

**YOUR  
ISTRC SYSTEM™  
REPORT**

**SAMPLE REPORT  
GOLF CLUB**



March 19, 2008  
Course: Green #5  
Course: Green #7  
Course: Greens 1 & 9  
Lab ID: 08020029

Presented To:

**Mr. [REDACTED], CGCS**

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March 19, 2008

Mr. [REDACTED], CGCS  
[REDACTED] GOLF CLUB  
[REDACTED]

re: Lab ID: [REDACTED]; ISTRC SYSTEM™ BenchMarking of undisturbed core samples from **The [REDACTED] Course: Green #5 [back center] – 1<sup>st</sup>, 2<sup>nd</sup>, & 3<sup>rd</sup> tiers; The [REDACTED] Course: Green #1 [back right] – 1<sup>st</sup>, 2<sup>nd</sup>, & 3<sup>rd</sup> tiers; Green #9 [back center]; and The [REDACTED] Course: Green #7 [center].**

Dear [REDACTED];

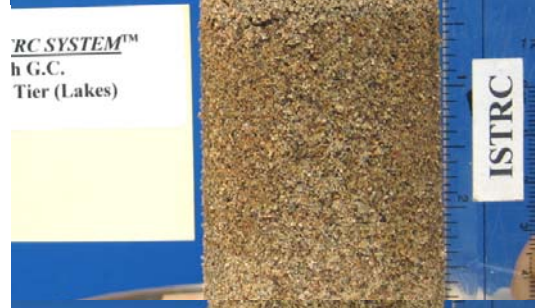
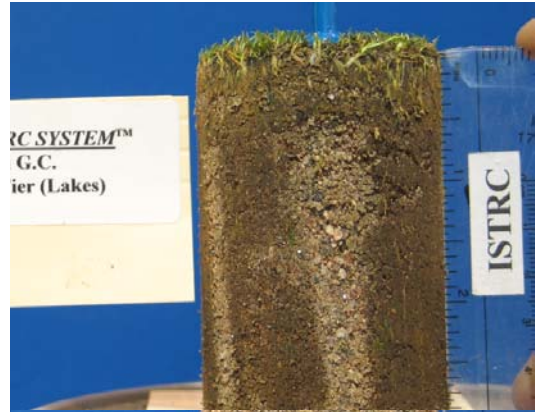
We have completed the ISTRC SYSTEM™ BenchMarking of the undisturbed core samples taken from **The [REDACTED] greens.**

The laboratory data can be found in its entirety at the end of this report. There are two sets of data. The first set of data consists of the physical evaluation, the evaluation of the root systems, and the measurement of the organic matter by layer. The second set of data contains the textural & particle size analysis. The textural analysis measures the percentage of gravel, sand, silt and clay comprising the soil. The particle size distribution analyzes the size distribution of the sand.

On the following pages we will discuss each of the tested greens. Included with the discussion are photos of the greens, selected time lapse photos of the root zone, our Target Table with the green's physical properties, and an inch-by-inch analysis of the Textural & Sand Particle Size Distribution. Tables 1 - 8 compare the current test results to their previous testing and to our recommended target range for well-drained, sand-based greens. The time lapse photos were taken to monitor the drying process of your greens and to provide visual confirmation of the tested physical properties. We have found the photos are also an excellent indicator of layering and/or variations in water retention within the profile. As a general rule the darker the sample the higher the organic content & water holding properties.

The [REDACTED] Golf Club consists of three 9-hole golf courses – [REDACTED]. The greens were originally built in the early 1980's using a relatively coarse root zone sand and established with 328 bermuda. Samples from [REDACTED] Green #5, [REDACTED] Greens 1 & 9, and [REDACTED] Green #7 were previously tested in February 2007 and their test results have been included within the report as a basis for comparison. The primary objective for testing is to document any changes in the greens' physical properties and/or particle distribution as a basis for monitoring the aging of the root zone and evaluating the effectiveness of the current cultural practices.

## Green #5 – ██████ Course



Green #5's low 1<sup>st</sup> tier infiltration rate coupled with a distinct imbalance in the air & water pores exceeding a 3:1 water to air ratio are classic symptoms of a high percentage of OM & buried thatch. The distinct contrasts in the 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> tier physical properties as well as the differences in coloration further highlight the impact of the OM.

**Table 1.**

'+ ' improvement, '=' no change, '- ' regressed

Green #5	Well-Drained Greens	Comp. Index* +,=,-	March 2008	Feb. 2007	March 2006	March 2005	March 2004
<b>Infiltration Rate [In/hr]</b>	At least 6	-	2.21	11.77	2.98	5.08	10.15
<b>Subsurface Air Capacity [Non-Capillary Porosity]</b>	~20%	-	11.06%	16.13%	14.69%	14.15%	13.98%
<b>Water Porosity [Capillary]</b>	15% to 25%	-	36.45%	31.06%	32.44%	31.47%	31.79%
<b>Bulk Density [g/cc]</b>	~1.35 to 1.45	-	1.41	1.37	1.34	1.38	1.37
<b>Water Holding</b>	10% to 20%	-	25.93%	22.59%	24.26%	22.78%	23.19%
<b>Organic Content: 0 – 1"</b>	1.5% to 2.5%	-	3.64%	2.82%	3.33%	2.24%	2.75%
<b>Organic Content: 1 – 2"</b>	1.0% to 2.0%	-	2.36%	1.57%	1.81%	1.22%	1.79%
<b>Organic Content: 2 – 3"</b>	0.5% to 2.0%	-	1.12%	0.76%	1.01%	0.70%	0.98%
<b>Organic Content: 3 – 4"</b>	0.5% to 1.5%	-	0.88%	0.58%	0.80%	0.47%	0.76%
<b>Root Mass</b>	at least ½ in.	=	5/8 in.	5/8 in.	½ in.	½ in.	5/8 in.
<b>Feeder Roots</b>	at least 3.5 in. –med. density	-	3 ½ in. sparse	4 in. sparse	3 ½ in. sparse	3 in. sparse	3 ½ in. sparse

