TORV
Sustainable Agronomics

June 1, 2021

[redacted]

Sean,

Thank you for giving me the opportunity to sample your water and greens and make evaluations again this year. I really enjoyed coming to your course and doing the sampling. The two diverse environments that you manage turf in are unique. I was also struck by the amount of work you and your staff do and the challenges that you encounter.

Similar to last year, I used FAO handbook 29 guidelines to make the comparisons. FAO is the Food and Agricultural Organization of the United Nations and widely recognized as a leading source for irrigation water quality guidelines. The samples submitted at this time appear not to pose any significant negative soil interactions. However, the irrigation sample taken from the washpad does indicate that there is a potential for negative soil interactions due to moderate bicarbonate and sodium levels. Because the storage pond samples taken now and, in the past, have exhibited little to no concerns for irrigation usage, we have theorized that the underground spring that may be finding its way into your wet well may be responsible for the increased bicarbonate and sodium levels found in your irrigation water. Based on our discussions, it may be prudent to test the water again in the summer if drought conditions prevail along with performing a SPE (saturated paste extract) test to measure the effect the water is having on the soil at that particular time. As we discussed it will also help to formulate a measurable, proactive response. We may see some seasonal differences that may require adjustments to the water, cultural practices, and nutritional/supplemental applications.

The nutritional requirements for the green samples submitted are minimal. Nitrogen will be the main element to manage this season. Nutrient recommendations were based on 3.8 lbs. of annual nitrogen applied. There was a slight deficiency (.25 lbs.) of K_2O on 14 green and (.25 lbs.) of P on 7 green. Other than iron and/or manganese for color, no other nutrients are recommended at this time using MLSN guidelines and growth potential modeling for your specific area.

Based on summer water testing and SPE results, some additional amendments such as gypsum and/or acid may be recommended to counteract sodium and/or bicarbonate buildup if that should occur.

The OM% testing and results are now providing a baseline for making future cultural management decisions. The results correlated with your perception of green performance will determine future management practices to achieve your goals.

I would welcome any questions you might have regarding the evaluations.

I look forward to coming back up and doing it again!

Best Regards,

Eric Foerster, CGCS, MG
TORV, LLC

How to interpret these results

The Minimum Levels for Sustainable Nutrition (MLSN) guidelines are applied in this report. These guidelines are developed and based on two key principles (Global Soil Survey):

1. Excellent turf conditions can be produced when essential nutrients are present in the soil at or above the MLSN guideline. As long as the element of interest remains above the MLSN guideline, adding more of that element is not expected to confer an improvement to turfgrass performance.
2. The amount of nitrogen supplied to the grass controls the growth rate and consequently the uptake of mineral nutrients by the grass.

How and why MLSN works

It works by ensuring the grass is supplied with all the nutrients it can use while keeping a safe amount of each nutrient untouched in the soil as a reserve. The MLSN calculation identifies the amount of nutrients the grass uses at a particular site. It then ensures the grass is either supplied with 100% of those nutrients from fertilizer, from soil, or from a combination of soil and fertilizer (Woods et al., 2014).

This approach recognizes that grass uses nutrients. Rather than trying to maintain all the nutrients the grass could ever use, and then some, in a hypothetical optimum soil that doesn't exist, the MLSN approach makes a careful estimate of plant use and makes sure the grass is supplied with that much while still keeping a safe amount in reserve, untouched, in the soil. This approach puts the turfgrass manager in control.

"The fundamental principle of successful greenkeeping is the recognition of the fact that the finest golfing grasses flourish on poor soil and that more harm is done by over-, rather than underfertilizing" (MacKenzie, 1998).

Why MLSN is needed

Conventional soil test interpretation is based on guidelines that are higher than required to produce high quality turf. Turner and Waddington (1978) described this problem 40 years ago:

"Unfortunately, turfgrass recommendations appear to be based on research done with other crops, such as forages, results from turfgrass fertility studies not designed to relate to soil testing, and the best judgement of the agronomist making the recommendations."

Carrow et al. (2001, p. 164) wrote about this problem in their Turfgrass Soil Fertility book:

"In some cases, turfgrasses have been placed in a 'high' P and K requirement category, while pasture grasses were in a 'low' category. This decision was based on economics, not agronomics. The cost of fertilization was not considered of primary importance for turf."

The MLSN approach to soil test interpretation is designed to make a fertilizer recommendation that is based on supplying the grass all the nutrients that it can use, while ensuring a safe amount remains in the soil. This solves – or more precisely, avoids – many of the problems of conventional soil test interpretation.

The following "Frequently asked questions" is directly from Dr. Micah Woods's "MLSN Cheat Sheet", February 1, 2018.

Frequently asked questions

How do I know the nutrients are available?

You know the nutrients are available because you've done a soil test. That's what a soil test is – by definition it produces a nutrient availability index. If you don't trust the soil tests, then I suggest skipping them altogether. Instead, assume the soil can supply nothing, and supply to the grass 100% (or a little more) of its possible use of each element. This isn't the most efficient way to do it, but you won't need to worry about availability, and it is guaranteed to supply all that the grass can use.

MLSN guideline, target level or minimum level?

Conventional soil test interpretation may give the impression that there are target or optimum levels in the soil. The MLSN guideline is a minimum value – minimum is the M in MLSN so we haven't always repeated that – that one doesn't want to drop below. It's not a level below which one will have deficiency. It's not a target level that one ideally will have the soil at. What the MLSN guideline represents is a level in the soil with enough of that element to produce high quality turf. There is high quality turf in soils with less of that element too, and that's why we are confident the MLSN guideline is a safe level. But there aren't a lot of soils with less, so we suggest keeping the soil from dropping below the MLSN guideline.

Seriously, the same minimum for every grass, soil, and location? No regional customization?

