CITY OF GERALDTON – GREENOUGH

REPORT ON WONTHELLA OVAL

JANUARY 2010

SPORTS TURF TECHNOLOGY

Report prepared by
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INTRODUCTION

This report was commissioned by the City of Geraldton – Greenough to:

- Investigate the proposed ground rationalization plan and the potential impact of additional usage on the turf quality at Wonthella Oval.
- Conduct a detailed assessment of the existing turf condition and management practices at Wonthella Oval.
- Make recommendations as per these findings to manage the proposed additional usage at Wonthella Oval.
- Provide cost estimates for implementing these recommendations.

The site investigation at Wonthella Oval was carried out on the 18th of November 2009.

Background information provided by the City of Geraldton - Greenough

The proposed ground rationalization plan involves the permanent closure of Greenough Oval and transferring the existing ground usage to Wonthella Oval. The following table outlines the current level of usage on both ovals.

Season	Activity	Wonthella Oval	Greenough Oval
Winter	Football matches	Saturday every week (9am-12pm) Sunday every second week (10am-5pm)	Saturday every week (9am-12pm) Sunday every second week (10am-5pm)
	Football training	4 days per week (4-7pm)	4 days per week (4-7pm)
Summer	Cricket matches	Saturday and Sunday every week (9am-5pm)	-
	Touch Football	-	2 days per week (5.30-10pm)

FINDINGS OF THE SITE INVESTIGATION

Turf Condition

At the time of inspection, the playing surface was in excellent condition. There was a full cover of turf, consisting of a mixture of saltene and couch, with a small amount of kikuyu. The playing surface was smooth, with no potholes or bare patches. The turf was fully recovered from football wear damage, and there was no re-turfing necessary. The turf had also regenerated rapidly following scarifying approximately three weeks prior to inspection, indicating that it was healthy and actively growing.

Based on the turf condition at the time of inspection, the oval was found to be coping well with the existing level of usage under the current turf management regime. However, it was not possible to assess the extent of winter wear damage due to the timing of the inspection. The most intensive wear damage occurs during the football season, when the turf growth and wear recovery are naturally slower.

Given the turf condition at the time of inspection, it is anticipated that the oval should have the capacity to carry additional usage. The oval currently has a high level of usage during the football season, with training four days per week and matches every weekend. The proposed ground rationalization will impose a significant amount of additional usage, leading to more severe wear damage than is currently the case.

To accommodate the proposed increase in ground usage, it will be necessary to implement changes to the turf management regime. This would involve increasing the inputs of fertilisers, soil amendments and wetting agents; more intensive turf renovation; re-turfing worn areas if necessary; and improving the water quality for irrigation.

Another consideration is the additional wear damage during winter on the turf wicket block, which should be protected from football training in wet weather.

Soil Profile

The oval has been constructed with layer of free draining sand, ranging in depth from approximately 25-45cm, over a slow draining sub-soil. The particle size distribution of the existing sand is within the ideal range for a turf root zone. The depth of sand should provide adequate drainage capacity in most circumstances. However, the shallower depth of sand found at the southern end may have contributed to the previous drainage problems on the southeastern side of the oval.

The most limiting factor for drainage at the time of inspection was the mat layer on the surface of the root zone. The proportion of fine organic matter to sand in the mat layer is excessive. As sand is no longer the primary medium on the surface of the root zone, it will not perform like a typical free draining sand profile. The surface infiltration rate at the time of inspection was found be below the acceptable rate for a playing field.

Excessive mat layer development is most detrimental when the surface is exposed to heavy traffic in wet conditions. The mat layer becomes compacted or sealed, which impedes water movement and causes the surface to stay wet for extended periods, increasing the risk of the ground becoming excessively soft and muddy.

To assist the winter performance of the oval with the proposed increase in usage, the existing mat layer needs to be alleviated. This is done most effectively through renovation activities, including scarifying, shallow coring with hollow tines, and applying sand top dressing. It is essential to break through the restrictive layer to improve water movement into the profile, and incorporate sand to dilute the organic matter.

The sand profile below the mat layer, from 100-200mm depth, was found to have high hardness readings on the penetrometer, and would benefit from de-compaction. This requires a different process to the renovation activities outlined above, such as deep coring with solid tines.

