YOUR
ISTRC SYSTEM™
REPORT

SAMPLE REPORT
GOLF & COUNTRY CLUB

January 5, 2010
Greens 4, 9, 13, & 15
Lab ID: 0000000

Presented To:

Mr. [redacted], GCS

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January 5, 2010

Mr. [redacted]
[redacted] GOLF & COUNTRY CLUB
[redacted]

re: Lab ID: [redacted]; ISTRC SYSTEM™ BenchMarking of undisturbed core samples from Green #4 [center]; Green #9 [center] – 1st & 2nd tiers; Green #13 [center] – 1st & 2nd tiers; Green #15 [center]; and a sample of the current Topdressing Sand.

Dear [redacted];

We have completed the ISTRC SYSTEM™ BenchMarking of the undisturbed core samples taken from Green #4 [center]; Green #9 [center] – 1st & 2nd tiers; Green #13 [center] – 1st & 2nd tiers; Green #15 [center], and a sample of the current Topdressing Sand. The test results are attached and the time lapse photos are included. The section references in this report are to our **ISTRC's Guidebook**.

I. CURRENT CONDITIONS
(per Information Supplied to ISTRC)

The [redacted] Golf Club was originally built in 1961 and opened for play in 1962. The greens were originally built to a native soil, push-up construction and seeded with bentgrass. We understand several of the greens have been rebuilt over the years. Of the tested greens, Greens 4 & 13 were rebuilt while Greens 9 & 15 reflect the original native soil construction. Green #13 was rebuilt approximately 25 years ago using what appears to be a high soil/organic mix. Green #4 was rebuilt 6 years ago using an 80/10/10 Sand/Soil/Peat blend. The turf on all the greens is predominately *Poa annua*. The primary objective for testing is to establish an initial benchmark of the greens as a basis for monitoring the aging of the root zone and evaluating the impact of the past & current cultural practices.

The greens are currently aerified twice per year (May & August) using ½ inch tines on 1.5 x 2.0 inch centers. The greens are also vented on a monthly basis using a deep slicer along with a light verti-cutting & topdressing. Over the years the program has done a good job amending the particle distribution in the upper 3 to 4 inches of the newer & older greens using a quality USGA topdressing sand; unfortunately a high percentage of organic matter is masking the amended particle distribution in all four greens. A build up of organic matter & thatch is often a gradual process that occurs when the rate of plant-deposited biomass exceeds the rate of

microbial decomposition and the physical removal through hollow coring & verti-cutting. The current plans to switch to a straight sand topdressing coupled with an intensified displacement program should go a long way to improving the overall health & sustainability of the greens.

Table 1 is used to incorporate your evaluation of the tested green's turf quality and micro-environment (growing conditions). As a general rule, turf quality is a function of the interrelationship between the physical properties of the root zone and the green's micro-environment. Our research has found that it is possible to compensate for poor growing conditions by manipulating the physical properties of the root zone. Conversely, it is possible to compensate for poor physical properties with an excellent micro-environment. See, Section IV, D – *The Green's Micro-Environment* – at page 15.

Table 1. **Scale: 1 [bad] – 5 [moderate] – 10 [excellent]**

	Turf Quality (Current)	Air Movement	Direct Sunlight	Comments
Green #4	8	10	10	Wide open location
Green #9	8	9	8	Open location but trees to the south limits the winter sun
Green #13	8	5	6	Sits in a bowl with trees around the green
Green #15	8	6	9	Restricted air flow but good sunlight – open to the east

II. DISCUSSION OF LAB RESULTS

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.

We have also attached an aerification displacement chart at the end of the report. We designed the displacement chart to calculate the percentage of surface area that is removed from the green with various size tines and spacings. We have found that the chart is an excellent reference to evaluate the effectiveness of your program.

On the following pages we will discuss the current test results. Included with the discussion is a selected time lapse photo of the root zone and our Target Table with the greens' physical properties. Tables 2 & 4 compare the newer greens to our recommended target range for well-drained, sand-based greens while Tables 3 & 5 compare the original greens to our target ranges for native soil, push-ups. The time lapse photos were taken to monitor the drying process of your greens and to provide visual confirmation of the tested physical properties. The X's & check marks represent 5-minute increments in the drying process. We have found the photos are an excellent indicator of layering and/or variations in water holding properties throughout the profile.