The 2<sup>nd</sup> & 3<sup>rd</sup> tier (4-8 & 8-12 in.) samples for [redacted] Green #5 and [redacted] Green #1 are in very good physical condition. The accelerated infiltration rates & air porosities describe greens with ample drainage once the water bypasses the upper 3 to 4 inches of the root zone. The water holding & water porosity properties in the lower root zone are relatively low and mirror the 2<sup>nd</sup> & 3<sup>rd</sup> tier organic contents at or below 0.21 percent.

**Table 2.** '+ improvement, '=' no change, '-' regressed

Green #5 2 <sup>nd</sup> tier (4-8 in.)	Well-Drained Greens	Comparison Index* +,-,=	March 2008	Feb. 2007	Feb. 2002
Infiltration Rate [In/hr]	10+	+	27.12 [excellent – short of problems with the gravel and/or drain tile the 2 <sup>nd</sup> & 3 <sup>rd</sup> tier physical properties should describe a green with excellent drainage once the water bypasses the upper 3 to 4 inches]	10.85	20.19
Subsurface Air Capacity [Non-Capillary Porosity]	At least 20%	+	28.52% [excellent]	21.23%	25.27%
Water Porosity [Capillary]	Less than 20%	=	11.96% [ok for a 2 <sup>nd</sup> or 3 <sup>rd</sup> tier sample – indicative of a mix with little to no organic matter]	11.62%	9.98%
Bulk Density [g/cc]	~1.40 to 1.50	+	1.60 [high but not unexpected given the coarseness of the particle distribution]	1.63	1.63
Water Holding	Less than 15%	=	7.49% [ok]	7.14%	6.12%
Organic Content: 4 – 5"	0.1% to 1.0%	=	0.06% [ok]	0.30%	0.23%
Organic Content: 5 – 6"	0.1% to 1.0%	=	0.02% [ok]	0.18%	0.14%
Organic Content: 6 – 7"	0.1% to 1.0%	=	0.01% [ok]	0.14%	0.11%
Organic Content: 7 – 8"	0.1% to 1.0%	=	0.02% [ok]	0.12%	0.10%
Root Mass	N/A	=	N/A	N/A	N/A
Feeder Roots	at least 3.5 in. –med. density	-	None	7 in. Sparse	None

**Table 3.** '+ improvement, '=' no change, '-' regressed

Green #5 3 <sup>rd</sup> tier (8-12 in.)	Well-Drained Greens	Comparison Index* +,-,=	March 2008	Feb. 2007	Feb. 2002
Infiltration Rate [In/hr]	10+	+	32.60 [excellent]	7.62	15.29
Subsurface Air Capacity [Non-Capillary Porosity]	At least 20%	+	28.60% [excellent]	19.77%	23.69%
Water Porosity [Capillary]	Less than 20%	-	20.44% [ok]	11.94%	9.98%
Bulk Density [g/cc]	~1.40 to 1.50	+	1.49 [significant improvement since last year – reflects a significant reduction in compaction]	1.64	1.60
Water Holding	Less than 15%	-	13.75% [ok]	7.26%	6.25%
Organic Content: 8 – 9"	0.1% to 1.0%	-	0.21% [ok]	0.07%	0.11%
Organic Content: 9 – 10"	0.1% to 1.0%	=	0.17% [ok]	0.07%	0.10%
Organic Content: 10 – 11"	0.1% to 1.0%	=	0.10% [ok]	0.06%	0.08%
Organic Content: 11 – 12"	0.1% to 1.0%	=	0.02% [ok]	0.07%	0.07%
Root Mass	N/A	=	N/A	N/A	N/A
Feeder Roots	at least 3.5 in. –med. density	=	None	None	None