Water quality

The Water Corporation bore adjacent to the effluent treatment plant provides the best quality groundwater for turf irrigation in the vicinity of Wonthella Oval. The salinity level is slightly high (>1000mg/L), but is acceptable for turf irrigation. The water also has a high nutrient content that contributes to turf growth. Unfortunately, there is insufficient capacity in this bore to meet the total water requirements at Wonthella Oval, and the water supply needs to be supplemented with other inferior quality bore water.

Bores 1 and 2 have extremely high salinity levels (>3000mg/L) and are unacceptable for turf irrigation. The blended water from the three bores used to irrigate the oval has an estimated salinity level of 2300mg/L, which is classified as a very high salinity hazard for turf irrigation.

While the oval is currently performing well with this water supply, the salinity will become more critical with the proposed increase in ground usage. The preferred option would be to install a second bore adjacent to the effluent treatment plant with sufficient capacity to replace the water supplied by Bores 1 and 2.

The sodium level is high in the effluent bore and extremely high in Bores 1 and 2. As a result, the irrigation water has caused a build up of sodium in the soil. Excessive sodium has a detrimental impact on soil structure, making it more prone to compaction and drainage problems. This should be treated with regular applications of gypsum during the irrigation season.

Nitrogen from the effluent bore is making a significant contribution to turf growth, and fertilising should generally not be required during the irrigation season. However, it will be necessary to apply fertiliser during the peak period of ground usage, from April to September, when there will be minimal or no irrigation depending on rainfall.

RECOMMENDATIONS

The following recommendations relate to managing the oval with additional usage under the proposed ground rationalization plan.

Water supply

- The City should install a new production bore adjacent to the Water Corporation effluent treatment plant, to supplement the existing supply to Wonthella Oval from the Water Corporation bore.
- Bores 1 and 2 should not be used on Wonthella Oval due the extremely high salinity, provided there is a suitable quality alternative water source available.

Renovation

- The following turf renovation work should be undertaken annually. The preferred timing is around November for turf regeneration, however the temporary disruption to ground users may need to be considered.
    - Scarify in two directions with blades penetrating to a depth of 25mm below the soil surface, and sweep up greenwaste.
    - Low mow at a cutting height of approximately 10mm and pick up clippings.
    - Core the oval with hollow tines to a depth of 75mm, with a core hole diameter of 25mm on a spacing of 100-125mm, and sweep up cores.
    - Apply 10mm of sand topdressing using Catalano's Bullsbrook sand. Rub in the sand to backfill the core holes and spread evenly over the surface.
- De-compact the oval to a depth of 200mm, every 6 weeks during the football season. This can be achieved using the Verti-Drain with 18mm solid tines set with a 10degree kick.
- The City should consider purchasing a Verti-Drain machine to provide the flexibility of undertaking coring work 'in house'. The advantage of the Verti-Drain is that the tines are interchangeable, so it can be used for hollow tine coring at renovation and solid tine coring for de-compaction.

Fertilising

- Apply iron and manganese as a foliar spray, such as Ferrous Sulphate and Manganese Sulphate at 25kg/Ha, every two months between April and September.
- Apply granular nitrogen fertiliser, such as Sulphate of Ammonia at 200kg/Ha, every two months between April and September, alternating with the foliar iron and manganese.
- Monitor turf nutrient requirements with leaf tissue analysis three times per year, in autumn, winter and spring.

Soil amendment

- Apply granulated gypsum at 2 t/Ha, at least twice during the irrigation season.
- Monitor the soil salinity and sodium levels with soil analysis in spring and autumn.

Soil wetting agent

- Apply soil wetting agent, such as Stamina 90 at 25 L/Ha, every two months during the irrigation season.

Re-turfing

- Replace turf as required in worn areas, such as goal squares, centre circle and in the centre corridor, at the end of the football season using roll-on Velvetene.