Green #4

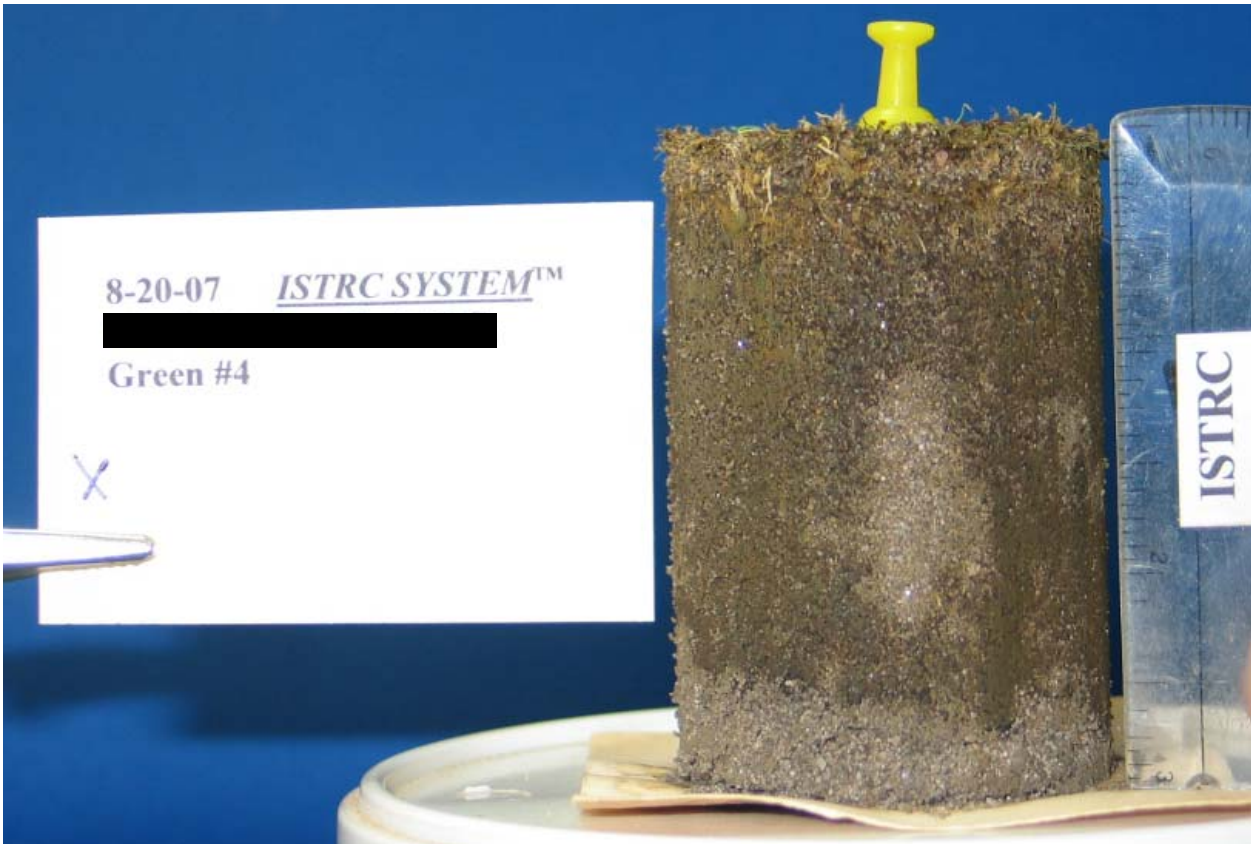

Table 2. **ISTRC Target Ranges**

	Green #4	Well-Drained Greens
Infiltration Rate [In/hr]	4.38 [highest of the tested 1st tiers – mirrors its higher air porosity and lower water holding properties]	At least 6
Subsurface Air Capacity [Non-Capillary Porosity]	14.04% [low]	~20%
Water Porosity [Capillary]	27.14% [little high – nearly a 2:1 water to air ratio]	15% to 25%
Bulk Density [g/cc]	1.47 [in your analysis of the tested bulk densities, particularly as they relate to the overall balance of physical properties, it is important to note two factors typically influences the bulk density – compaction tends to increase the bulk density while organic matter & thatch tends to lower the bulk density – Green #4's current bulk density at 1.47 g/cc is higher than expected given the percentages of organic matter, which would suggest the greens would also benefit from less compaction]	1.35 to 1.45
Water Holding	18.45% [ok]	10% to 20%
Organic Content –¼ to 1"	3.28% [high]	1.5% to 2.5%
Organic Content – 1 to 2"	2.46% [high]	1.0% to 2.0%
Organic Content – 2 to 3"	1.73% [ok]	0.5% to 2.0%
Organic Content – 3 to 4"	1.05% [ok]	0.5% to 1.5%
Root Mass	½ in.	at least ½ in.
Feeder Roots	Sparse at 3 in.	at least 3.5 in. –med. density

Green #9

Green 9 & 13's time lapse photos were stacked to represent the upper 8 inches of the root zone. The dark coloration, particularly in the lower root zone of both greens, reflects a combination of organic matter & fines and is the source of the physical deficiencies. The obvious textural differences between the 1st tier samples and the 2nd tier samples clearly highlight the effectiveness of the topdressing program over the years to amend the upper root zone. Green #9 has reported a 1st tier (0-4 in.) infiltration rate that is within our target range for a native soil green; however diluting the high percentage of organic matter would go a long way to improving the current imbalance between water & air.