## Green #1 – ██████ Course



**Table 4.** ‘+’ improvement, ‘=’ no change, ‘-’ regressed

Green #1	Well-Drained Greens	Comp. Index* +,-,=	March 2008	Feb. 2007	March 2006	March 2005	March 2004
<b>Infiltration Rate [In/hr]</b>	At least 6	+	0.87 [very low]	0.46	0.58	0.04	1.85
<b>Subsurface Air Capacity [Non-Capillary Porosity]</b>	~20%	=	9.90% [very low]	10.85%	10.08%	7.95%	7.83%
<b>Water Porosity [Capillary]</b>	15% to 25%	+	32.28% [high]	36.83%	41.29%	43.17%	41.15%
<b>Bulk Density [g/cc]</b>	~1.35 to 1.45	=	1.39 [high for the amount of OM – strong indicator of compaction]	1.36	1.30	1.27	1.37
<b>Water Holding</b>	10% to 20%	=	27.60% [high]	26.99%	31.82%	33.89%	29.97%
<b>Organic Content: 0 – 1"</b>	1.5% to 2.5%	-	3.14% [high]	2.38%	3.23%	2.93%	3.23%
<b>Organic Content: 1 – 2"</b>	1.0% to 2.0%	=	2.31% [high]	2.32%	2.95%	1.90%	2.48%
<b>Organic Content: 2 – 3"</b>	0.5% to 2.0%	=	1.93% [at our upper target range]	1.96%	1.89%	2.09%	1.75%
<b>Organic Content: 3 – 4"</b>	0.5% to 1.5%	=	1.32% [ok]	1.46%	1.13%	1.59%	1.41%
<b>Root Mass</b>	at least ½ in.	=	5/8 in.	5/8 in.	½ in.	½ in.	1/8 in.
<b>Feeder Roots</b>	at least 3.5 in. – med. density	-	3 in. medium	3 ½ in. sparse	3 in. sparse	3 ½ in. sparse	3 ½ in. sparse

Table 5.

+' improvement, '=' no change, '-' regressed

Green #1 2 <sup>nd</sup> tier (4-8 in.)	Well-Drained Greens	Comparison Index* +,-,=	March 2008	Feb. 2007	Feb. 2002
Infiltration Rate [ln/hr]	10+	+	18.17 [excellent]	11.77	20.19
Subsurface Air Capacity [Non-Capillary Porosity]	At least 20%	+	23.89% [excellent]	20.36%	25.27%
Water Porosity [Capillary]	Less than 20%	=	12.83% [ok]	11.82%	9.98%
Bulk Density [g/cc]	~1.40 to 1.50	+	1.62 [high but not unexpected given the coarseness of the particle distribution and the low total porosity at 36.72%]	1.67	1.63
Water Holding	Less than 15%	=	7.94% [ok]	7.06%	6.12%
Organic Content: 4 – 5"	0.1% to 1.0%	=	0.49% [ok]	0.37%	0.23%
Organic Content: 5 – 6"	0.1% to 1.0%	=	0.16% [ok]	0.23%	0.14%
Organic Content: 6 – 7"	0.1% to 1.0%	=	0.14% [ok]	0.14%	0.11%
Organic Content: 7 – 8"	0.1% to 1.0%	=	0.08% [ok]	0.11%	0.10%
Root Mass	N/A	=	N/A	N/A	N/A
Feeder Roots	at least 3.5 in. -med. density	-	None	1 root at 7 in.	None

Table 6.

+' improvement, '=' no change, '-' regressed

Green #1 3 <sup>rd</sup> tier (8-12 in.)	Well-Drained Greens	Comparison Index* +,-,=	March 2008	Feb. 2007	Feb. 2002
Infiltration Rate [ln/hr]	10+	-	29.42 [excellent]	41.54	15.29
Subsurface Air Capacity [Non-Capillary Porosity]	At least 20%	+	24.86% [excellent]	22.74%	23.69%
Water Porosity [Capillary]	Less than 20%	+	9.86% [ok]	11.17%	9.98%
Bulk Density [g/cc]	~1.40 to 1.50	-	1.59 [high]	1.55	1.60
Water Holding	Less than 15%	=	6.21% [ok]	7.22%	6.25%
Organic Content: 8 – 9"	0.1% to 1.0%	=	0.02% [as a general rule an organic content at or below 0.10% is the equivalent of a straight sand]	0.08%	0.11%
Organic Content: 9 – 10"	0.1% to 1.0%	=	0.01% [ok]	0.08%	0.10%
Organic Content: 10 – 11"	0.1% to 1.0%	=	0.01% [ok]	0.06%	0.08%
Organic Content: 11 – 12"	0.1% to 1.0%	=	0.07% [ok]	0.06%	0.07%
Root Mass	N/A	=	N/A	N/A	N/A
Feeder Roots	at least 3.5 in. -med. density	=	None	None	None

## Green #9 – ██████ Course



Over the years our testing & research has shown an excellent gauge of the overall health of the root zone is the balance between the air pores & water pores. The goal for the 1<sup>st</sup> tier (0-

4 in.) of a mature sand-based green would be a 1:1 air to water ratio; unfortunately with the combination of organic matter, buried thatch, and fines in the upper root zone Green #9 has reported nearly a 3:1 water to air ratio.