COST ESTIMATE

Maintenance Activities	Estimated Cost*
Renovation	
Scarify and sweep in two directions	$5 000
Low mow and pick up	$1 000
Coring - hollow tines and sweep	$2 500
Sand (300 tonnes x $20/t)	$6 000
Top dressing - spread and level	$3 500
De-compaction (5 times per year)	$7 500
Fertilising	
Granular Nitrogen (3 apps. per year)	$2 000
Foliar Iron and Manganese (3 apps. per year)	$3 000
Soil amendment	
Gypsum (2 apps. per year)	$9 000
Soil wetting agent	
Liquid (4 apps. per year)	$4 000
Re-turfing	
Remove existing turf and replace with roll-on saltene (500m^2 x $20/$m^2$)	$10 000
Total	**$53 500**

* Cost estimates are a guide only, based on typical contracting rates excluding mobilization charges and travel expenses to Geraldton.

Capital Items	Estimated Cost
Bore*	
Construct new bore and install pump	$25 000
Electrical control cabinet (not including power connection)	$15 000
Install connecting pipework	$50 000
Verti-Drain	
Redexim Charterhouse 75 series 2.1 m width, including sets of 18mm solid tines and 25mm hollow tines	$50 000
Total	**$140 000**

*Cost estimates based on information provided by Peter Buck.

RESULTS OF THE SITE INVESTIGATION

Site Observations

The oval was in excellent condition, with a full cover of healthy and actively growing turf. The turf type was predominantly saltene, mixed with couch and some patches of kikuyu around the wicket block.	
The oval had a smooth playing surface with no potholes or obvious undulations. There was an even turf cover with no bare patches. Re-turfing was not required after the football season, as the turf had fully recovered from wear damage.	
The turf density was generally very good, having recovered rapidly from scarifying approximately three weeks before the inspection. The high growth rate of turf is the response to the high concentration of nitrogen in the bore water.	
There was slight yellowing in the saltene on the eastern side of the oval, indicating symptoms of iron and manganese deficiency. This was not a concern at the time of inspection, but may cause a decline in turf condition during winter.	

The yellowing was more pronounced in the patches of kikuyu, indicating that kikuyu is more prone to iron and manganese deficiency than couch and saltene.	
There were symptoms of localized dry patch on the northwest side of the oval, with turf wilting from moisture stress. Soil wetting agent had been applied in the previous week, however the soil was found to have very severe water repellence.	
There was high soil moisture content in the good areas (29.8%).	
The wilted areas had lower soil moisture content (17.1%).	

The turf root zone has developed a defined layer of highly concentrated fine organic matter (mat layer) on the surface. The mat layer has the potential to impede water movement into the soil and create soft and muddy surface conditions in wet weather.	
The depth of mat layer was typically 20-30mm, with up to 50mm in some areas. There was generally clean sand below the mat layer. Additional renovation activities are required to treat the mat layer, such as hollow-tine coring and sand top dressing. A coring depth of approximately 75mm would be sufficient to target the mat layer.	
The surface infiltration rate was measured at 50mm/hr in front of the northern goal square. This is below the acceptable level of 100mm/hr. The infiltration rate would be expected to decline in high wear areas during the football season, due to the mat layer becoming compacted.	
Soil profile - northern end The depth of sand is approximately 45cm over clay loam sub-soil.	

Soil profile - eastern wing The depth of sand is also approximately 45cm over clay loam sub-soil.	
Soil profile - southern end The sand depth is shallower, with approximately 25cm of sand over clay loam subsoil. There have been drainage problems in the past on the southeastern side of the oval, which could possibly be related to the shallower depth of sand.	
Soil profile - western wing The depth of sand is approximately 40cm over clay loam sub-soil.	

Laboratory Results

Leaf Analysis

Client	**City of Geraldton-Greenoug**	**Sample number**	**LOP09180**
Site ID	**Wonthella Oval**	**Turf type**	**Saltene**
Sample date	**18-Nov-09**		

LEAF ANALYSIS RESULTS

		Deficient	Marginal	Sufficient	High
Nitrogen (%)	3.3				
Phosphorus (%)	0.35				
Potassium (%)	2.2				
Calcium (%)	0.46				
Magnesium (%)	0.33				
Sodium (%)	0.85				
Sulfur (%)	0.86				
Zinc (ppm)	42				
Copper (ppm)	12				
Iron (ppm)	81				
Manganese (ppm)	40				

Comments

- The nitrogen level in the turf was in the high range due to the high nitrogen content of the bore water used for irrigation. Nitrogen fertilising is not required during the irrigation season.
- The turf was deficient in iron due to the alkaline soil conditions and the high growth rate of the turf.
- The turf is also prone to manganese deficiency due to the high soil pH.
- The high sodium and sulphur levels in the turf were caused by the bore water.
- All other nutrients were sufficient for turf growth.