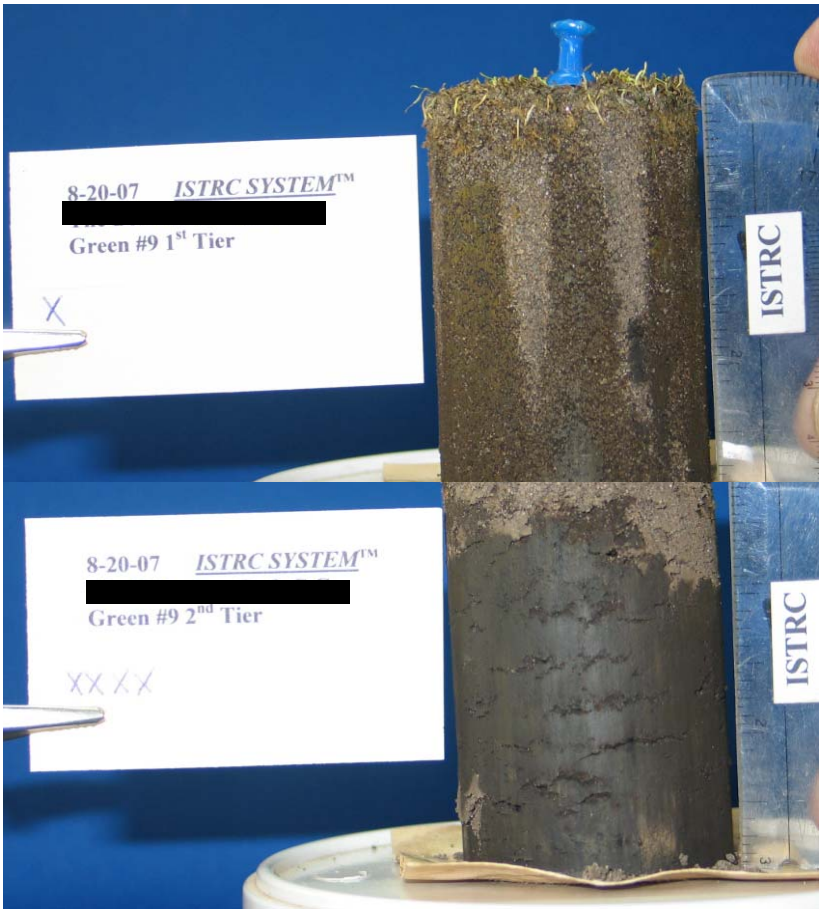

Table 3. **ISTRC Target Ranges**

Green #9	1st tier (0-4 in.)	2nd tier (4-8 in.)	Native Soil Greens
Infiltration Rate [In/hr]	3.00 [workable for a native soil green - improving the air/water permeability would not only help promote a deeper, more sustainable root system but also aid in the removal of excess moisture through evaporation]	0.01 [essentially sealed off – not uncommon for the lower root zone of a push-up green]	At least 2
Subsurface Air Capacity [Non-Capillary Porosity]	13.80% [at our lower target range]	6.77% [very low]	At least 12%
Water Porosity [Capillary]	28.98% [at our upper target range – exceeds a 2:1 water to air ratio]	39.53% [high]	15% to 30%
Bulk Density [g/cc]	1.47 [high for the amount of OM – strong indicator of compaction]	1.34 [low but consistent with the high percentage of OM]	1.35 to 1.45
Water Holding	19.66% [ok]	29.46% [high]	10% to 25%
Organic Content	[¼-1"] 3.38% [high]	[4-5"] 5.28% [very high]	1.5% to 2.5%
Organic Content	[1-2"] 2.59% [high]	[5-6"] 6.00% [very high]	1.0% to 2.0%
Organic Content	[2-3"] 2.75% [high]	[6-7"] 5.70% [very high]	0.5% to 2.0%
Organic Content	[3-4"] 4.05% [very high]	[7-8"] 5.78% [very high]	0.5% to 2.0%
Root Mass	½ in.	N/A	at least ½ in.
Feeder Roots	Less than 3 in.	None	at least 3.5 in. –med. density

Green #13

Green #13's 1st tier (0-4 in.) physical properties are similar to the other tested greens with a moderate to low infiltration rate, low air porosity, and high water holding properties.

Often times 2nd tier samples provide some excellent insight into the original root zone mix. While Green #13's 2nd tier has a considerably lower percentage of Silt & Clay than Green #9 it remains essentially sealed off due to a high percentage of organic matter. As a general rule organic matter deposited by the turf is confined to the upper 3 to 4 inches while organic matter deeper in the root zone likely reflects the original root zone mix or native soil.