**Table 7.**

‘+’ improvement, ‘=’ no change, ‘-’ regressed

Green #9	Well-Drained Greens	Comp. Index* + , = , -	March 2008	Feb. 2007	Feb. 2003	Mar. 2002
<b>Infiltration Rate [In/hr]</b>	At least 6	+	3.27 [higher than February 2007 but remains well below our recommended target range of at least 6 in./hr.]	0.63	2.53	1.12
<b>Subsurface Air Capacity [Non-Capillary Porosity]</b>	~20%	=	12.99% [low]	12.47%	11.64%	9.64%
<b>Water Porosity [Capillary]</b>	15% to 25%	=	37.75% [high – nearly a 3:1 water to air ratio]	37.19%	32.41%	38.84%
<b>Bulk Density [g/cc]</b>	~1.35 to 1.45	-	1.33 [lowest of the 1 <sup>st</sup> tier samples – indicative of a high percentage of OM & thatch]	1.36	1.35	1.31
<b>Water Holding</b>	10% to 20%	=	28.37% [high]	27.43%	24.06%	29.56%
<b>Organic Content: 0 – 1"</b>	1.5% to 2.5%	-	3.41% [high]	2.99%	3.72%	2.48%
<b>Organic Content: 1 – 2"</b>	1.0% to 2.0%	-	2.69% [high]	2.34%	2.02%	1.70%
<b>Organic Content: 2 – 3"</b>	0.5% to 2.0%	-	1.96% [at our upper target range]	0.67%	1.31%	1.14%
<b>Organic Content: 3 – 4"</b>	0.5% to 1.5%	=	1.38% [ok]	1.15%	0.67%	1.06%
<b>Root Mass</b>	at least ½ in.	=	5/8 in.	5/8 in.	½ in.	½ in.
<b>Feeder Roots</b>	at least 3.5 in. –med. density	-	3 ½ in. sparse	4 in. sparse	3 ½ in. sparse	4 in. sparse

## Green #7 – ██████ Course



Table 8.

'+ ' improvement, '=' no change, '- ' regressed

Green #7	Well-Drained Greens	Comp. Index* +, =, -	March 2008	Feb. 2007	March 2006	March 2005	March 2004
<b>Infiltration Rate [In/hr]</b>	At least 6	-	2.12 [low]	4.38	1.04	0.50	8.08
<b>Subsurface Air Capacity [Non-Capillary Porosity]</b>	~20%	=	12.40% [low]	12.47%	10.07%	10.22%	11.50%
<b>Water Porosity [Capillary]</b>	15% to 25%	=	34.64% [high]	35.23%	33.30%	35.08%	33.61%
<b>Bulk Density [g/cc]</b>	~1.35 to 1.45	-	1.41 [with the amount of OM we would expect a bulk density at or below 1.30 g/cc – the current bulk density is a strong indicator of compaction]	1.37	1.42	1.36	1.43
<b>Water Holding</b>	10% to 20%	=	24.62% [high]	25.69%	23.39%	25.71%	23.52%
<b>Organic Content: 0 – 1"</b>	1.5% to 2.5%	-	3.91% [very high]	2.01%	2.67%	3.07%	2.96%
<b>Organic Content: 1 – 2"</b>	1.0% to 2.0%	=	1.89% [at our upper target range]	1.80%	1.86%	1.87%	2.28%
<b>Organic Content: 2 – 3"</b>	0.5% to 2.0%	-	1.10% [ok]	0.91%	1.14%	1.42%	1.36%
<b>Organic Content: 3 – 4"</b>	0.5% to 1.5%	=	1.01% [ok]	0.99%	1.09%	1.27%	1.03%
<b>Root Mass</b>	at least ½ in.	=	5/8 in.	5/8 in.	½ in.	½ in.	5/8 in.
<b>Feeder Roots</b>	at least 3.5 in. –med. density	=	3 in. sparse	3 ½ in. sparse	3 in. sparse	4 in. sparse	3 ½ in. sparse



## Particle Distribution

	Textural Analysis				Sand Particle Size Distribution						
	Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
USDA (mm)	.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
U.S. Sieve (mesh)	270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
SAMPLE NAME	% Retained on Sieve										
→ .25 - 1.0 in.	94.10	2.00	3.85	0.05	6.92	28.62	36.22	10.57	3.70	4.97	3.10
→ 1.0 - 2.0 in.	94.74	1.74	3.35	0.17	9.80	30.35	35.82	9.07	3.45	4.15	2.10
→ 2.0 - 3.0 in.	94.15	2.93	2.47	0.45	7.77	25.97	37.07	11.42	4.20	5.10	2.62
→ 3.0 - 4.0 in.	90.56	3.33	2.81	3.30	12.87	24.47	30.10	10.40	4.02	5.50	3.20
→ 4.0 - 5.0 in.	88.72	3.10	2.21	5.97	22.17	28.47	23.22	7.02	2.67	3.00	2.17
→ 5.0 - 6.0 in.	88.58	0.04	3.61	7.77	24.82	29.70	22.80	5.77	2.05	2.22	1.22
→ 6.0 - 7.0 in.	89.88	0.04	3.46	6.62	22.95	29.15	24.72	6.57	2.45	2.52	1.52
→ 7.0 - 8.0 in.	87.67	0.05	4.03	8.25	24.77	27.97	22.52	6.62	2.17	2.32	1.30
→ 8.0 - 9.0 in.	89.61	0.04	3.48	6.87	25.17	30.25	22.72	6.20	2.05	2.07	1.15
→ 9.0 - 10.0 in.	89.96	0.04	3.10	6.90	24.42	29.35	23.60	6.87	2.25	2.25	1.22
→ 10.0 - 11.0 in.	89.55	0.04	3.16	7.25	26.72	30.12	21.80	5.95	1.82	2.02	1.12
→ 11.0 - 12.0 in.	89.81	0.05	4.39	5.75	19.70	28.52	26.75	7.80	2.70	2.87	1.47
→ .25 - 1.0 in.	94.27	2.02	3.59	0.12	8.80	28.42	35.75	10.45	3.75	4.40	2.70
→ 1.0 - 2.0 in.	94.50	0.02	5.33	0.15	10.37	30.55	35.77	9.17	3.20	3.72	1.72
→ 2.0 - 3.0 in.	94.40	0.02	5.36	0.22	7.90	26.47	37.65	9.97	4.37	5.27	2.77
→ 3.0 - 4.0 in.	90.33	4.97	3.90	0.80	7.20	20.87	34.87	12.97	5.45	7.27	1.70