Soil Analysis

Client	**City of Geraldton-Greenough**	**Sample number**	**U1S09128**
Site ID	**Wonthella Oval**		
Sample date	**18-Nov-09**		

SOIL ANALYSIS RESULTS

Soil pH (calcium chloride)	7.9	Very Acidic / Acid / Alkaline / Very Alkaline
Electrical conductivity (ms/cm)	0.408	Non Saline / Slighlty Saline / Moderately Saline / Very Saline
Phosphorus (ppm)	19	Low / Moderate / High / Very High
Phosphorus retention index	1	Weak / Moderate / Strong / Very Strong
Potassium (ppm) (3% saturation)	125	Low / Moderate / High / Very High
Calcium (ppm) (58% saturation)	988	Low / Moderate / High / Very High
Magnesium (ppm) (20% saturation)	209	Low / Moderate / High / Very High
Sodium (ppm) (18% saturation)	354	Low / Moderate / High / Very High
Cation exchange capacity (meq/100g)	8.5	Low / Moderate / High / Very High

Comments

- The soil pH is high, which limits the availability of the trace elements iron and manganese.
- Soil salinity (0-100mm depth) is in the slightly saline range, despite the very high salinity of the bore water.
- Sodium has accumulated to a very high level in the soil, due to the high sodium content of the bore water, making the soil prone to compaction. This should be treated with gypsum (calcium sulphate).
- The levels of phosphorus and potassium in the soil are sufficient for turf growth and these nutrients should generally not be required with fertilising.

Particle Size Distribution

Sieve size mm	Description	Wonthalla Oval (turf root zone)	Catalano's Screened Sand	Catalano's Loam Sand	Catalano's Bullsbrook Sand	**Ideal range %**
1.0-2.0	Very Coarse Sand	2.8	6.7	6.4	3.7	**0-10**
0.5-1.0	Coarse Sand	16.9	26.3	24.6	17.4	**0-20**
0.25-0.5	Medium Sand	54.1	28.2	29.8	52.0	**55-90**
0.10-0.25	Fine Sand	19.5	25.7	22.4	15.5	**0-20**
0.05-0.1	Very Fine Sand	2.2	7.0	7.2	8.6	**0-10**
< 0.05	Silt/Clay	4.1	6.0	8.7	2.7	

Note: The analysis reports are shown on the following pages.

Comments

- The particle size distribution of the existing soil type at Wonthella Oval is within the ideal range for a turf root zone. This is based on the specification for P-Type sand, which is the industry standard benchmark in Australia.
- The locally available soils supplied by Catalano's were tested for their suitability as top dressing materials. Catalano's screened sand and loam sand were both found to have unsuitable particle size distribution of for use on turf.
- The particle size distribution of Catalano's Bullsbrook sand is close to the existing soil at Wonthella Oval and would be suitable for top dressing.