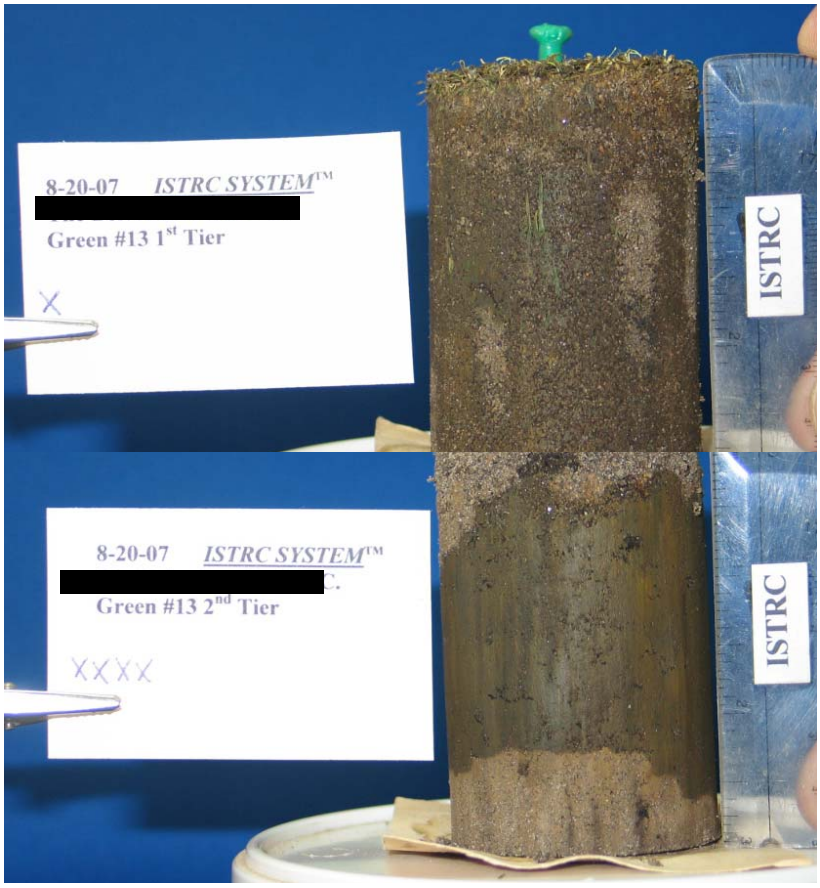

Table 4. **ISTRC Target Ranges**

Green #13	1st tier (0-4 in.)	2nd tier (4-8 in.)	Well-Drained Greens
Infiltration Rate [In/hr]	1.54 [very low]	0.37 [very low but consistent with the high soil/organic mix used to rebuilt the green]	At least 6
Subsurface Air Capacity [Non-Capillary Porosity]	12.20% [very low]	8.33% [very low]	~20%
Water Porosity [Capillary]	29.64% [high]	36.62% [high]	15% to 25%
Bulk Density [g/cc]	1.43 [while rolling has likely contributed to the compaction in the upper root zone the fundamental problem remains the percentage of organic matter & buried thatch, which is extremely prone to layering & compaction]	1.33 [comparable to Green #9's 2nd tier – a low bulk density is a classic indicator of excess OM]	1.35 to 1.45
Water Holding	20.66% [high]	27.46% [high]	10% to 20%
Organic Content	[¼-1"] 3.16% [high]	[4-5"] 4.42% [very high]	1.5% to 2.5%
Organic Content	[1-2"] 2.30% [high]	[5-6"] 3.96% [high]	1.0% to 2.0%
Organic Content	[2-3"] 2.52% [high]	[6-7"] 2.63% [high]	0.5% to 2.0%
Organic Content	[3-4"] 3.40% [high]	[7-8"] 2.43% [high]	0.5% to 1.5%
Root Mass	½ in.	N/A	at least ½ in.
Feeder Roots	Less than 3 in.	None	at least 3.5 in. –med. density