Specifications	89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.
Guidelines	89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	15 to 25	40+	10 to 15	20 - #80	10 Max. w/Silt & Clay
		10 Max. w/ Fine & V.F.		10 Max.		65 to 85 Optimum				10 Max. w/Silt & Clay

Above is the inch-by-inch analysis of the Textural & Particle Size Distribution for the Arroyo Course - Green #1's 1<sup>st</sup> tier (red arrow), Green #1's 2<sup>nd</sup> tier (blue arrow), Green #1's 3<sup>rd</sup> tier (green arrow) and Arroyo Course Green #9's 1<sup>st</sup> tier (yellow arrow). A complete particle size analysis for all the tested greens, including Lakes Green #5 and Dunes Green #7, is also attached to the end of the report. The lower box contains the USGA specifications & ISTRC Guidelines - the upper set of guidelines from the USGA and the lower set of expanded guidelines from ISTRC. As documented in the 2007 report, the greens fail to meet the USGA recommended specifications due to the cumulative percentage of fines (140, 270, Silt, & Clay) as well as the high percentage of gravel & very coarse sand in the lower root zone (blue box). Green #1's 2<sup>nd</sup> & 3<sup>rd</sup> tier (4-8 & 8-12 in.) remains comparatively coarser than Green #5's 2<sup>nd</sup> & 3<sup>rd</sup> tiers.

## Summary

A general discussion on Maintenance Practices is contained in Section V of **The ISTRC Guidebook**. We encourage you to reference the Guidebook for a wide range of topics relating to the root zone, environmental factors, and maintenance.

The greens would continue to benefit from higher 1<sup>st</sup> tier (0-4 in.) infiltration rates, higher air porosities, and lower water holding properties. A combination of organic matter, fines, and compaction in the upper 2 to 3 inches are the major contributors to the physical deficiencies. Short of rebuilding the greens improving the overall health of the root zone will be dependent on an aggressive cultural program. Given the excellent permeability & air porosity in the lower root zone we do not see an immediate need for deep tine aerification; rather targeting a depth of 3 ½ to 4 inches should effectively penetrate below the layering creating channels for drainage & gas exchange.

Over the past ten years we have been conducting an ongoing study into the annual displacement percentage and its impact on the aging of greens. Frequency has been a common measure of aerification; however with the wide range of tines & setups it provides very little information as to the impact of aerification. Our goal through this study has been to establish a quantifiable measure for aerification and through its correlation to the physical properties help establish appropriate short & long-term programs. Given the current conditions, age of the green, and turf-type our general recommendation for your greens this upcoming years would that targets 20 to 25 percent annual surface area displacement (calculation based on tine OD). To effectively achieve our displacement goals for your greens it will likely require a minimum of three aerifications. The 3/8<sup>th</sup> & 1/2 inch tines on a quadline setup have proven to maximize the surface area displacement while maintaining acceptable recovery times. For your reference we have attached a copy of our Aerification Displacement Chart at the end of the report.

All the greens would also continue to benefit from regular non-disruptive venting using equipment such as the HydroJect, Planet Air, needle/solid tines, bayonet tines, cross/star tines, slicer, or deep spiker. The goal is to enhance permeability, promote gas exchange, and dissipate layering. An appropriate schedule for your greens would be every 2 to 3 weeks. Regular verti-cutting & light topdressing will also play a key role in the long-term health & playability of the greens. As organic contents become heavily concentrated in the upper 1/4 to 1/2 inch of the root zone with limited topdressing sand buffering the accumulation it is common for greens to report extreme contrasts in their playing conditions from soft & spongy when wet to extremely hard and difficult to re-wet if allowed to dry out.

We would recommend that you continue to monitor your greens with regular testing. The information derived from regular testing will allow you to monitor the aging process of the greens, evaluate the effectiveness of the current cultural practices, modify the program based on hard data, make adjustments to the program to meet the individual needs of specific greens, and detect problems before they affect the health of the greens.

If you have any questions or need any additional information we encourage you to give us a call. We are always available to answer questions and discuss ideas with you. Our service is not confined to analyzing undisturbed cores. We do not charge for telephone calls and we encourage our client superintendents to use us as a resource.