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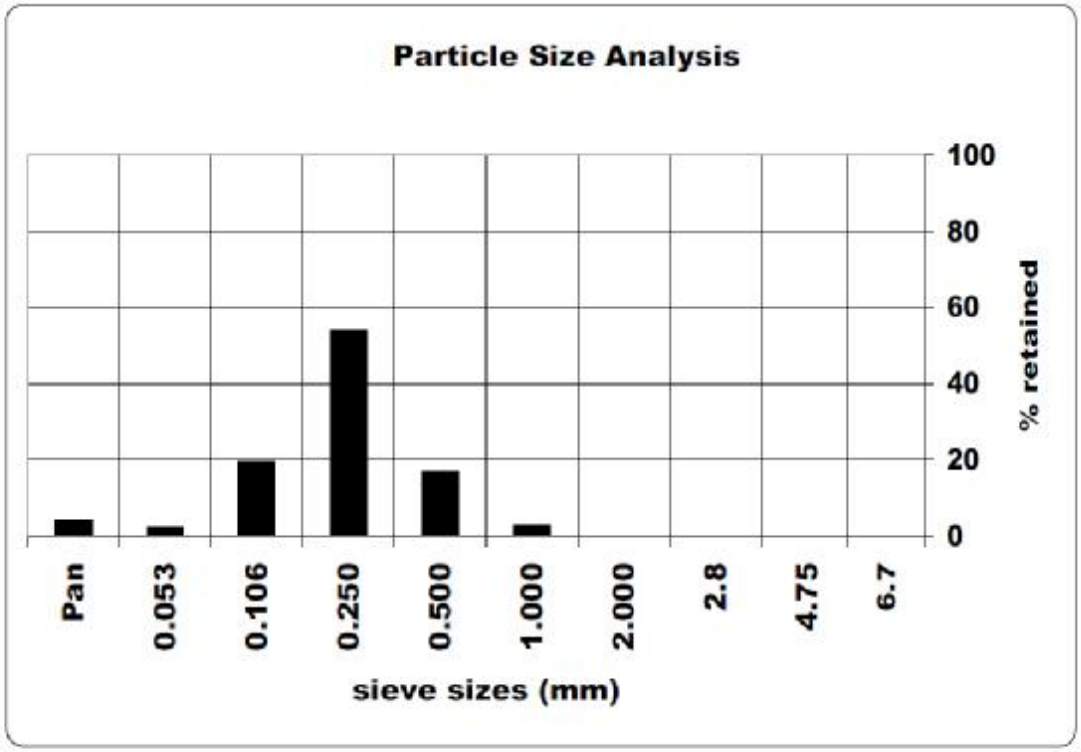
Particle Size Analysis

client :	SPORTS TURF TECHNOLOGY (WA)	job No:	GS1155/1
project :	CITY OF GERALDTON	report No.	CS
location :	WA	test date:	23/11/2009
sample Id:	WONTHALLA SAND	Sample No. : # 43	date sampled : -
material description :	SILTY SAND, fine to coarse, red brown		



sieve size mm	% retained
6.7	0
4.75	0.0
2.8	0.0
2.000	0.3
1.000	2.8
0.500	16.9
0.250	54.1
0.106	19.5
0.053	2.2
Pan	4.1

D(15)	0.177
D(85)	0.582

test procedure : AS1289 3.6.1, 2.1.1
Note: Sampled by client, tested "as received"

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NATA Accredited Laboratory No. 15055

Ernst Gmehling
Approved Signatory
Date 25-Nov-09

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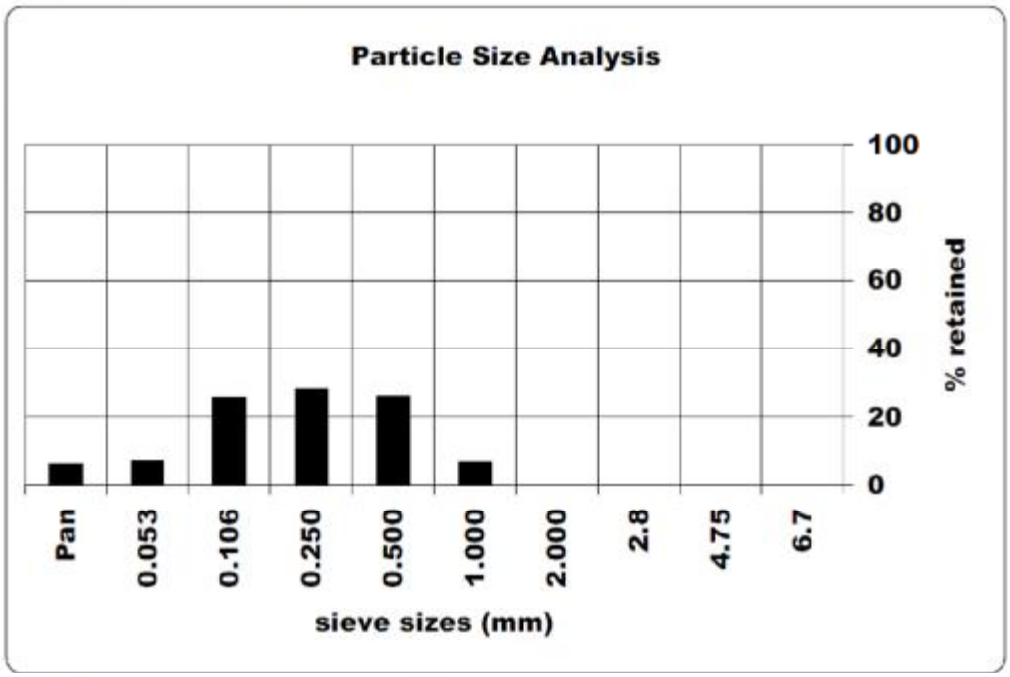
Particle Size Analysis