Green #15

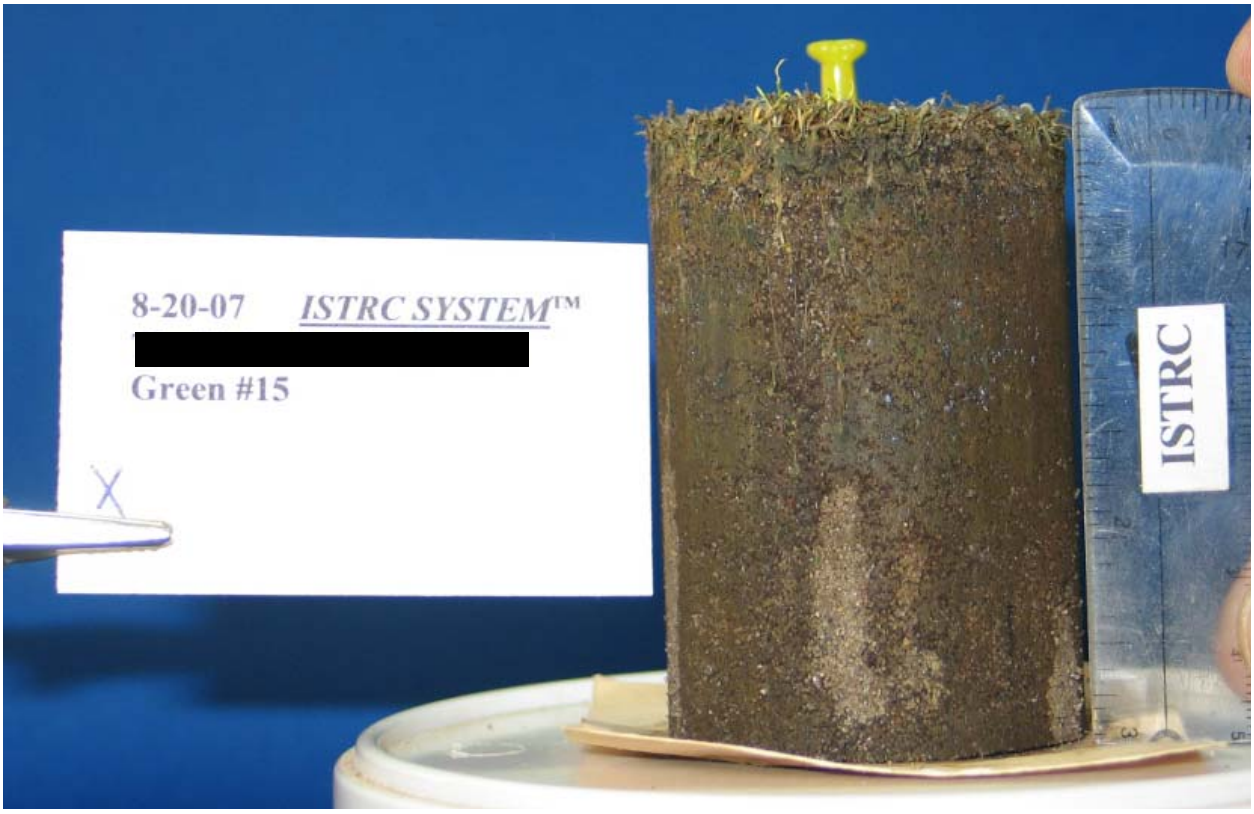

Table 5. **ISTRC Target Ranges**

	Green #15	Native Soil Greens
Infiltration Rate [In/hr]	1.27 [low]	At least 2
Subsurface Air Capacity [Non-Capillary Porosity]	8.41% [very low]	At least 12%
Water Porosity [Capillary]	35.25% [high – as the greens continue to mature an excellent gauge of the overall health of a root zone will be the balance between the air pores & water pores – our general recommendation for sand-based greens is at least a 1:1 air to water ratio and no greater than a 2:1 water to air ratio for native soil greens]	15% to 30%
Bulk Density [g/cc]	1.41 [in addition to our higher than expected bulk densities in the 1st tier sample and excellent indicator of compaction is the dense appearance of the root zone in the time lapse photos]	1.35 to 1.45
Water Holding	24.97% [at our upper target range]	10% to 25%
Organic Content –¼ to 1"	3.54% [high]	1.5% to 2.5%
Organic Content – 1 to 2"	2.40% [high]	1.0% to 2.0%
Organic Content – 2 to 3"	2.88% [high]	0.5% to 2.0%
Organic Content – 3 to 4"	3.25% [high]	0.5% to 2.0%
Root Mass	½ in.	at least ½ in.
Feeder Roots	Less than 3 in.	at least 3.5 in. –med. density

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.	96.69	2.15	1.16	0.00	1.15	18.60	65.10	8.43	1.35	1.13	0.93
1.0 - 2.0 in.	96.42	1.73	1.85	0.00	1.45	18.43	64.18	9.20	1.48	0.98	0.70
2.0 - 3.0 in.	94.01	3.80	2.04	0.15	1.20	18.75	64.45	7.13	1.03	0.75	0.70
3.0 - 4.0 in.	93.92	3.87	2.08	0.13	1.20	21.68	63.55	5.73	0.73	0.53	0.50
.25 - 1.0 in.	96.29	1.78	1.90	0.03	1.40	21.13	62.25	8.13	1.38	1.10	0.90
1.0 - 2.0 in.	94.76	2.50	2.69	0.05	1.30	17.25	61.43	10.35	1.88	1.45	1.10
2.0 - 3.0 in.	95.04	2.37	2.54	0.05	1.53	20.43	59.05	9.30	1.85	1.63	1.25
3.0 - 4.0 in.	82.16	12.87	4.44	0.53	3.50	21.55	40.25	8.88	2.58	2.70	2.70
4.0 - 5.0 in.	75.81	18.85	3.91	1.43	6.13	17.20	32.65	8.85	2.95	3.75	4.28
5.0 - 6.0 in.	45.43	41.57	12.62	0.38	2.25	5.10	11.55	6.85	3.60	6.35	9.73
6.0 - 7.0 in.	47.21	39.81	12.08	0.90	2.25	6.00	13.13	7.15	3.48	6.15	9.05
7.0 - 8.0 in.	44.44	41.73	13.33	0.50	2.05	4.65	11.48	7.10	3.60	6.13	9.43
.25 - 1.0 in.	96.28	0.25	3.44	0.03	1.50	21.25	63.75	6.95	1.18	0.90	0.75
1.0 - 2.0 in.	95.67	2.11	1.84	0.38	1.58	19.68	62.63	8.70	1.40	0.95	0.73
2.0 - 3.0 in.	95.33	2.41	2.11	0.15	2.18	22.93	58.88	8.03	1.43	1.08	0.80
3.0 - 4.0 in.	87.65	8.24	3.98	0.13	2.88	24.98	44.28	9.25	2.40	2.18	1.68
4.0 - 5.0 in.	82.94	8.66	8.35	0.05	3.25	14.23	41.25	14.58	3.85	3.40	2.38
5.0 - 6.0 in.	86.34	9.09	4.39	0.18	3.73	13.90	43.53	15.73	4.05	3.30	2.10
6.0 - 7.0 in.	91.42	4.40	4.10	0.08	3.70	15.98	46.90	16.33	4.08	3.00	1.43
7.0 - 8.0 in.	88.39	7.02	4.46	0.13	3.48	14.50	45.68	15.90	4.05	3.10	1.68
.25 - 1.0 in.	96.56	1.84	1.60	0.00	1.53	23.83	61.95	6.68	1.05	0.87	0.65
1.0 - 2.0 in.	95.97	2.10	1.83	0.10	2.18	23.83	60.20	7.08	1.13	0.85	0.70
2.0 - 3.0 in.	95.79	2.15	2.01	0.05	2.13	22.68	60.25	7.60	1.35	1.03	0.75
3.0 - 4.0 in.	93.61	2.28	3.98	0.13	3.58	31.90	48.75	5.90	1.30	1.23	0.95
Sample Run #1	99.21	0.67	0.04	0.08	0.33	12.68	72.20	10.65	1.85	1.20	0.30
Sample Run #2	99.32	0.41	0.02	0.25	0.68	13.35	71.88	10.30	1.73	1.08	0.30
Average	**99.27**	**0.54**	**0.03**	**0.17**	**0.51**	**13.02**	**72.04**	**10.48**	**1.79**	**1.14**	**0.30**