We are confident that the MLSN guideline is enough to produce high quality turf for every grass, everywhere. MLSN has the ultimate customization, however, because the grass use of elements is entirely site specific. In order to ensure the soil doesn't drop below the MLSN guideline, one has to estimate the expected nutrient use by the plant over time. That's where the customization comes in.

How is this different than conventional soil test interpretation?

The focus of MLSN is on keeping the soil from dropping below a known safe level. To do this, one must account for how much the grass uses over time. The MLSN approach explicitly calculates the grass use. The conventional interpretation (Carrow et al., 2004) is about classifying based on soil levels.

What about micronutrients?

I don't worry about them. They are used in tiny amounts by the grass. The grass uses about 400 times as much N as it does the most used micronutrient. The grass probably can get all the micronutrients it needs from the soil, because it uses such small quantities of them. And because it uses such small quantities of them, if you are worried about it, apply micronutrients. It doesn't cost much and is easy to do.

What about salinity?

Salinity can kill the grass. That's a major problem. To keep the grass from getting killed by high salinity, one needs to leach the salts from the soil. I wouldn't worry much about soil nutrient levels or MLSN if I have a salinity problem. I would leach the salts, and I would supply 100% or a little more than the grass can use.

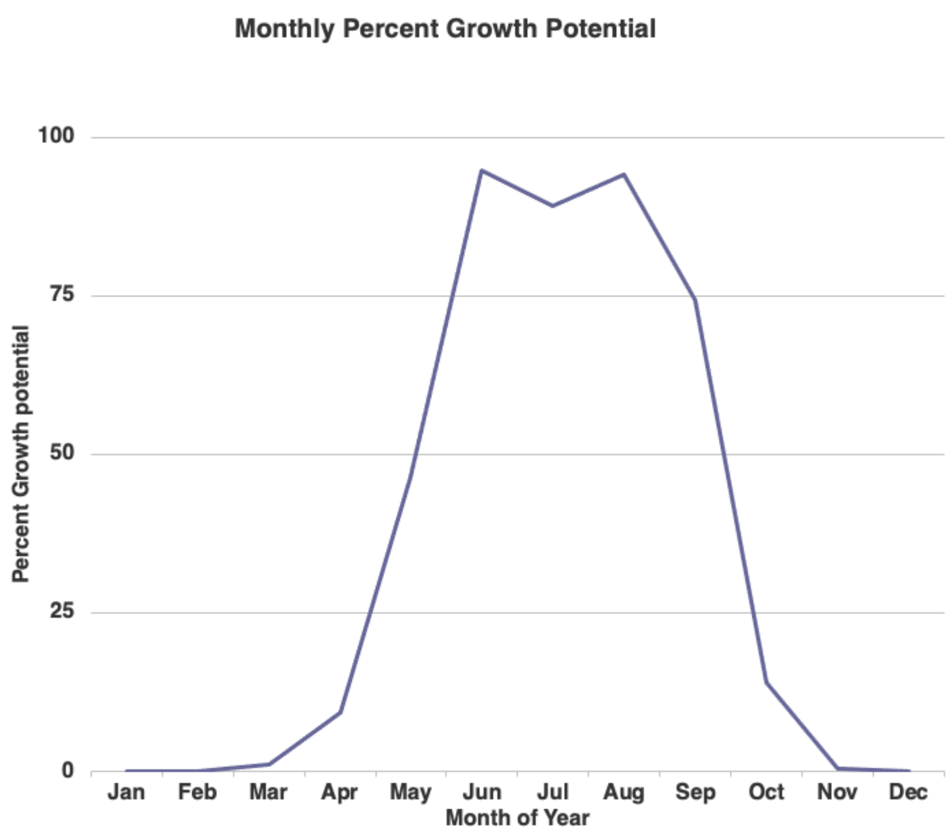
Turf growth potential model

This growth potential model is based upon the estimated annual nitrogen input that was provided, 3.81 lbs on greens. The temperature and rainfall data is provided by weatherbase.com and is specific to your location. Pace Turf, LLC (Gelernter and Stowell, 2005) developed the growth potential model to explain the myriad of ways in which weather impacts turf growth. The model considers turf growth to be good when the GP is between 50% and 100% (the best possible growth occurs at a GP of 100%). However, when weather conditions are either too hot or too cold for optimal turf growth, the GP falls below 50%, and turf becomes progressively more stressed. When the GP falls to 10% or lower, growth is extremely limited. Appearing below is your model specific to The [redacted].

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg T (F)	27.1	30.4	37.7	46.2	55.6	64.7	72.8	71.5	60.3	48.2	35.8	26.5
Rainfall (in)	0.50	0.50	1.10	1.70	2.20	2.10	1.30	0.80	1.30	1.20	0.60	0.50

Grass Maximum N/month lb/1000 sq ft =	**0.90**	
Optimum Growth Temperature (F) =	*68*	*Set to 68 for cool season and 88 for warm season grass*
Variance =	*10*	*Set to 10 for cool season and 12 for warm season grass*

% Growth Potential	0	0	1	9	46	95	89	94	74	14	1	0	Total lb/1000 sq ft	Removed from Soil ppm	Plus MLSN ppm
N lb/1000 sq ft	0.0	0.0	0.0	0.1	0.4	0.9	0.8	0.8	0.7	0.1	0.0	0.0	**3.81**	NA	NA
K lb/1000 sq ft	0.00	0.00	0.00	0.04	0.21	0.43	0.40	0.42	0.33	0.06	0.00	0.00	1.91	62	99
P lb/1000 sq ft	0.00	0.00	0.00	0.01	0.05	0.11	0.10	0.11	0.08	0.02	0.00	0.00	0.48	16	37
Ca lb/1000 sq ft	0.00	0.00	0.00	0.01	0.04	0.09	0.08	0.08	0.07	0.01	0.00	0.00	0.38	12	343
Mg lb/1000 sq ft	0.00	0.00	0.00	0.01	0.03	0.05	0.05	0.05	0.04	0.01	0.00	0.00	0.24	8	55
S lb/1000 sq ft	0.00	0.00	0.00	0.01	0.03	0.06	0.06	0.06	0.05	0.01	0.00	0.00	0.29	9	15
Fe lb/1000 sq ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.019	1	45
Mn lb/1000 sq ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.007	0	6