client :	SPORTS TURF TECHNOLOGY (WA)	job No:	GS1155/1
project :	CITY OF GERALDTON	report No.	CT
location :	WA	test date:	23/11/2009
sample Id:	CANTALANO SCREENED SAND	Sample No. : # 44	date sampled : -

material description : SAND, fine to coarse, red brown



sieve size mm	% retained
6.7	0
4.75	0.0
2.8	0.0
2.000	0.0
1.000	6.7
0.500	26.3
0.250	28.2
0.106	25.7
0.053	7.0
Pan	6.0

D(15)	0.117
D(85)	0.761

test procedure : AS1239 3.6.1, 2.1.1
Note: Sampled by client, tested "as received"

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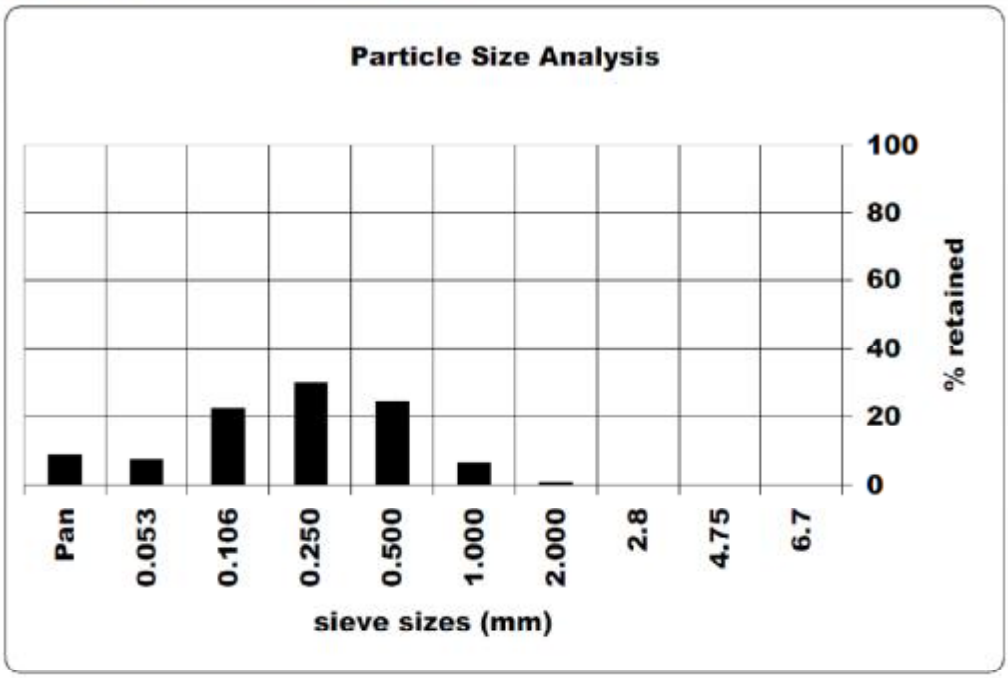
Particle Size Analysis

client :	SPORTS TURF TECHNOLOGY (WA)	job No:	GS1155/1
project :	CITY OF GERALDTON	report No:	CR
location :	WA	test date:	23/11/2009
sample Id:	CATALANO LOAM SAND	Sample No. : # 42	date sampled : -
material description :	SILTY SAND, fine to coarse, red brown		



sieve size mm	% retained
6.7	0
4.75	0.0
2.8	0.0
2.000	0.7
1.000	6.4
0.500	24.6
0.250	29.8
0.106	22.4
0.053	7.2
Pan	8.7