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

Above is the inch-by-inch analysis (upper 4") of the Textural & Particle Size Distribution for Green #4's 1st tier (red arrow), Green #9's 1st tier (blue arrow), Green #9's 2nd tier (green arrow), Green #13's 1st tier (yellow arrow), Green #13's 2nd tier (orange arrow), Green #15's 1st tier (purple arrow), and a sample of the current Topdressing Sand (black arrow). A complete inch-by-inch analysis for all the tested greens & topdressing sand is also attached to the end of the report. The lower box contains the USGA specifications & ISTRC Guidelines - the upper set is the USGA specifications and the lower set is the expanded guidelines from ISTRC. The tested particle distributions for all four greens are very consistent with their age & construction type. Green #4's tested particle distribution resembles the 80/10/10 Sand/Soil/Peat blend while Green #13 (yellow & orange arrows) was clearly constructed using a finer mix. Green 9 & 15's inch-by-inch analysis provides some excellent insight into the native soil as well as the topdressing sand(s) over the years. As highlighted in Green #9's 2nd tier (green arrow), the native soil is comprised of a high percentage of fine & very fine sand, silt, and clay.

A sample of the current topdressing sand was also submitted for analysis (black arrow). The sand falls well within the USGA recommended specifications with a distinct peak on the 60 sieve. The low percentage of material retained on the 10 & 18 sieves is very desirable in a topdressing sand since the larger particles are often left on the surface and picked up by the

mowers. The very low percentage of fine & very fine sand, silt, or clay is also desirable in a topdressing or root zone sand. Given the current particle distribution, the sand should emphasize accelerated infiltration rates with above average air porosity and relatively low water holding properties. In addition to its particle distribution, a shape analysis was conducted on the submitted Topdressing Sand. Based on the sand sample, as received, our classification of the shape would be Sub-Angular to Sub-Rounded with Medium Sphericity. Over the years our testing & research has shown angularity not only plays a significant role in the porosity & permeability of a root zone but also its stability. Angular sands tend to be more stable, produce a firmer putting surface, and support better physical properties than round sands. With the dedicated water line we would strongly agree with your plans to switch to a straight sand topdressing. The topdressing sand, as received, would be an excellent material for not only light, frequent topdressing but also aerification fill.

III. SUMMARY

Our general recommendations are contained in Section V – *Maintenance Practices* – on page 20 of **The ISTRC Guidebook**. We encourage you to reference this section.

The greens would benefit from higher 1st tier (0-4 in.) infiltration rates, higher air porosities, and lower water holding properties. A combination of organic matter & excess compaction appear to be the major contributors to the physical deficiencies. With exception to Green #4, the greens have a noticeable transition in their particle distribution at 3 to 4 inches and below, which is a classic of an older green and simply reflects the transition depth between the modified root zone and the original greensmix or native soil.

Over the past few 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 our general recommendation for both the sand-based and native soil greens would be a program that targets at least 15 to 20 percent annual surface area displacement. With the addition of the larger tines on the quadtine setup it has allowed many superintendents to significantly increase their annual displacement goals and improve their agronomic conditions without increasing the number of aerifications per year. As we discussed on the phone, reducing the current spacing to a quad block (1.50 x 1.50 inch centers) would increase the amount of displacement (sum of spring & fall) from 13.08% to 17.46%. Attached to the end of the report is an Aerification Displacement Chart. We can also e-mail you a copy of our Aerification Displacement Calculator for your reference.

As with most older sand-based or push-up greens the current physical properties would indicate the greens would benefit from deep tine aerification. Deep needle/solid tines on a Soil Reliever or Verti-Drain tend to be very effective in creating drainage channels for evaporation

and gas exchange. To avoid a significant reduction in the annual surface area displacement many clubs have elected to incorporate a deep tine aerification immediately before or after their scheduled hollow core aerifications. While deep aerification would be beneficial it is important to reiterate the **1st priority** remains the upper root zone.

Non-disruptive aerification (venting) such as the Planet Air, HydroJect, Air Injector, needle/pencil tines, slicer, or deep spiker are also very important in keeping greens open & breathing. Most superintendents will target at least a monthly supplemental venting in conjunction with their regular grooming, verti-cutting, and topdressing. The goal is to minimize surface disruption while promoting soil oxygen and gas exchange, which are crucial to a healthy turf and root system. Improving the ability for the root zone to breathe should also enhance microbial activity and help accelerate the natural decomposition of the organic matter & thatch.