Executive Summary of Nutrient Recommendations Based on Findings using MLSN Guidelines

SOIL AUDIT

Greens

This is a summary and recommendations for the average of all seven green samples, 1, 2, 7, 11, 13, 14, and 16. Recommendations are based on 3.81 lbs of annual applied nitrogen, MLSN guidelines, and specific growth potential modeling for Billings, Montana (59101) where The [redacted] is located. 40 years of historical weather data for your specific location was used in your model.

pH The average pH is 7.62. This is within the optimum range for soil microbial activity and soil nutrient availability.

Organic matter The average organic matter is 2.55%. This is OK. Keep consistent cultural practices to dilute and manage OM.

Available nitrogen The average nitrate is 1.15 ppm. This is OK and indicates that the plant is using the available nitrogen. Green 13 reported the highest nitrate available at 3.3 ppm.

Potassium The average potassium is 109 ppm. 99 ppm is required. Green 14 is DEFICIENT. Apply .25 lbs of K_2O to Green 14. No more applications of potassium are required at this time.

Phosphorus The average phosphorus is 45 ppm Mehlich III. 37 ppm is required. Green 7 is DEFICIENT in P. Apply .25 lbs of P to Green 7.

Calcium The average calcium is 1109 ppm. This is more than enough of the 343 ppm required. None is required as fertilizer for this year.

Magnesium The average magnesium is 141 ppm. This is more than enough of the 55 ppm required. None is required as fertilizer for this year.

Sulfur The average sulfur is 49 ppm. This is more than enough of the 15 ppm required. None is required as fertilizer for this year.

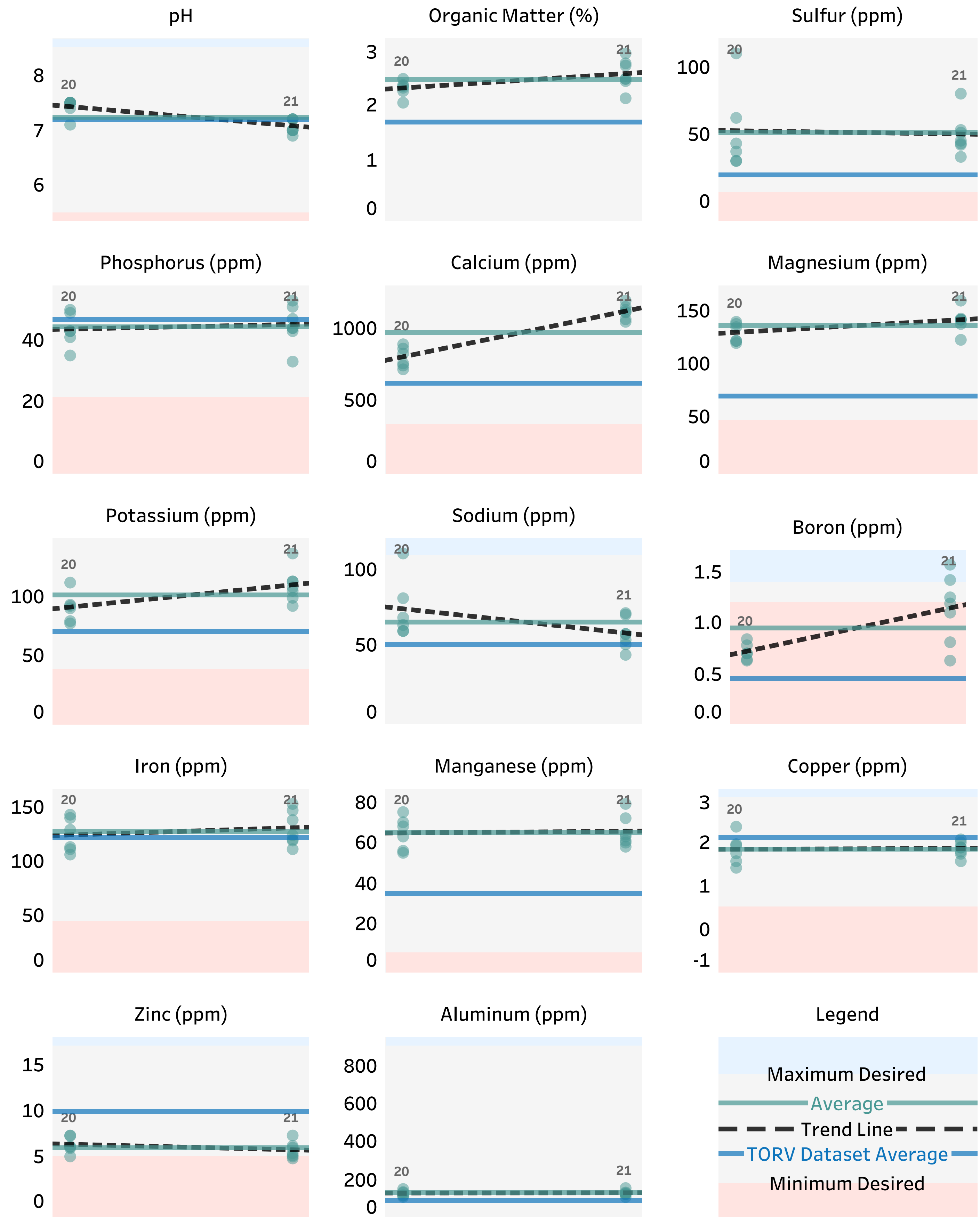
Iron The average iron is 130 ppm. This is more than enough of the 45 ppm required. None is required as fertilizer for this year. Apply iron as needed to correct chlorosis symptoms when they appear.