D(15)	0.098
D(85)	0.761

test procedure : AS1289 3.6.1, 2.1.1
Note: Sampled by client, tested "as received"

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Date 25-Nov-09

Water Analysis

	Effluent Bore	Bore 1	Bore 2
pH	7.0	7.3	7.4
Elect. Cond. (dS/m)	2.03	**6.05**	**8.84**
Salinity TDS (mg/L)	1116	**3327**	**4862**
Ammonium (mg/L)	**16.3**	< 0.1	< 0.1
Nitrate (mg/L)	**7.4**	**7.7**	**8.0**
Phosphorus (mg/L)	0.81	0.8	0.3
Potassium (mg/L)	32.8	41.9	53.8
Sodium (mg/L)	324	**1087**	**1677**
Chloride (mg/L)	514	**2110**	**3334**
Magnesium (mg/L)	43	197	229
Calcium (mg/L)	81	163	298
Sulphur (mg/L)	26	96	153
Copper (mg/L)	< 0.05	< 0.05	< 0.05
Zinc (mg/L)	< 0.05	< 0.05	< 0.05
Manganese (mg/L)	0.45	< 0.05	< 0.05
Iron (mg/L)	0.05	0.07	< 0.05
Boron (mg/L)	0.41	0.76	0.83

Comments

- The water quality in Bores 1 and 2 is unacceptable for turf irrigation, due to the extremely high levels of total salinity, sodium and chloride.
- The salinity level in the effluent bore is in the high range, but is acceptable for turf irrigation.
- Based on a blend of 60% Effluent bore, 20% Bore 1 and 20% Bore 2, the salinity of the irrigation water would be approximately 2300 mg/L. This is in the very high range for turf irrigation and it would be beneficial to reduce the salinity level.
- Nitrogen in the effluent bore is making a significant contribution to turf growth.

Soil Water Repellence

	Water Repellence Rating	Category
0-50mm depth	4	Very Severe

Comment

- The soil is prone to developing dry patch. Soil water repellence was still very severe after the wetting agent application prior to the inspection.

Soil Salinity (dry patches)

	Electrical Conductivity	Category
0-50mm depth	72 mS/m	Moderately Saline

Comment

- The soil salinity is elevated on the surface of the dry patches, which increases the moisture stress on the turf.

Rootzone Organic Matter

Mat Layer (up to 50mm depth)	Wonthella Oval	Acceptable Level
Volume of Organic Fines	72 %	< 30 %
Volume of Sand	28 %	> 70 %

Comments

- The high concentration of organic matter in the mat layer leaves the surface prone to becoming muddy and compacted under traffic in wet conditions, reducing the surface infiltration rate.

Nematode Analysis

Common Name	*Genus*	*Nematodes /100ml soil*	
		Wonthella Oval	*Threshold Level*
Sting	*Belonolaimus.*	None detected	25
Dagger	*Xiphinema*	None detected	40
Stubby Root	*Paratrichodorus.*	None detected	100
Lesion	*Pratylenchus.*	None detected	150
Sheath	*Hemicycliophora*.	1	200
Lance	*Hoplolaimus*.	None detected	200
Stunt	*Tylenchorhynchus*	None detected	300
Ring	*Macroposthonia*	None detected	300
Spiral	*Helicotylenchus*	1	400

Comment

- The numbers of plant parasitic nematodes were negligible and of no concern.

Field measurements

Infiltration Rate

	Wonthella Oval	Acceptable Level
Surface (Northern goal square)	50 mm/hour	> 100 mm/hour

Comment

- The high wear areas are prone to developing drainage problems caused by low surface infiltration during rainfall periods in winter.

Soil hardness

STT Penetrometer	Wonthella Oval	Acceptable Level
0-100mm depth	71 Nm	< 90 Nm
100-200mm depth	118 Nm	

Comment

- The soil profile is prone to becoming hard at depth.