The current testing has established an initial benchmark of your greens. 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

encl.: ISTRC's Guidebook

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INVOICE

ISTRC EIN: 48-1078972

Invoice Number:
000000

Company: [redacted]	***Facility:*** Greens 4, 9, 13, & 15
Address: [redacted]	***Material tested:*** N/A
City: [redacted]	***Invoice Date:*** 02/05/10
Attention: [redacted]	***Due Date:*** 03/05/10

Phone:	***Secondary Phone or E-mail:***	***Fax:***
[redacted]		

Lab ID #:	***Customer Rep.:***	***Account No.:***
[redacted]	[redacted]	[redacted]

Quantity	*Description*	*Unit Price*	*Invoiced Amount*
6	ISTRC SYSTEM Undisturbed Core Analysis	$475.00	$ 2,850.00
	TOTAL DUE THIS INVOICE:		**$ 2,850.00**

Thank You For Your Business

We Accept: VISA MasterCard

*$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

Company: [redacted]
Name:
Address:
City, ST, Zip

Account No. [redacted]
Date 6-Sep-07
Facility
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						
07080022-G04	.25 - 1.0 in.	96.69	2.15	1.16	0.00	1.15	18.60	65.10	8.43	1.35	1.13	0.93
Green #4	1.0 - 2.0 in.	96.42	1.73	1.85	0.00	1.45	18.43	64.18	9.20	1.48	0.98	0.70
Center	2.0 - 3.0 in.	94.01	3.80	2.04	0.15	1.20	18.75	64.45	7.13	1.03	0.75	0.70
	3.0 - 4.0 in.	93.92	3.87	2.08	0.13	1.20	21.68	63.55	5.73	0.73	0.53	0.50
07080022-G09	.25 - 1.0 in.	96.29	1.78	1.90	0.03	1.40	21.13	62.25	8.13	1.38	1.10	0.90
Green #9	1.0 - 2.0 in.	94.76	2.50	2.69	0.05	1.30	17.25	61.43	10.35	1.88	1.45	1.10
Center	2.0 - 3.0 in.	95.04	2.37	2.54	0.05	1.53	20.43	59.05	9.30	1.85	1.63	1.25
1st Tier	3.0 - 4.0 in.	82.16	12.87	4.44	0.53	3.50	21.55	40.25	8.88	2.58	2.70	2.70
07080022-G09	4.0 - 5.0 in.	75.81	18.85	3.91	1.43	6.13	17.20	32.65	8.85	2.95	3.75	4.28
Green #9	5.0 - 6.0 in.	45.43	41.57	12.62	0.38	2.25	5.10	11.55	6.85	3.60	6.35	9.73
Center	6.0 - 7.0 in.	47.21	39.81	12.08	0.90	2.25	6.00	13.13	7.15	3.48	6.15	9.05
2nd Tier	7.0 - 8.0 in.	44.44	41.73	13.33	0.50	2.05	4.65	11.48	7.10	3.60	6.13	9.43
07080022-G13	.25 - 1.0 in.	96.28	0.25	3.44	0.03	1.50	21.25	63.75	6.95	1.18	0.90	0.75
Green #13	1.0 - 2.0 in.	95.67	2.11	1.84	0.38	1.58	19.68	62.63	8.70	1.40	0.95	0.73
Center	2.0 - 3.0 in.	95.33	2.41	2.11	0.15	2.18	22.93	58.88	8.03	1.43	1.08	0.80
1st Tier	3.0 - 4.0 in.	87.65	8.24	3.98	0.13	2.88	24.98	44.28	9.25	2.40	2.18	1.68
USGA		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
Recommended Specifications			10 Max. w/ Fine & V.F.		10 Max.						10 Max. w/Silt & Clay	
ISTRC Guidelines		**89 to 100**	**5 Max.**	**3 Max.**	**3 Max.**	**10 Max.**	**15 to 25**	**40+**	**10 to 15**	**20 - #80**	**5 Max.**	
			10 Max. w/ Fine & V.F.		**10 Max.**		**65 to 85 Optimum**				**10 Max. w/Silt & Clay**	

Reviewed by: _____

I.S.T.R.C.

International Sports Turf Research Center, Inc."

11372 Strang Line Rd.
Lenexa, KS 66215

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Phone: 800-362-8873
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Company: [redacted]
Name:
Address:
City, ST, Zip

Account No. [redacted]
Date 6-Sep-07
Facility [redacted]
ISTRC Rep.