Sincerely,

**I.S.T.R.C.**

by:

Matt Pulis, M.S.  
Agronomist

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Website: [www.istrc.com](http://www.istrc.com)

**INVOICE**  
ISTRC EIN: 48-1078972

Invoice Number:

**000000**

<b>Company:</b> [REDACTED]	<b>Facility:</b> [REDACTED]	
<b>Address:</b> [REDACTED]	<b>Material tested:</b> N/A	
<b>City:</b> [REDACTED]	<b>Invoice Date:</b> 03/06/08	
<b>Attention:</b> Mr. [REDACTED], CGCS	<b>Due Date:</b> 04/06/08	
<b>Phone:</b> [REDACTED]	<b>Secondary Phone or E-mail:</b> [REDACTED]	<b>Phone:</b> [REDACTED]
<b>Lab ID #:</b> [REDACTED]	<b>Customer Rep.:</b> [REDACTED]	<b>Lab ID #:</b> [REDACTED]

Quantity	Description	Unit Price	Invoiced Amount
8	ISTRC SYSTEM Undisturbed Core Analysis	\$475.00	\$ 3,800.00
<b>TOTAL DUE THIS INVOICE:</b>			<b>\$ 3,800.00</b>

*Thank You For Your Business*



\*\$10.00 Convenience fee for credit card processing will be applied

# I.S.T.R.C.

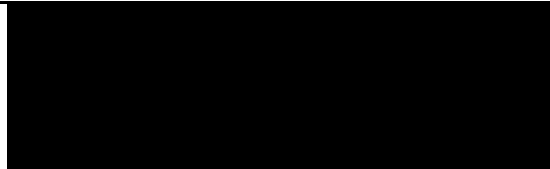
## "International Sports Turf Research Center, Inc."

11372 Strang Line Rd.  
 Lenexa, KS 66215

Phone: 913-829-8873  
 Phone: 800-362-8873  
 Fax: 913-829-4013

### The I.S.T.R.C. System™

Company:  
 Name:  
 Address:  
 City, ST, Zip



Account No. [Redacted]  
 Date 10-Mar-08

Facility [Redacted]  
 ISTRC Rep. [Redacted]

### Physical Evaluation

#### ISTRC SYSTEM™ Core Analysis

#### Porosity

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Total Porosity %	Capillary [Water Pores] %	Non-Capillary [Air Pores] %
08020029-G01	Green #1, Back Right, 1st Tier, Arroyo C.	0.87	27.60	1.39	51.82	48.18	38.28	9.90
	Organic [ISTRC Walkley/Black] .25 to 1 in.	3.14%				Root Mass: 5/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.31%				Feeders: 3" medium		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.93%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.32%						
08020029-G01	Green #1, Back Right, 2nd Tier, Arroyo C.	18.17	7.94	1.62	63.28	36.72	12.83	23.89
	Organic [ISTRC Walkley/Black] 4 to 5 in.	0.49%				Root Mass: N/A		
	Organic [ISTRC Walkley/Black] 5 to 6 in.	0.16%				Feeders: none		
	Organic [ISTRC Walkley/Black] 6 to 7 in.	0.14%						
	Organic [ISTRC Walkley/Black] 7 to 8 in.	0.08%						
08020029-G01	Green #1, Back Right, 3rd Tier, Arroyo C.	29.42	6.21	1.59	65.28	34.72	9.86	24.86
	Organic [ISTRC Walkley/Black] 8 to 9 in.	0.02%				Root Mass: N/A		
	Organic [ISTRC Walkley/Black] 9 to 10 in.	0.01%				Feeders: none		
	Organic [ISTRC Walkley/Black] 10 to 11 in.	0.01%						
	Organic [ISTRC Walkley/Black] 11 to 12 in.	0.07%						
08020029-G09	Green #9, Back Center, Arroyo C.	3.27	28.37	1.33	49.26	50.74	37.75	12.99
	Organic [ISTRC Walkley/Black] .25 to 1 in.	3.41%				Root Mass: 5/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.69%				Feeders: 3 1/2" sparse		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.96%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.38%						
	USGA Sample Range [Root Zone Mix]	at least 6	10 to 20	1.4 to 1.7	45 to 65	35 to 55	15 to 25	15 to 30

Reviewed by: \_\_\_\_\_

# I.S.T.R.C.

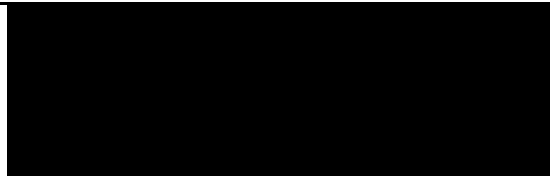
## "International Sports Turf Research Center, Inc."

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 Lenexa, KS 66215

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 Fax: 913-829-4013

### The I.S.T.R.C. System™

Company:  
 Name:  
 Address:  
 City, ST, Zip



Account No. [Redacted]

Date 10-Mar-08

Facility  
 ISTRC Rep.