Manganese The manganese is 65 ppm. This is more than enough of the 6 ppm required. None is required as fertilizer for this year.

Sodium The sodium levels reported are OK. Sodium levels dropped. Based on discussions concerning green performance during extended periods of dry weather and relying upon the irrigation system, periodic soil testing during the summer months may be recommended to determine if there is a sodium problem and to what extent.

Micronutrients All are present. None are required as fertilizer.

Soil Testing | Greens



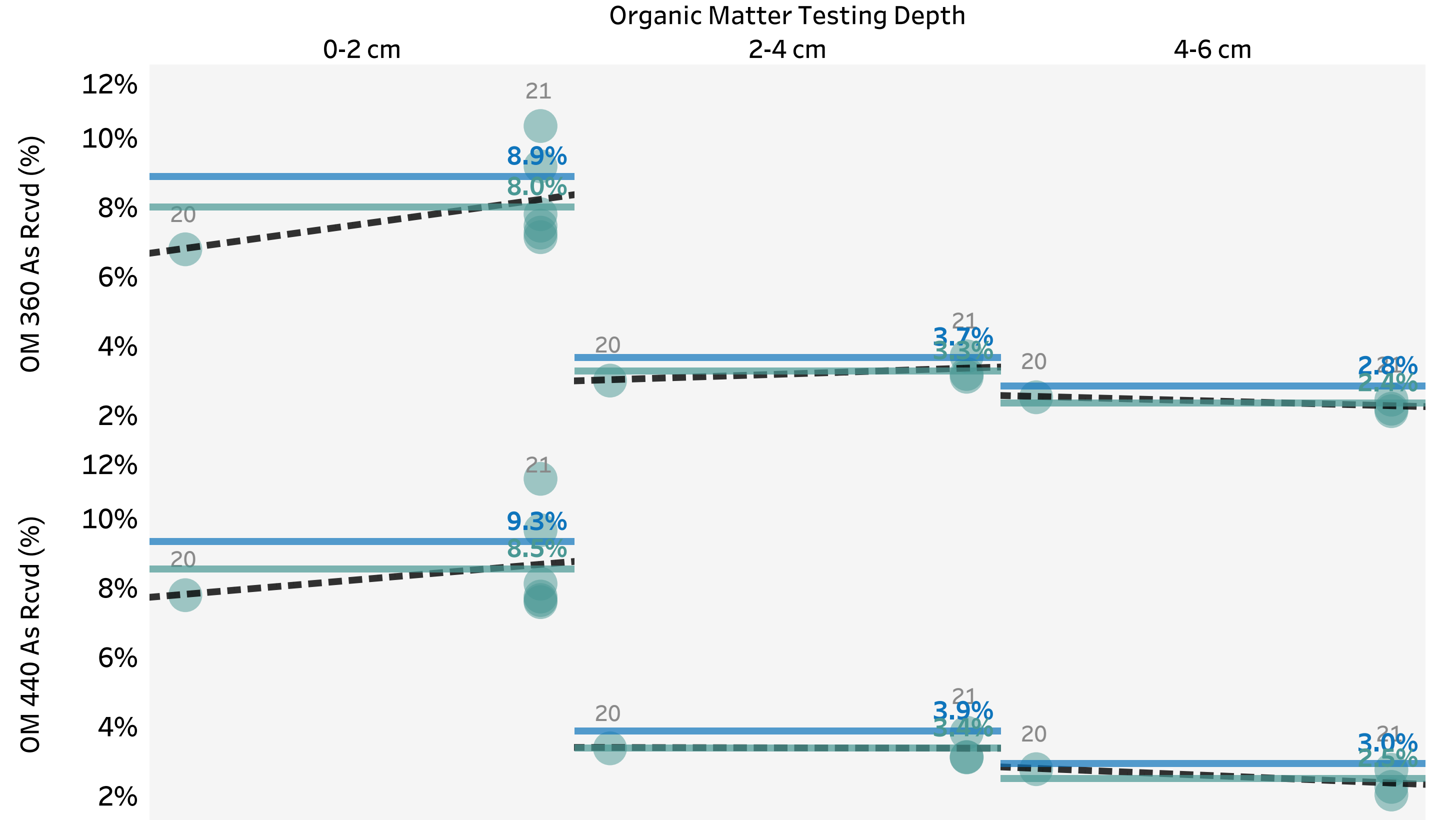
OM %

These measurements are neither good nor bad. They are a baseline. Now that a baseline has been established, a year from now we can do the same test and measure any differences. We can then use the information such as fertilizer applied, cultural practices, sand applied, verti-cutting, aerification, etc. to see how these practices have changed the OM% by depth. Ideally, once a desired OM% has been identified based on playability and turf performance, fertility and cultural practices can be adjusted to maintain the desired OM%.

The S196 test package includes the entire sample submitted. This includes leaves, stems, and roots. This differs from the standard soil test which filters out most of the components. This is the reason why the percentages appear higher than that on the standard soil test.

