BEFORE THE COMMISSIONERS APPOINTED BY

THE OTAGO REGIONAL COUNCIL

In the Matter	of an application under RM19.151
Between	BSTGT Ltd and A P McQuilkin, N J McQuilkin, K L Skeggs, S A McQuilkin and G M Todd being Trustees of the A P McQuilkin Family Trust
	Consent Application RM19.151

BRIEF OF EVIDENCE OF DAVID RUSSELL HOWARD

GALLAWAY COOK ALLAN
LAWYERS
DUNEDIN

Solicitor on record: Phil Page
Solicitor to contact: Phil Page
PO Box 143, Dunedin 9054
Ph: (03) 477 7312
Fax: (03) 477 5564
Email: phil.page@gallawaycookallan.co.nz

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1. My full name is David Russell Howard, I am a Senior Agronomist at New Zealand Sports Turf Institute in Dunedin. My experience includes over 39 years of consultancy and training experience in the sports turf sector in NZ. I joined the New Zealand Sports Turf Institute in 1981 and moved to Dunedin in 1993. I provide turf agronomy advisory services to a range of clients (e.g. golf, cricket, bowls, councils, stadiums, schools, croquet) throughout the lower South Island.

2. I hold a Bachelor of Agricultural Science (Massey University) 1980.

3. I have been provided with a copy of the Environment Court's Code of Conduct for Expert Witnesses set out in the Courts Practice Note 2014. I confirm that the matters in this evidence are within my knowledge and expertise and I have not omitted to consider any material matter that could influence my opinion.

Background

4. NZ Sports Turf Institute has been asked to provide information about water use and irrigation of golf courses from a New Zealand perspective and how this compares with a pastoral situation.

Objective of watering on a golf course

5. Although both pastoral and turf systems grow grass and need supplementary water (irrigation) during periods of moisture deficit, there are differing requirements and expectations for each system.

    (a) Pastoral situation: In the case of the pastoral farming system, the objective is to maximise growth rate or yield.

    (b) Golf course: Although not requiring maximum growth, golfers require from the playing surfaces the highest turf density, excellence in presentation and adequate growth for recovery from any damage/wear incurred. Management practices including irrigation are based on achieving the minimum growth necessary to achieve these stated objectives.

(c) Conclusion: Golf course watering is based on applying water to the irrigated turf areas:

(i) With the highest level of uniformity. A coefficient of uniformity (measurement of how uniform water is applied to a turf area) of 80% or better is required.

(ii) Consented water volumes are based on weather data, impacts etc. However, from a usage perspective, best practice irrigation should be based on maintaining soil moisture levels between site specific target soil moisture levels.

(iii) Overwatering and the resultant lush growth will not provide the key playing requirements of a golfing surface, namely;

(1) All golf surfaces - firmness, tight and uniform lie

(2) Greens - trueness of ball roll and adequate green speed

Grasses used on golf courses in the lower South Island

6. Generally, there is a difference in grass types used on turf as opposed to pasture. In terms of water use and irrigation there are four key considerations;

(a) Grass type

(b) Surface type

(c) Grass leaf height

(d) Root depth

7. The comparison of these items between pasture and turf are summarised below.

Item	Turf	Pasture [Note 1)]
Grass type	Browntop (Agrostis capillaris) Fine fescue (Festuca sp) Water use [Beard,Turgeon] • Turgeon identified that fine fescue has moderate to good	Ryegrass (Lolium sp) Clover (Trifolium sp)

	drought tolerance, which is better than ryegrass. • Beard found that water use by fine fescue was classified as medium, while ryegrass was classified high when grown in their respective climate regions and preferred management regime.	
Surface type	Beard noted that denser turf canopies and low growing grasses, used on fairways and greens used less water than more vigorous upright growing grasses which had a lower density.	
Grass length	Short cut cool season grasses such as browntop and fescue used on turf are known to use less water than a pastoral situation. In simple terms wind – runs over the top of turf canopies resulting in less water use than more upright growing grasses. **In turf, best practice guidelines identify that turf loses at least 20% less water due to evapotranspiration than pastoral length grass.** Studies have also shown that irrigating turf areas using water amounts less than maximum evapotranspiration loss, e.g. 60-80% ET in the summer and 40-60% in the autumn could be undertaken on fairway cut turf without being detrimental to the overall turf quality (B Huang, 2012)	Ryegrass pasture because of its height, rapid growth and more open density uses approximately 20% more water than turf, i.e. wind/air moves through the turf canopy increasing water loss.
Root depth	Root depth on turf is as a result of mowing heights and surface compaction considerably shorter than pasture. With the exception of the rough, typical root depths on golf courses range from 50 to 120mm. **The consequence is that turf systems have less buffering capacity to survive dry periods and on average are watered more frequently than pasture.**	Ryegrass/ clover system would typically have root depths in excess of 250mm and consequently have a greater inherent water storage to allow the plant to survive during periods of moisture deficit.
Note 1	For a pastoral system it accepted a range of plants will be used. However, for comparison purposes the norm, rye/clover has been considered.	