### Physical Evaluation

#### ISTRC SYSTEM™ Core Analysis

#### Porosity

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Total Porosity %	Capillary [Water Pores] %	Non-Capillary [Air Pores] %
08020029-G05	Green #5, Back Center, 1st Tier, Lakes C.	2.21	25.93	1.41	52.49	47.51	36.45	11.06
	Organic [ISTRC Walkley/Black] .25 to 1 in.	3.64%				Root Mass: 5/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	2.36%				Feeders: 3 1/2" sparse		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.12%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	0.88%						
08020029-G05	Green #5, Back Center, 2nd Tier, Lakes C.	27.12	7.49	1.60	59.52	40.48	11.96	28.52
	Organic [ISTRC Walkley/Black] 4 to 5 in.	0.06%				Root Mass: N/A		
	Organic [ISTRC Walkley/Black] 5 to 6 in.	0.02%				Feeders: none		
	Organic [ISTRC Walkley/Black] 6 to 7 in.	0.01%						
	Organic [ISTRC Walkley/Black] 7 to 8 in.	0.02%						
08020029-G05	Green #5, Back Center, 3rd Tier, Lakes C.	32.60	13.75	1.49	50.96	49.04	20.44	28.60
	Organic [ISTRC Walkley/Black] 8 to 9 in.	0.21%				Root Mass: N/A		
	Organic [ISTRC Walkley/Black] 9 to 10 in.	0.17%				Feeders: none		
	Organic [ISTRC Walkley/Black] 10 to 11 in.	0.10%						
	Organic [ISTRC Walkley/Black] 11 to 12 in.	0.02%						
08020029-G07	Green #7, Center, Dunes C.	2.12	24.62	1.41	52.96	47.04	34.64	12.40
	Organic [ISTRC Walkley/Black] .25 to 1 in.	3.91%				Root Mass: 5/8"		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	1.89%				Feeders: 3" sparse		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	1.10%						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	1.01%						
	USGA Sample Range [Root Zone Mix]	at least 6	10 to 20	1.4 to 1.7	45 to 65	35 to 55	15 to 25	15 to 30

Reviewed by: \_\_\_\_\_

# I.S.T.R.C.

## International Sports Turf Research Center, Inc."

11372 Strang Line Rd.  
Lenexa, KS 66215

Phone: 913-829-8873  
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Fax: 913-829-4013

Company:  
Name:  
Address:  
City, ST, Zip

Account No. [REDACTED]

Date 10-Mar-08

Facility [REDACTED]

ISTRC Rep. [REDACTED]

		Textural Analysis				Sand Particle Size Distribution						
		Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
USDA (mm)		.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
U.S. Sieve (mesh)		270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
LAB ID NO.	SAMPLE NAME	% Retained on Sieve										
08020029-G01	.25 - 1.0 in.	94.10	2.00	3.85	0.05	6.92	28.62	36.22	10.57	3.70	4.97	3.10
<b>Green #1</b>	1.0 - 2.0 in.	94.74	1.74	3.35	0.17	9.80	30.35	35.82	9.07	3.45	4.15	2.10
<b>Back Right</b>	2.0 - 3.0 in.	94.15	2.93	2.47	0.45	7.77	25.97	37.07	11.42	4.20	5.10	2.62
<b>1st Tier</b>	3.0 - 4.0 in.	90.56	3.33	2.81	3.30	12.87	24.47	30.10	10.40	4.02	5.50	3.20
08020029-G01	4.0 - 5.0 in.	88.72	3.10	2.21	5.97	22.17	28.47	23.22	7.02	2.67	3.00	2.17
<b>Green #1</b>	5.0 - 6.0 in.	88.58	0.04	3.61	7.77	24.82	29.70	22.80	5.77	2.05	2.22	1.22
<b>Back Right</b>	6.0 - 7.0 in.	89.88	0.04	3.46	6.62	22.95	29.15	24.72	6.57	2.45	2.52	1.52
<b>2nd Tier</b>	7.0 - 8.0 in.	87.67	0.05	4.03	8.25	24.77	27.97	22.52	6.62	2.17	2.32	1.30
08020029-G01	8.0 - 9.0 in.	89.61	0.04	3.48	6.87	25.17	30.25	22.72	6.20	2.05	2.07	1.15
<b>Green #1</b>	9.0 - 10.0 in.	89.96	0.04	3.10	6.90	24.42	29.35	23.60	6.87	2.25	2.25	1.22
<b>Back Right</b>	10.0 - 11.0 in.	89.55	0.04	3.16	7.25	26.72	30.12	21.80	5.95	1.82	2.02	1.12
<b>3rd Tier</b>	11.0 - 12.0 in.	89.81	0.05	4.39	5.75	19.70	28.52	26.75	7.80	2.70	2.87	1.47
08020029-G09	.25 - 1.0 in.	94.27	2.02	3.59	0.12	8.80	28.42	35.75	10.45	3.75	4.40	2.70
<b>Green #9</b>	1.0 - 2.0 in.	94.50	0.02	5.33	0.15	10.37	30.55	35.77	9.17	3.20	3.72	1.72
<b>Back Center</b>	2.0 - 3.0 in.	94.40	0.02	5.36	0.22	7.90	26.47	37.65	9.97	4.37	5.27	2.77
	3.0 - 4.0 in.	90.33	4.97	3.90	0.80	7.20	20.87	34.87	12.97	5.45	7.27	1.70
<b>USGA</b>		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
<b>Recommended Specifications</b>		10 Max. w/ Fine & V.F.		10 Max.			10 Max. w/Silt & Clay					
<b>ISTRC Guidelines</b>		<b>89 to 100</b>	<b>5 Max.</b>	<b>3 Max.</b>	<b>3 Max.</b>	<b>10 Max.</b>	<b>15 to 25</b>	<b>40+</b>	<b>10 to 15</b>	<b>20 - #80</b>	<b>5 Max.</b>	
		<b>10 Max. w/ Fine &amp; V.F.</b>		<b>10 Max.</b>			<b>65 to 85 Optimum</b>			<b>10 Max. w/Silt &amp; Clay</b>		