		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						
07080022-G13	4.0 - 5.0 in.	82.94	8.66	8.35	0.05	3.25	14.23	41.25	14.58	3.85	3.40	2.38
Green #13	5.0 - 6.0 in.	86.34	9.09	4.39	0.18	3.73	13.90	43.53	15.73	4.05	3.30	2.10
Center	6.0 - 7.0 in.	91.42	4.40	4.10	0.08	3.70	15.98	46.90	16.33	4.08	3.00	1.43
2nd Tier	7.0 - 8.0 in.	88.39	7.02	4.46	0.13	3.48	14.50	45.68	15.90	4.05	3.10	1.68
07080022-G15	.25 - 1.0 in.	96.56	1.84	1.60	0.00	1.53	23.83	61.95	6.68	1.05	0.87	0.65
Green #15	1.0 - 2.0 in.	95.97	2.10	1.83	0.10	2.18	23.83	60.20	7.08	1.13	0.85	0.70
Center	2.0 - 3.0 in.	95.79	2.15	2.01	0.05	2.13	22.68	60.25	7.60	1.35	1.03	0.75
	3.0 - 4.0 in.	93.61	2.28	3.98	0.13	3.58	31.90	48.75	5.90	1.30	1.23	0.95
07080022-S01	Sample Run #1	99.21	0.67	0.04	0.08	0.33	12.68	72.20	10.65	1.85	1.20	0.30
Sand as Rec'd	Sample Run #2	99.32	0.41	0.02	0.25	0.68	13.35	71.88	10.30	1.73	1.08	0.30
	Average	**99.27**	**0.54**	**0.03**	**0.17**	**0.51**	**13.02**	**72.04**	**10.48**	**1.79**	**1.14**	**0.30**
USGA		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At Least 60		20 Max.		5 Max.	
Recommended Specifications			10 Max. w/ Fine & V.F.		10 Max.						10 Max. w/Silt & Clay	
ISTRC Guidelines		**89 to 100**	**5 Max.**	**3 Max.**	**3 Max.**	**10 Max.**	**15 to 25**	**40+**	**10 to 15**	**20 - #80**	**5 Max.**	
			10 Max. w/ Fine & V.F.		**10 Max.**		**65 to 85 Optimum**				**10 Max. w/Silt & Clay**	

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The I.S.T.R.C. System™

Company: [redacted]
Name:
Address:
City, ST, Zip

Account No. [redacted]
Date 6-Sep-07
Facility
ISTRC Rep. [redacted]

Physical Evaluation

ISTRC SYSTEM™ Core Analysis

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Porosity: Total Porosity %	Porosity: Capillary [Water Pores] %	Porosity: Non-Capillary [Air Pores] %
07080022-G04	Green #4, Center	4.38	18.45	1.47	58.82	41.18	27.14	14.04
	Organic [ISTRC Walkley/Black] .25 to 1 in.	**3.28%**				**Root Mass: 1/2"**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	**2.46%**				**Feeders: 3" sparse**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	**1.73%**						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	**1.05%**						
07080022-G09	Green #9, Center, 1st Tier	3.00	19.66	1.47	57.22	42.78	28.98	13.80
	Organic [ISTRC Walkley/Black] .25 to 1 in.	**3.38%**				**Root Mass: 1/2"**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	**2.59%**				**Feeders: less than 3"**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	**2.75%**						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	**4.05%**						
07080022-G09	Green #9, Center, 2nd Tier	0.01	29.46	1.34	53.70	46.30	39.53	6.77
	Organic [ISTRC Walkley/Black] 4 to 5 in.	**5.28%**				**Root Mass: N/A**		
	Organic [ISTRC Walkley/Black] 5 to 6 in.	**6.00%**				**Feeders: none**		
	Organic [ISTRC Walkley/Black] 6 to 7 in.	**5.70%**						
	Organic [ISTRC Walkley/Black] 7 to 8 in.	**5.78%**						
07080022-G13	Green #13, Center, 1st Tier	1.54	20.66	1.43	58.16	41.84	29.64	12.20
	Organic [ISTRC Walkley/Black] .25 to 1 in.	**3.16%**				**Root Mass: 1/2"**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	**2.30%**				**Feeders: less than 3"**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	**2.52%**						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	**3.40%**						
	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

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The I.S.T.R.C. System™

Company: [redacted]
Name:
Address:
City, ST, Zip

Account No. [redacted]
Date 6-Sep-07
Facility [redacted]
ISTRC Rep.

Physical Evaluation

ISTRC SYSTEM™ Core Analysis

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Porosity: Total Porosity %	Porosity: Capillary [Water Pores] %	Porosity: Non-Capillary [Air Pores] %
07080022-G13	Green #13, Center, 2nd Tier	0.37	27.46	1.33	55.05	44.95	36.62	8.33
	Organic [ISTRC Walkley/Black] 4 to 5 in.	**4.42%**				**Root Mass: N/A**		
	Organic [ISTRC Walkley/Black] 5 to 6 in.	**3.96%**				**Feeders: none**		
	Organic [ISTRC Walkley/Black] 6 to 7 in.	**2.63%**						
	Organic [ISTRC Walkley/Black] 7 to 8 in.	**2.43%**						
07080022-G15	Green #15, Center	1.27	24.97	1.41	56.34	43.66	35.25	8.41
	Organic [ISTRC Walkley/Black] .25 to 1 in.	**3.54%**				**Root Mass: 1/2"**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.	**2.40%**				**Feeders: less than 3"**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.	**2.88%**						
	Organic [ISTRC Walkley/Black] 3 to 4 in.	**3.25%**						
	Organic [ISTRC Walkley/Black] .25 to 1 in.					**Root Mass:**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					**Feeders:**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	Organic [ISTRC Walkley/Black] .25 to 1 in.					**Root Mass:**		
	Organic [ISTRC Walkley/Black] 1 to 2 in.					**Feeders:**		
	Organic [ISTRC Walkley/Black] 2 to 3 in.							
	Organic [ISTRC Walkley/Black] 3 to 4 in.							
	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: _____

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
¼” Hollow Tines	3.14%	2.18%	1.23%	0.79%	
3/8” Hollow Tines	7.07%	4.91%	2.76%	1.77%	
½” 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%
¾” Hollow Tines				7.07%	1.77%
¾” 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)	1mm Blade 3.93%	2mm Blade 7.87%	3mm Blade 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