Soil type and available moisture

8. Pastoral situation: Pastoral areas are based on essentially existing (except fertility) soil types.

9. Turf situation: To meet the expectations of golfers, some turf areas on the golf course use highly modified rootzones. On greens and tees the norm is to use sand. Sand has very limited moisture storage as compared with normal 'mineral soils'.

Soil texture of the rootzone	Typical plant available water holding capacity for a 300mm deep root system	
	Range (mm)	Average (mm)
Sand	Up to 20mm	15
Silt loam	53 to 56	53
Clay loam	48 – 53	51

10. Conclusion: The combination of soil type and shallow root systems, means turf areas typically need to be watered more frequently than a pastoral system.

Irrigated area

11. While the "playing areas" (greens, tees, fairways and small area of the rough) of a golf course are normally irrigated on NZ golf courses, there are large areas of land that remain unirrigated. These areas normally have no or minimal management undertaken and are either planted in trees or the grasses which are left to seed over summer to provide a textural and colour contrast to the playing areas.

    (a) Pastoral system: The norm on a pastoral system in a similar environment is to water most of the farm to meet production goals.

    (b) Turf system: Typically, only 40 – 60% of the total golf course (average area of 18 hole golf course is approx.50 – 60ha) is irrigated and is made up as follows:

        (i) Greens – approx. 4-6% of total golf course area

        (ii) Tees – approx. 2-3% of total golf course area

(iii) Fairways/primary rough -approx. 35-45% of total golf course area

Optimising water use efficiency

12. Using water correctly on a golf course is not only important from an ecological and plant health perspective, it is also important for achieving the desired firm playing performance requirements for golf.

13. Overwatering and maintaining the profiles too wet will result in soft spongy greens and fairways susceptible to disease invasion and poor turf health and an ecological shift away from the desired slower growing, more drought tolerant grasses such as fine fescues.

14. Hence there is an incentive to avoid overwatering due to these detrimental downstream effects.

15. Golf courses, given expectation of their playing surfaces adopt a number of practices which differ significantly from pasture that assist to optimise water use and include:

    (a) Using moisture measuring devices

    (b) They allow a golf club to develop site specific soil-based moisture levels for each turf area and irrigate to achieve these levels. (Batchelor, 2014; Sims 2017). Research showed that using active monitoring could result in 40 – 50% saving in water use (Connellan, 2013). Turf managers in NZ have also achieved significant water savings once they use active monitoring (moisture meters) for irrigation scheduling and still maintain good plant health (in some cases better) as well as playing quality expectations.

    (c) Thatch control

    (d) Golf clubs actively encourage/improve infiltration by managing thatch and with aeration treatments such as coring.

    (e) Dry patch

(f) Wetting agents are routinely used to manage dry patch and assist in achieving uniform rewetting of soil profiles.

(g) Irrigation maintenance

(h) Regular maintenance and weekly checking of irrigation operation over the summer all assist with effective water use.

(i) Unlike many pastoral systems, irrigation is undertaken at night when water losses due to evapotranspiration are lowest and more effective wetting of the profile is achieved.

Non watering uses

16. There are situations on golf courses when water is used in addition to irrigating the turf. This would include water used to wash in products applied during the growing season (not necessarily all year round), water used to apply products and also cleaning equipment.

Barley Station

17. I have visited the golf course on Barley Station on the Crown Terrace in November 2017. I am generally familiar with the layout and turf type, on that site.

18. I am satisfied that the evidence I give above on the expected differences between irrigation water demand between golf course turf and irrigated pasture are applicable to the Barley Station situation.

19. I would expect, if the land occupied by golf course were to revert back to irrigated pasture or cropping then the likely seasonal water demand would increase substantially.

20. I am advised that on 14 March 2021, Barley Station's consultant wrote to the ORC advising:

> *We have extracted data from the irrigation system and found that the maximum volume used for irrigating the golf course over the past 6 years was 1,949.43 m3/ha. At the time of writing this letter, 36 ha of paddock is occupied by the golf course, of which 20 ha is irrigated. Based on this, the maximum annual irrigation demand for the golf course should be around 38,989 m3/yr. If this land had remained in*

pasture then the average annual irrigation demand would be 274,960 m3/yr.

21. Although I have not been asked to prepare an irrigation demand estimate for the golf course, in broad terms I expect that based on my turf experience that pasture will use more water than turf.

References

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3. Huang B. 2012. Water: less is best. NZ Turf Management Journal, Autumn, 2012 pp14-18

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6. Connellan, G. 2013.Water Use Efficiency for irrigated Turf and Landscape. Published by CSIRO Publishing, 2013.p 287.

Author **David Howard** **Senior Regional Agronomist – Dunedin**	Peer review **David Ormsby** **Senior Regional Agronomist - Waikato**

Date:17th March ,2021

David Howard