt Waverley Victoria 3149 P +61 3 9558 6514 E info@striaustralia.com.au

Soil Nutrient Analysis

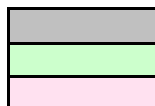
Ballarat Golf Club

9 October 2023

	Ideal Range	6th Tee	16th Tee	7th FWY	13th FWY					
pH (water 1:5)	6.0 - 7.0	7.3	7.4	7.5	7.4					
Elect Cond. (dS/m) (1:5)	< 0.60	0.05	0.05	0.09	0.07					
Phosphorus (Colwell) (ppm)	50 - 80	48	36	25	57					
Exchangeable cations										
Potassium (meq /100g)	0.5 - 0.6	0.2	0.1	0.1	0.1					
Calcium (meq /100g)	> 3.5	2.5	1.9	1.8	2.2					
Magnesium (meq /100g)	0.8 - 1.0	0.8	0.9	0.7	0.8					
Calcium Magnesium Ratio	2 - 5	3.1	2.1	2.5	2.9					
Sum of Cations (CEC) (meq%)	> 5	3.6	3.1	2.8	3.2					
% of CEC (Base Saturation)										
Potassium (%)	> 10	5	5	4	3					
Calcium (%)	60 - 70	69	62	64	68					
Magnesium (%)	18 - 23	22	30	25	24					
Sodium (%)	< 5	1	1	4	2					
Trace Elements										
Sulphur (ppm)	10 - 50	4	4	25	19					
Zinc (ppm)	1 - 10	2.2	2.0	1.1	2.9					
Copper (ppm)	1 - 10	0.4	0.4	0.2	0.3					
Manganese (ppm)	1 - 4	2.1	1.9	1.2	1.7					
Iron (ppm)	10 - 75	53	53	97	56					
Boron (ppm)	0.3 - 1.0	0.2	0.3	0.3	0.4					
Chloride (ppm)	< 100	10	10	20	13					
Organic matter (%)	2 - 5									
Sample Number		130449286	130449276	130696329	130449277					



low
medium
high



DISCLAIMER: Results are based on the analysis of the samples as received. Because of the variability of the sampling procedures, environmental and managerial conditions, the Company does not accept liability for lack of performance based on these recommendations. Recommendations are made in good faith based on the sample and information supplied.

STRI Australia

Unit 112 / 45 Gilby Road Mt Waverley Victoria 3149 P +61 3 9558 6514 E info@striaustralia.com.au