OM Testing Summary | Green

-----Average----- | -----TORV-Dataset-Average----- | -----Trendline-----



Measurement Name / Organic Matter Testing Depth

			OM 360 As Rcvd (%)			OM 440 As Rcvd (%)		
			0-2 cm	2-4 cm	4-6 cm	0-2 cm	2-4 cm	4-6 cm
1	2021	May 17, 2021	7.3%			7.7%		
		WT AVG YEAR	7.3%			7.7%		
	WT AVG HOLE		7.3%			7.7%		
3	2021	May 17, 2021	7.8%	3.2%	2.2%	8.1%	3.2%	2.1%
		WT AVG YEAR	7.8%	3.2%	2.2%	8.1%	3.2%	2.1%
	WT AVG HOLE		7.8%	3.2%	2.2%	8.1%	3.2%	2.1%
4	2021	May 17, 2021	7.2%	3.7%	2.5%	7.6%	3.9%	2.8%
		WT AVG YEAR	7.2%	3.7%	2.5%	7.6%	3.9%	2.8%
	WT AVG HOLE		7.2%	3.7%	2.5%	7.6%	3.9%	2.8%
6	2020	October 16, 2020	6.8%	3.0%	2.6%	7.8%	3.4%	2.8%
		WT AVG YEAR	6.8%	3.0%	2.6%	7.8%	3.4%	2.8%
	2021	May 17, 2021	7.5%	3.1%	2.2%	7.8%	3.1%	2.3%
		WT AVG YEAR	7.5%	3.1%	2.2%	7.8%	3.1%	2.3%
	WT AVG HOLE		7.2%	3.1%	2.4%	7.8%	3.3%	2.5%
9	2021	May 17, 2021	9.2%			9.7%		
		WT AVG YEAR	9.2%			9.7%		
	WT AVG HOLE		9.2%			9.7%		
18	2021	May 17, 2021	10.4%			11.2%		
		WT AVG YEAR	10.4%			11.2%		
	WT AVG HOLE		10.4%			11.2%		
WT AVG TOTAL			8.0%	3.3%	2.4%	8.5%	3.4%	2.5%

Storage Pond

	Lab Value	Likelihood of Soil Problems: Low	Medium	High
ECw (Conductivity) (mmhos/cm)	.56	< 0.7	0.7 - 3.0	> 3.0
TDS (mg/l, ppm)	356.48	< 450	450 - 2000	> 2000
SAR 0 -3	1.53	ECw > 0.7	ECw 0.7 - 0.2	ECw < 0.2
SAR 3 - 6		ECw > 1.2	ECw 1.2 - 0.3	ECw < 0.3
SAR 6 - 12		ECw > 1.9	ECw 1.9 - 0.5	ECw < 0.5
SAR 12 - 20		ECw > 2.9	ECw 2.9 - 1.3	ECw < 1.3
Sodium Na (mg/l, ppm)	48.05	< 70	70 - 200	> 200
RSC (me/l)*	-1.55	< 1.25	> 1.25	
Nitrate NO3 - N (mg/l, ppm)		< 5	5 - 20	> 30
Ammonium NH4 - N (mg/l, ppm)		< 5	5 - 20	> 20
Boron B (mg/l, ppm)	.12	< 0.5	0.5 - 3.0	> 3.0
Bicarbonate HCO3 (mg/l, ppm)	133.48	92	92 - 520	> 520
Chloride Cl (mg/l, ppm)	6.98	< 105	> 105	

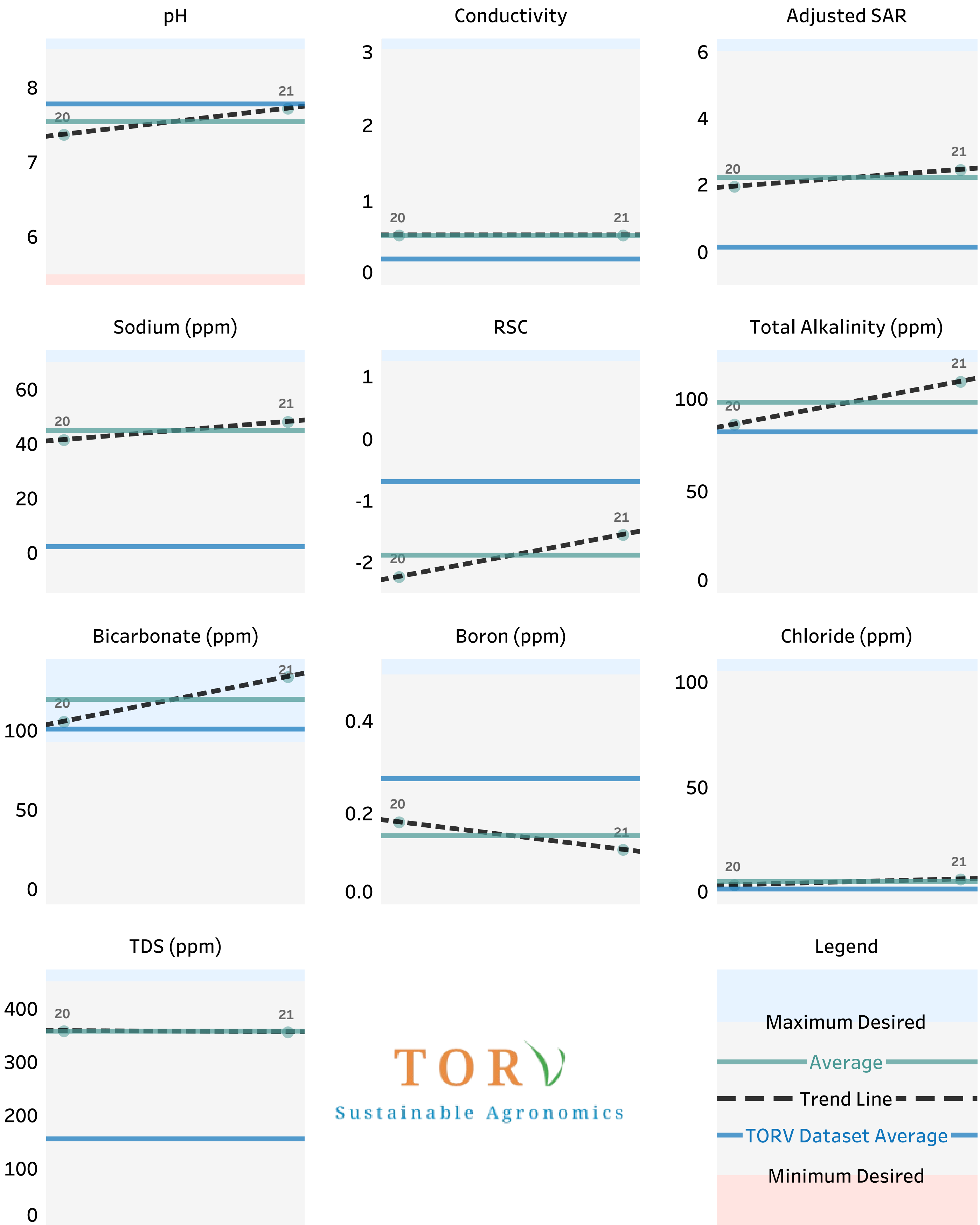
- The bicarbonates pose a medium risk for soil problems.
- Overall water quality at the time of sampling poses little risk for soil problems.