Reviewed by: \_\_\_\_\_

# I.S.T.R.C.

## International Sports Turf Research Center, Inc."

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Lenexa, KS 66215

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Company:  
Name:  
Address:  
City, ST, Zip

Account No. [REDACTED]

Date 10-Mar-08

Facility [REDACTED]  
ISTRC Rep. [REDACTED]

		Textural Analysis				Sand Particle Size Distribution						
		Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
		.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
		270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
LAB ID NO.	SAMPLE NAME	% Retained on Sieve										
08020029-G05	.25 - 1.0 in.	93.01	0.02	6.97	0.00	7.45	25.17	35.32	11.45	4.45	5.47	3.70
<b>Green #5</b>	1.0 - 2.0 in.	93.92	0.02	6.06	0.00	8.82	27.42	36.42	10.60	3.77	4.57	2.32
<b>Back Center</b>	2.0 - 3.0 in.	93.33	0.02	6.28	0.37	7.10	26.27	36.22	11.02	4.32	5.45	2.95
<b>1st Tier</b>	3.0 - 4.0 in.	91.96	1.95	5.44	0.65	7.02	23.30	34.15	12.42	5.12	6.35	3.60
08020029-G05	4.0 - 5.0 in.	91.50	0.04	4.04	4.42	12.22	30.10	30.95	8.62	3.47	4.17	1.97
<b>Green #5</b>	5.0 - 6.0 in.	92.73	0.03	3.24	4.00	10.12	29.67	33.62	9.47	3.60	4.55	1.70
<b>Back Center</b>	6.0 - 7.0 in.	93.08	0.03	3.09	3.80	10.27	30.35	33.77	9.12	3.60	4.22	1.75
<b>2nd Tier</b>	7.0 - 8.0 in.	92.88	0.03	3.27	3.82	10.87	28.75	33.80	9.52	3.75	4.37	1.82
08020029-G05	8.0 - 9.0 in.	89.83	0.03	5.59	4.55	10.52	28.77	30.35	9.17	3.80	4.77	2.45
<b>Green #5</b>	9.0 - 10.0 in.	92.48	0.05	4.52	2.95	10.37	29.57	32.07	9.45	3.87	4.85	2.30
<b>Back Center</b>	10.0 - 11.0 in.	92.23	0.04	3.98	3.75	8.90	26.50	34.22	10.32	4.35	5.42	2.52
<b>3rd Tier</b>	11.0 - 12.0 in.	94.51	0.03	3.29	2.17	7.07	27.42	37.00	11.27	4.40	5.30	2.05
08020029-G07	.25 - 1.0 in.	94.21	1.82	3.77	0.20	7.45	26.87	37.85	11.35	4.02	4.40	2.27
<b>Green #7</b>	1.0 - 2.0 in.	93.96	1.94	4.03	0.07	6.92	26.90	38.92	11.00	3.82	4.40	2.00
<b>Center</b>	2.0 - 3.0 in.	93.42	4.33	2.08	0.17	6.40	25.30	36.60	11.90	4.62	5.70	2.90
	3.0 - 4.0 in.	90.69	2.57	5.34	1.40	5.07	19.25	32.97	14.20	6.10	8.25	4.85
<b>USGA</b>		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At Least 60		20 Max.		5 Max.	
<b>Recommended Specifications</b>			10 Max. w/ Fine & V.F.		10 Max.					10 Max. w/Silt & Clay		
<b>ISTRC Guidelines</b>		<b>89 to 100</b>	<b>5 Max.</b>	<b>3 Max.</b>	<b>3 Max.</b>	<b>10 Max.</b>	<b>15 to 25</b>	<b>40+</b>	<b>10 to 15</b>	<b>20 - #80</b>	<b>5 Max.</b>	
			<b>10 Max. w/ Fine &amp; V.F.</b>		<b>10 Max.</b>		<b>65 to 85 Optimum</b>				<b>10 Max. w/Silt &amp; Clay</b>	

Reviewed by: \_\_\_\_\_

# ISTRC

## International Sports Turf Research Center Aerification Displacement Chart

Tine Size	1.25" x 1.25" Centers	1.5" x 1.5" Centers	2.0" x 2.0" Centers	2.5" x 2.5" Centers	5" x 5" Centers
1/4" Hollow Tines	3.14%	2.18%	1.23%	0.79%	
3/8" Hollow Tines	7.07%	4.91%	2.76%	1.77%	
1/2" Hollow Tines	12.57%	8.73%	4.91%	3.14%	
5/8" Hollow Tines		13.64%	7.67%	4.91%	
5/8" Hollow Vertidrain					1.23%
3/4" Hollow Tines				7.07%	1.77%
3/4" Hollow Vertidrain					1.77%
1" Hollow Tines					3.14%
1" Hollow Vertidrain					3.14%
7/8" Drill & Fill (7" Ctrs)					1.23%
Graden Verticutter (15 Blades @ 1" Spacings)	<u>1mm Blade</u> 3.93%	<u>2mm Blade</u> 7.87%	<u>3mm Blade</u> 11.81%		

Note: 1/4" Quadtines remove as much material as Regular 1/2" Hollow Tines  
 3/8" minimum for ease of topdressing fill if replacement of material is required  
 For double aerification make two passes at approx. 37° (slightly less than 45°) to minimize overlap