Irrigation Washpad

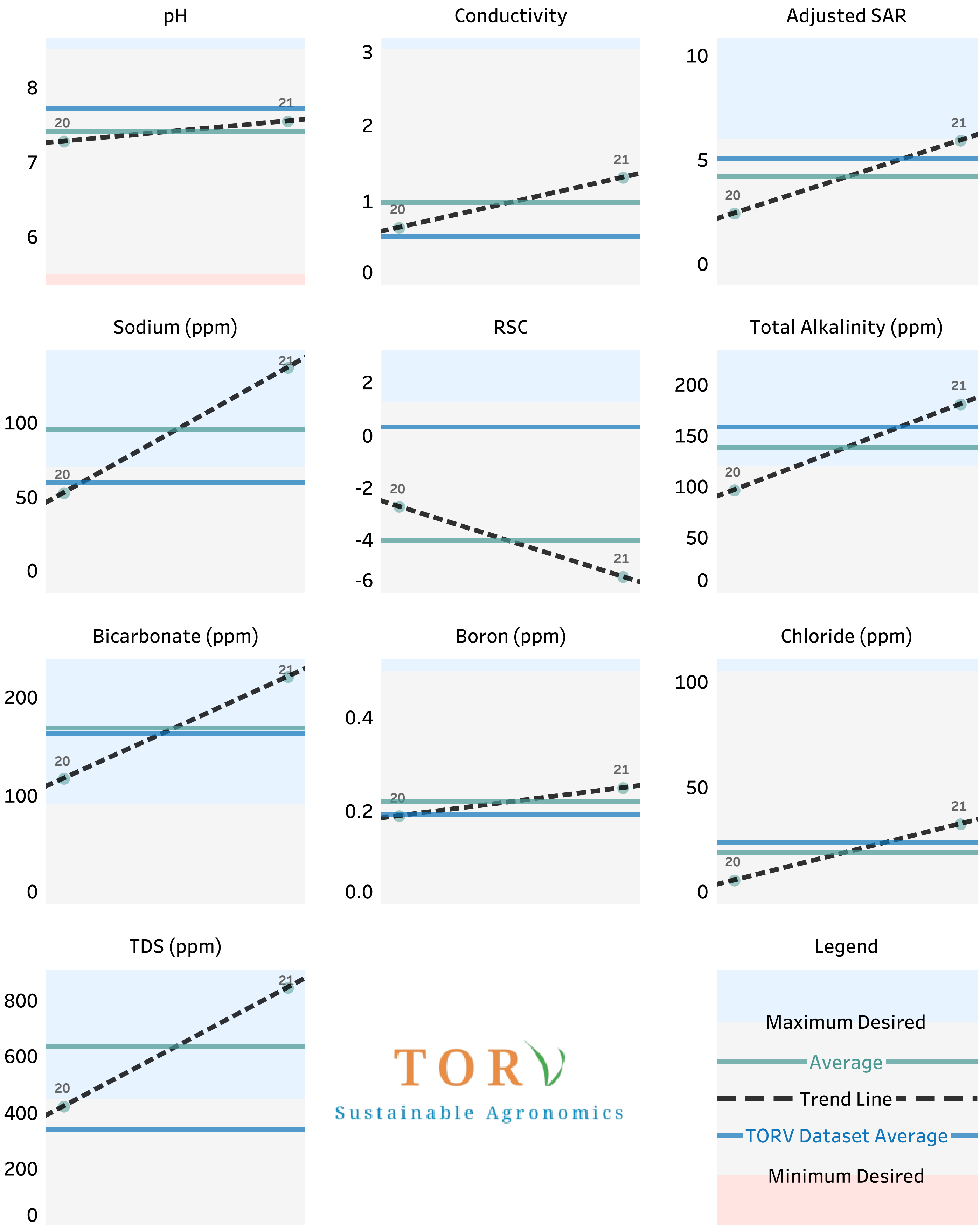
	Lab Value	Likelihood of Soil Problems: Low	Medium	High
ECw (Conductivity) (mmhos/cm)	1.32	< 0.7	0.7 - 3.0	> 3.0
TDS (mg/l, ppm)	844.42	< 450	450 - 2000	> 2000
SAR 0 -3	2.81	ECw > 0.7	ECw 0.7 - 0.2	ECw < 0.2
SAR 3 - 6		ECw > 1.2	ECw 1.2 - 0.3	ECw < 0.3
SAR 6 - 12		ECw > 1.9	ECw 1.9 - 0.5	ECw < 0.5
SAR 12 - 20		ECw > 2.9	ECw 2.9 - 1.3	ECw < 1.3
Sodium Na (mg/l, ppm)	137.10	< 70	70 - 200	> 200
RSC (me/l)*	-5.40	< 1.25	> 1.25	
Nitrate NO3 - N (mg/l, ppm)		< 5	5 - 20	> 30
Ammonium NH4 - N (mg/l, ppm)		< 5	5 - 20	> 20
Boron B (mg/l, ppm)	.25	< 0.5	0.5 - 3.0	> 3.0
Bicarbonate HCO3 (mg/l, ppm)	220.57	92	92 - 520	> 520
Chloride Cl (mg/l, ppm)	33.02	< 105	> 105	

- The sodium levels pose a medium risk for soil problems. High sodium levels in the soil can prohibit nutrient uptake and undermine soil structure.
- The bicarbonates pose a medium risk for soil problems.
- As discussed, there appears to be significant difference in water quality between the irrigation pond and the irrigation washpad sample. It is theorized that groundwater from a nearby spring is leaching into the wet well and contaminating the irrigation water. In the fall of 2020 this water was tested and found to contain high levels of sodium and bicarbonates.
- As this is the primary source point for turfgrass irrigation, it is recommended that a SPE (saturated paste extract) test be conducted this season. This test will determine the effect that your water is having on the turfgrass plant. Conducting this test periodically throughout the growing season will determine the level of risk and a proactive remedy.

Water Testing | Storage Pond



Water Testing | Irrigation



TORV
Sustainable Agronomics

#/1000

BROOKSIDE LABORATORIES, INC.

84398-2

SOIL AUDIT AND INVENTORY REPORT

Name The [redacted] City Billings State MT

Independent Consultant TORV, LLC Date 05/25/2021

Sample Location	GREEN	1		2		7
Sample Identification		4 in		4 in		4 in
Lab Number		0046-1		0047-1		0048-1
Total Exchange Capacity (ME / 100 g)		8.23		7.27		7.24
pH (H_2O 1:1)		7.0		7.0		7.2
Organic Matter (360°C LOI) %		2.71		2.43		2.75
Estimated Nitrogen Release	# / 1000	1		1		1
ANIONS: SOLUBLE SULFUR*	ppm	53		33		42
PHOSPHORUS: MEHLICH III # / 1000	P as P_2O_5	4		3		2
	ppm of P	53		43		33
PHOSPHORUS: BRAY II # / 1000	P as P_2O_5	11		9		9
	ppm of P	153		123		128
PHOSPHORUS: OLSEN # / 1000	P as P_2O_5					
	ppm of P					
EXCHANGABLE CATIONS: CALCIUM*	# / 1000	36		33		32
	ppm	1189		1061		1043
MAGNESIUM*	# / 1000	5		4		4
	ppm	160		138		142
POTASSIUM*	# / 1000	3		3		3
	ppm	113		108		113
SODIUM*	# / 1000	2		2		2
	ppm	70		50		57
BASE SATURATION PERCENT						
Calcium	%	72.24		72.97		72.03
Magnesium	%	16.20		15.82		16.34
Potassium	%	3.52		3.81		4.00
Sodium	%	3.70		2.99		3.42
Other Bases	%	4.40		4.40		4.20
Hydrogen	%	0.00		0.00		0.00
EXTRACTABLE MINORS						
Boron* (ppm)		1.10		1.19		1.25
Iron* (ppm)		153		120		119
Manganese* (ppm)		79		72		60
Copper* (ppm)		1.99		1.87		1.73
Zinc* (ppm)		7.26		5.92		5.10
Aluminum* (ppm)		158		126		135
OTHER TESTS: Soluble Salts (mmhos / cm)		0.19		0.13		0.17
Chlorides (ppm)		103.44		14.72		13.78
NO_3-N (ppm)		0.9		0.8		1.0
NH_4-N (ppm)		3.3		3.9		3.5

d - specific

* Mehlich III Extractable

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BROOKSIDE LABORATORIES, INC.

84398-2

SOIL AUDIT AND INVENTORY REPORT

Name The [redacted] City Billings State MT

Independent Consultant TORV, LLC Date 05/25/2021

Sample Location	GREEN	11		13		14
Sample Identification		4 in		4 in		4 in
Lab Number		0049-1		0050-1		0051-1
Total Exchange Capacity (ME / 100 g)		7.64		7.65		7.64
pH (H_2O 1:1)		7.0		7.2		6.9
Organic Matter (360°C LOI) %		2.47		2.93		2.12
Estimated Nitrogen Release	# / 1000	1		1		1
ANIONS: SOLUBLE SULFUR*	ppm	80		51		45
PHOSPHORUS: MEHLICH III # / 1000	P as P_2O_5	3		4		3
	ppm of P	44		51		47
PHOSPHORUS: BRAY II # / 1000	P as P_2O_5	9		9		8
	ppm of P	131		134		116
PHOSPHORUS: OLSEN # / 1000	P as P_2O_5					
	ppm of P					
EXCHANGABLE CATIONS: CALCIUM*	# / 1000	34		34		35
	ppm	1108		1112		1146
MAGNESIUM*	# / 1000	4		4		4
	ppm	142		142		123
POTASSIUM*	# / 1000	3		4		3
	ppm	105		137		92
SODIUM*	# / 1000	2		2		1
	ppm	71		53		43
BASE SATURATION PERCENT						
Calcium	%	72.51		72.68		75.00
Magnesium	%	15.49		15.47		13.42
Potassium	%	3.52		4.59		3.09
Sodium	%	4.04		3.01		2.45
Other Bases	%	4.40		4.20		4.50
Hydrogen	%	0.00		0.00		1.50
EXTRACTABLE MINORS						
Boron* (ppm)		1.42		1.57		0.63
Iron* (ppm)		111		138		147
Manganese* (ppm)		64		58		63
Copper* (ppm)		1.78		2.06		1.88
Zinc* (ppm)		5.33		6.12		4.97
Aluminum* (ppm)		125		111		131
OTHER TESTS: Soluble Salts (mmhos / cm)		0.27		0.17		0.17
Chlorides (ppm)		12.09		13.51		9.22
NO_3-N (ppm)		0.8		3.3		0.6
NH_4-N (ppm)		5.3		4.3		2.5

d - specific

* Mehlich III Extractable

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BROOKSIDE LABORATORIES, INC.

SOIL AUDIT AND INVENTORY REPORT

Name The [redacted] City Billings State MT

Independent Consultant TORV, LLC Date 05/25/2021

Sample Location		GREEN	16			
Sample Identification			4 in			
Lab Number			0052-1			
Total Exchange Capacity (ME/100 g)			7.64			
pH (H_2O 1:1)			7.2			
Organic Matter (360°C LOI) %			2.47			
Estimated Nitrogen Release		#/1000	1			
ANIONS	SOLUBLE SULFUR*	ppm	43			
ANIONS – PHOSPHORUS	MEHLICH III #/1000	P as P_2O_5	3			
		ppm of P	44			
	BRAY II #/1000	P as P_2O_5	8			
		ppm of P	113			
	OLSEN #/1000	P as P_2O_5				
		ppm of P				
EXCHANGABLE CATIONS	CALCIUM*	#/1000	35			
		ppm	1126			
	MAGNESIUM*	#/1000	4			
		ppm	143			
	POTASSIUM*	#/1000	3			
		ppm	99			
	SODIUM*	#/1000	2			
		ppm	57			
BASE SATURATION PERCENT						
	Calcium	%	73.69			
	Magnesium	%	15.60			
	Potassium	%	3.32			
	Sodium	%	3.24			
	Other Bases	%	4.20			
	Hydrogen	%	0.00			
EXTRACTABLE MINORS						
	Boron* (ppm)		0.81			
	Iron* (ppm)		124			
	Manganese* (ppm)		61			
	Copper* (ppm)		1.56			
	Zinc* (ppm)		4.75			
	Aluminum* (ppm)		127			
OTHER TESTS	Soluble Salts (mmhos/cm)		0.17			
	Chlorides (ppm)		9.77			
	NO_3-N (ppm)		0.7			
	NH_4-N (ppm)		3.4			

d - specific

* Mehlich III Extractable

BROOKSIDE LABORATORIES, INC.

** WATER ANALYSIS

The [redacted]
3429 [redacted] Blvd
Billings, MT 59101

File Number: 84398
Date Received:05/20/2021
Date Reported:05/21/2021

Submitted By:TORV, LLC

Lab Number	1119
Sample Location	THE [redacted]
Sample Description	IRRIGATION

pH		7.55
Hardness	(ppm)	451.30
Hardness	(grains/gal)	26.39
Conductivity	(mmhos/cm)	1.32
Sodium Adsorp. Ratio		2.81
Adjusted SAR		5.94
Adjusted RNa		3.59
pHc		7.28
Residual Sodium Carbonate (RSC)		-5.40

		(ppm)	meq/l	lbs/ac in
Calcium	(Ca)	120.40	6.01	27.31
Magnesium	(Mg)	36.56	3.01	8.29
Potassium	(K)	5.14	0.13	1.17
Sodium	(Na)	137.10	5.96	31.09
Iron	(Fe)	< 0.10		
Total Alkalinity	(CaCO3)	180.76		41.00
Carbonate	(CO3)	0.00		
Bicarbonate	(HCO3)	220.57	3.62	50.03
Hydroxide	(OH)	0.00		
Chloride	(Cl)	33.02	0.93	7.49
Sulfur as	(S04)	513.30	10.69	116.42
Salt Concentration	(TDS)	844.42		191.51
Boron	(B)	0.25		0.06

Cation/Anion Ratio	0.99

Reviewed by: [signature]

BROOKSIDE LABORATORIES, INC.

** PHYSICAL ANALYSIS REPORT **

The [redacted]
3429 [redacted] Blvd
Billings, MT 59101

File Number: 84398
Date Received: 05/20/2021
Date Reported: 05/26/2021

Submitted By: TORV, LLC

SAMPLE LOCATION: GREEN OM

NBR	FIELD	DESCRIPTION	OM 360 As Rcvd (%)	OM 440 As Rcvd (%)
004	3	0-2	7.82	8.14
005	3	2-4	3.22	3.15
006	3	4-6	2.15	2.07
007	4	0-2	7.16	7.61
008	4	2-4	3.73	3.85
009	4	4-6	2.48	2.78
010	6	0-2	7.49	7.77
011	6	2-4	3.14	3.14
012	6	4-6	2.22	2.29
013	1	0-2	7.29	7.67
014	9	0-2	9.20	9.68
015	18	0-2	10.36	11.18

BROOKSIDE LABORATORIES, INC.

** WATER ANALYSIS

The [redacted]
3429 [redacted] Blvd
Billings, MT 59101

File Number: 84398
Date Received:05/20/2021
Date Reported:05/21/2021

Submitted By:TORV, LLC

Lab Number	1120
Sample Location	THE [redacted]
Sample Description	IRRIGATION POND

pH		7.72
Hardness	(ppm)	187.31
Hardness	(grains/gal)	10.95
Conductivity	(mmhos/cm)	0.56
Sodium Adsorp. Ratio		1.53
Adjusted SAR		2.45
Adjusted RNa		1.63
pHc		7.79
Residual Sodium Carbonate (RSC)		-1.55

		(ppm)	meq/l	lbs/ac in
Calcium	(Ca)	49.92	2.49	11.32
Magnesium	(Mg)	15.15	1.25	3.44
Potassium	(K)	2.92	0.07	0.66
Sodium	(Na)	48.05	2.09	10.90
Iron	(Fe)	0.17		0.04
Total Alkalinity	(CaCO3)	109.40		24.81
Carbonate	(CO3)	0.00		
Bicarbonate	(HCO3)	133.48	2.19	30.27
Hydroxide	(OH)	0.00		
Chloride	(Cl)	6.98	0.20	1.58
Sulfur as	(S04)	165.69	3.45	37.58
Salt Concentration	(TDS)	356.48		80.85
Boron	(B)	0.12		0.03

Cation/Anion Ratio 1.01

Reviewed by: