Playing Field Evaluations for M-NCPPC

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Introduction

The Prince George's County Department of Parks and Recreation is seeking to improve maintenance practices on some of its sports fields to provide safe, agronomically sound play areas for county residents and amateur sports teams. The county would like to do a "turf inventory" on its recreational sports fields and Board of Education fields, which the Department of Parks and Recreation may take over in the near future. While it wasn't feasible within the framework of the class to examine every sports field, PLSC402 "Sports Turf Management" students examined and researched three fields, which were representative of other county field conditions and traffic and play patterns.

The results of standard sports turf field assessment measurements, including shear strength, surface hardness, bulk density, and volumetric water content, are included in this report. Based on these findings, field visits, and observations agronomic recommendations were developed and included in this report.

Materials and Methods

To assess the field characteristics and attributes related to playability, player safety and agronomic quality, several parameters were measured on the field: infiltration rate, shear strength, surface hardness, volumetric water content and bulk density. All these measurements were taken in order to inspect the field conditions and give the recommendations for the fields. Descriptions of each test are included below.

Infiltration Rate

The infiltration rate of soil is calculated using a double-ring infiltrometer, which measures the rate at which water infiltrates into soil. It is a measurement of the amount of water that enters into the soil (depth in mm) in one hour.

Shear Strength

A Shear Vane is used to measure the shear strength of turfgrass. A rod with vane supporting it is inserted into the ground to measure the reading. The instrument is rotated clockwise or counterclockwise so the gauge at the top can take a reading. The higher the reading, the greater the shear strength of the turfgrass. It is measured in Newton-meters (N-m).

Surface Hardness

A Clegg Hammer (also called a Clegg Impact Soil Tester or Clegg Decelerometer) tests surface hardness by measuring the deceleration of a free-falling hammer from a fixed height onto the surface. The instrument is connected by a cable to a device that displays the measurement readings in G-max. The higher the reading, the greater the soil's hardness.

Volumetric Water Content

Time domain reflectometry (TDR) measures the soil's moisture content as percentage of volumetric water content (%VWC) based on the soil's electrical conductivity. The instrument comprises two stainless steel soil probes that detect the soil layer densities, soil permeability levels, and soil types. to measure VWC. The instrument indicates VWC by measuring the dielectric between the two probes, a direct correlation to the water content of the soil.

Bulk Density

Bulk density provides an indication of soil compaction. It can be defined as the soil's dry weight divided by its volume. Volume typically includes the volume of soil particles and the volume of pores among the soil particles. It is expressed in g/cm3.

The instrument measurements were taken at three Prince George's County parks—Acredale Park, Powder Mill Park, and Riverdale Park.

Two of the parks—Acredale and Powder Mill—were divided into quadrants: southeast, southwest, northeast and northwest. At these two parks, three readings were taken in each quadrant by each instrument (except Clegg Hammer measurements at Powder Mill Park).

For the baseball field at Riverdale Park measurements were taken in locations to evaluate the functionality of different parts of the field. Infiltrometer readings were taken randomly at two different locations of the field for 10 minutes and the reading was then calculated (extrapolated) for one hour. Soil profiles were also collected for the field. The soil samples for bulk density were collected in different quadrants of the field.

Data from Acredale Park were collected on September 22, 2020; however due to the data transmission cable breaking on the Clegg Hammer for part of the readings, Clegg data at Acredale and bulk density data at Powder Mill Park were re-taken on December 4, 2020. Data were taken at Powder Mill on September 29, 2020 and at Riverdale on November 3, 2020. Statistical means and t-tests were calculated for the data from each park. Analysis of Variance (ANOVA) tables are in the Appendix.

Data Tables

Table 1: Acredale Park: Percentage VWC, Surface Hardness, and Shear Strength

Quadrant	Mean		
	%VWC (Sep 22)	Clegg (G_{max}) (Dec 4)	Shear Strength (N-m) (Sep 22)
NE	31.2	73.7	21.5
SE	21.0	86.3	16.3
SW	25.6	111.7	17.7
NW	28.2	112.7	26.3

Table 2: Powder Mill Park: PercentageVWC, Surface Hardness, and Shear Strength

<table>
<tr><th rowspan="3">Quadrant</th><th colspan="4">Mean</th></tr>
<tr><th rowspan="2">%VWC</th><th colspan="2">Clegg Hammer (G_{max})</th><th rowspan="2">Shear Strength (N-m)</th></tr>
<tr><th>Before shockwave</th><th>After shockwave</th></tr>
<tr><td>NE</td><td>37.3</td><td rowspan="2">107</td><td rowspan="2">61</td><td>10.5</td></tr>
<tr><td>SE</td><td>34.5</td><td>12.3</td></tr>
<tr><td>SW</td><td>37.7</td><td rowspan="2">122</td><td rowspan="2">72</td><td>12.2</td></tr>
<tr><td>NW</td><td>35.9</td><td>11.0</td></tr>
</table>

Table 3: Riverdale Park: Percentage VWC, Surface Hardness, and Shear Strength

Quadrant	Mean		
	%VWC	Clegg (G_{max})	Shear Strength (N-m)
Left	27.7	48	12.0
Center	26.0	48	10.3
Right	25.5	47	13.0

Mound	42.2	58	10.5
Base	34.0	45	12.5

Table 4: Infiltration rate in Acredale, Powder Mill, and Riverdale Parks

Quadrant	Acredale	Powder Mill	Riverdale
South-Central	0.6”	0.2”	0.6”
NW	1.8”	1.8”	2.4”

Table 5: Bulk Density Measurements for Powder Mill, Riverdale, and Acredale Parks

Powder Mill Park			**Riverdale Park**			**Acredale Park**		
Area/ quadrant	Bulk Density (g/cm^3)		Area/ quadrant	Bulk Density (g/cm^3)		Area/ quadrant	Bulk Density (g/cm^3)	
SE	114 g	1.27	Left field	111 g	1.23	NE	69 g	0.77
SW	117 g	1.30	Front of mound*	107 g	1.25	SW	127 g	1.41
NW	126 g	1.40	Back of mound*	66 g	0.65	SE	110 g	1.22
SE	121 g	1.34	Outfield*	92 g	0.92	NW*	n/a	

*“Front of mound,” “Back of mound,” and “Outfield” bulk density samples didn’t encompass the entire sampling cup, so the bulk density calculations reflect an adjusted volume of soil in the sampler. The NW Acredale sample was misprocessed and could not be calculated.

Figures

Figure 1. Percent VWC in Acredale, Powder Mill, and Riverdale Parks

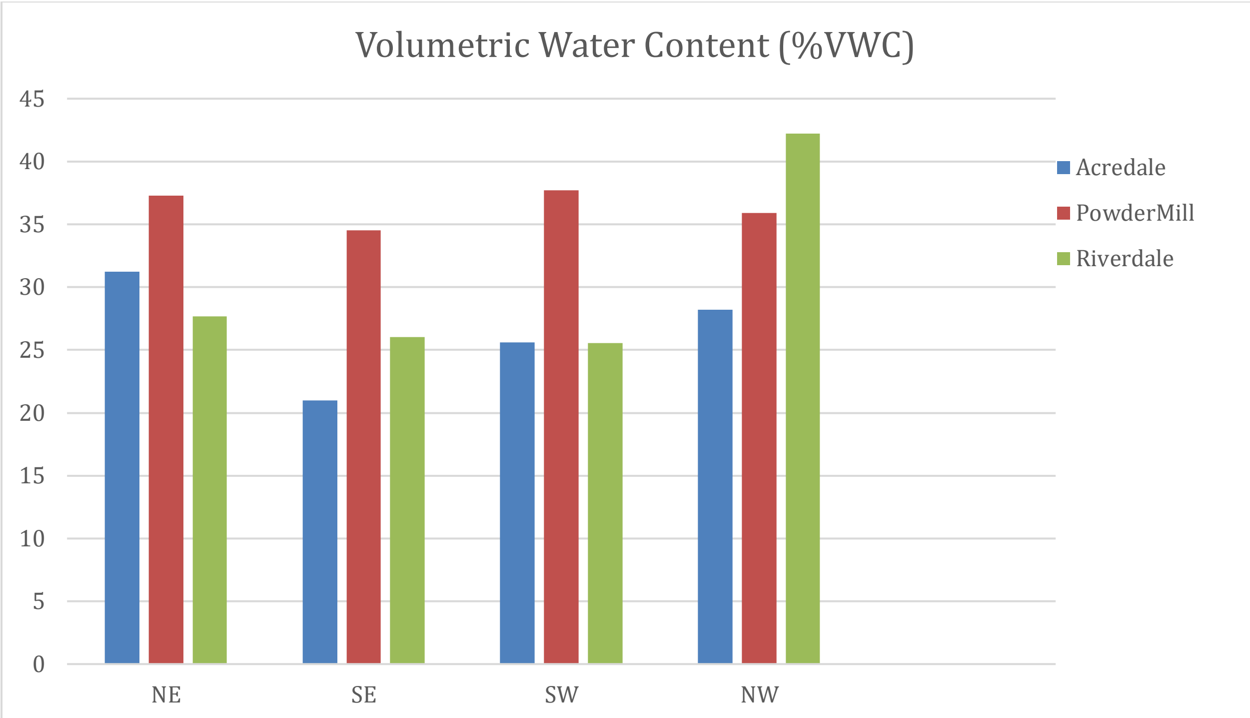


Figure 2. Shear strength readings in Acredale, Powder Mill, and Riverdale Parks

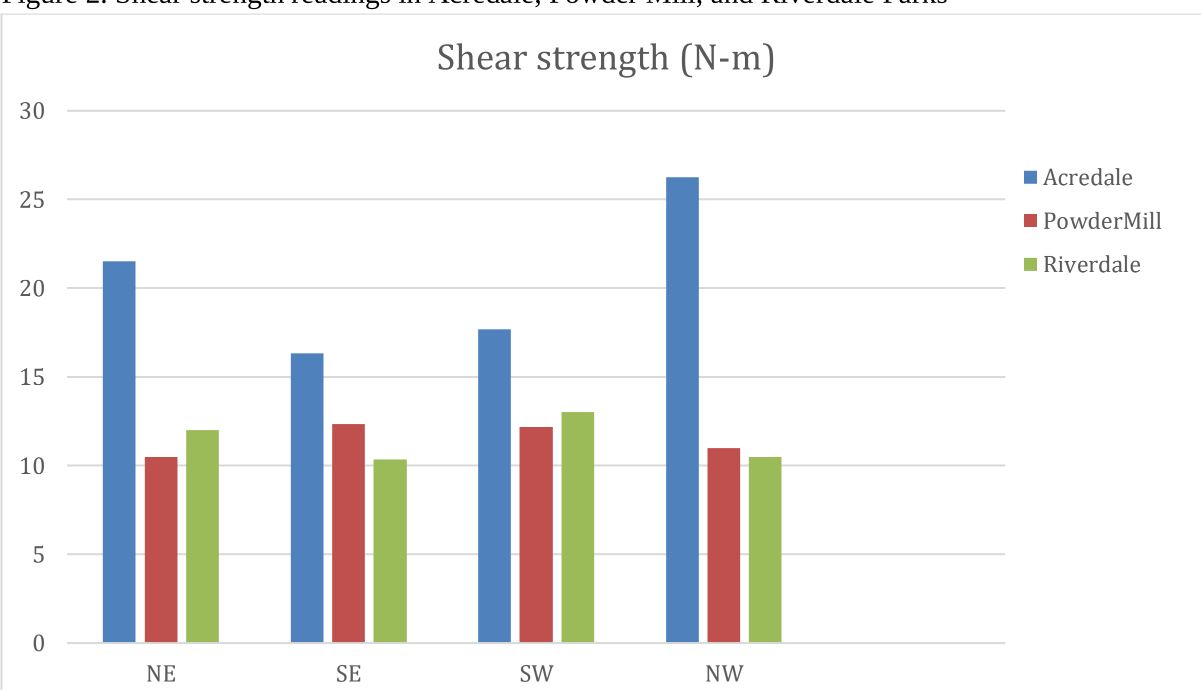
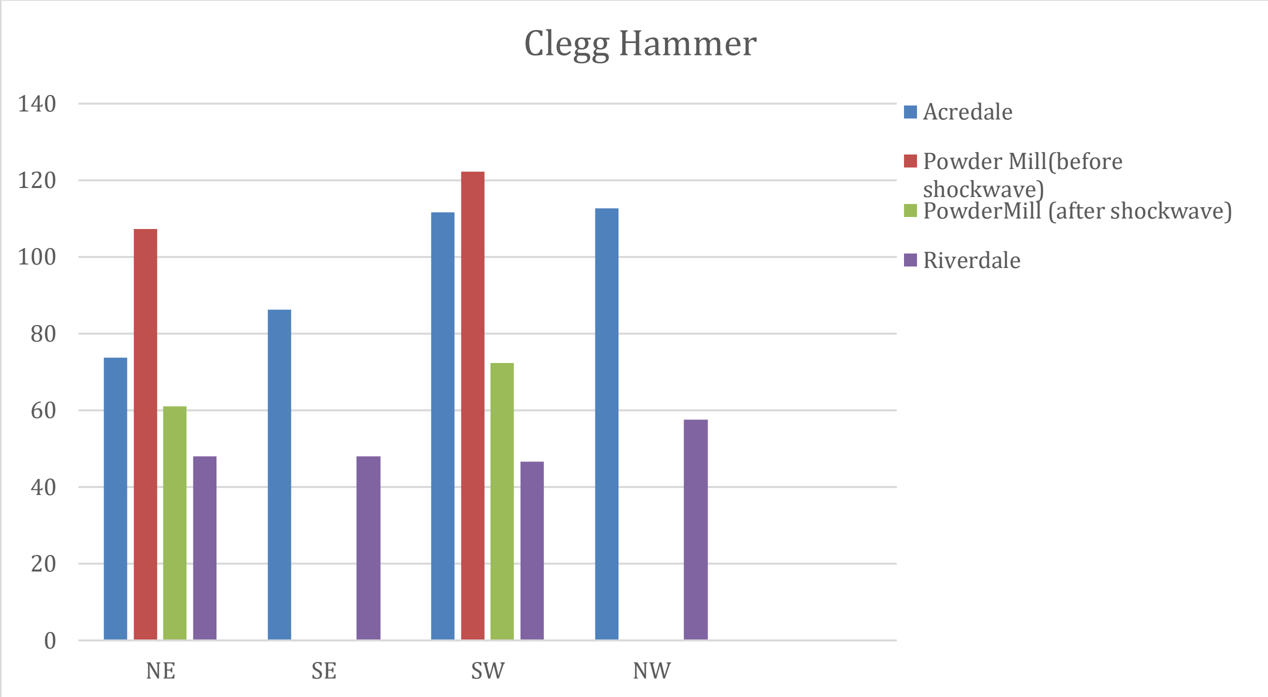


Figure 3. Clegg Hammer readings at Acredale, Powder Mill, and Riverdale Parks



Results

The Analysis of Variance (ANOVA) is a statistical test used to discern statistically real differences between any two or more means that are independent groups. The readings at the different parks were taken on different days. Powder Mill and Riverdale Parks readings were taken on September 29 and November 3, respectively. Bulk density measurements for Powder Mill were re-taken on December 4. However, in Acredale Park volumetric water content and shear strength readings were taken on September 22 and Clegg Hammer readings were taken on December 4, due to an instrument malfunction during the initial visit.

Comparing the three parks, the percentage of volumetric water content (VWC) was highest in Powder Mill Park and Shear Strength was highest in Acredale Park. The lowest percentage of VWC was observed at Acredale Park and Riverdale Park showed the lowest shear strength. Shear strength differences were statistically significant for Acredale Park but not for the other two parks.

Clegg differences were very significant before and after the shockwave treatment at Powder Mill, were significant at Acredale, but were not significantly different at Riverdale. Figure 3 shows some major differences in Powder Mill Park in the Clegg hammer readings collected before and after the shockwave. Since a shockwave treatment was being performed during our visit, we took Clegg measurements before and after (these are taken in geographical reference to the approximate football field yard lines instead of quadrants of the field). The readings after shockwave are significantly lower compared to those before.

For example, the northeast quadrant Clegg reading was 105 G-max before shockwave and 61 G-max after shockwave. This large reduction in the Clegg reading indicates a reduction in surface hardness by reducing the soil compaction. The Clegg readings were moderate for Riverdale Park, indicating a desirable surface hardness on the playing field. Clegg readings at Acredale Park were higher than 100 G-max in the play field’s northwest and southwest quadrants.

Infiltration rate is an important parameter for gauging how well water will infiltrate into the soil and to some degree, it can indicate soil compaction. Two double-ring infiltrometer readings were taken at each park. In all three, one of the readings was in the moderate range (>1”/hour) and in the low range (<1”/hour). While infiltration is influenced by soil texture and soil compaction, the low-moderate readings indicate that drainage on the fields is poor or fair, depending on the location. A commitment to cultivation practices that improve infiltration rate is an important part of any future agronomic program.

Discussion

Acredale and Powder Mill Parks both need changes to their agronomic plans to provide the best playing surface with the resources available. This report highlights the benefits of capital investment in these fields.

One of the most important requirements for turfgrass health includes ample water for turf growth and recovery. Neither of these two parks have an irrigation system and would greatly benefit from one. The investment to fit these fields with irrigation would improve turf health and player safety. These fields are well used and it is left to mother nature to meet the turf stands’ water requirement. An irrigation system would allow the turf manager to set up a program that could increase turf uniformity, increase root growth, and minimize damaged by drought stress.

The top priority of a yearly agronomic plan for these fields is to create the best playing surface possible. Ensuring that culture practices are performed correctly and undertaken during the most effective parts of the growing season is crucial. Both of these fields are composed of a mix of weeds and two types of turfgrass—Tall fescue and Bermuda grass—that are managed in very different ways.

If the manager decides to make a predominantly Bermuda grass field, the mowing height should be adjusted to around 1 inch. This height favors the Bermuda grass’s lateral growth as well as stressing the weed species and mitigating other weed control tactics needed in later processes. If the manager decides to make the field a Tall fescue stand, then mowing heights should be raised to 2½ to 3 inches. This height encourages the fescue to cover bare spots and limits the amount of weed seed germination.

When choosing the correct mowing height, it's important to follow the One-third Rule, that is, not removing more than one-third of the leaf tissue. This rule limits mowing damage by evenly redistributing plant tissue back into the turf stand to be broken down into organic matter. It's also essential to mow with sharp blades. Mowed with dull blades pulls and shreds the leaf tissue instead of making a clean clip, which causes a discoloration of the field after mowing and also creates more stress on the plant.

Pest management in these fields will be crucial to controlling the weed-infested turfgrass stand. The term pest management encompasses weeds, disease, and insect control, but because these fields show limited signs of disease and insect damage the best use of the budget would be to focus on weed prevention and control. A pre-emergent herbicide in the early spring would control crabgrass and goosegrass, two of the commonly found weeds. Pendimethalin is a broad spectrum weed pre-emergent for use on the species of turf we're trying to promote.

When applying herbicide, timing is important. It should be applied when seeding will not take place for at least 6-8 weeks, and after aeration. If aeration takes place after the application the soil disruption will break the barrier of the pre-emergent. A slow-release fertilizer should be applied during the course of the growing season. One benefit of a slow-release, encapsulated urea fertilizer is its length of activity; it provides the turfgrass with nutrients for weeks, saving labor hours of the multiple applications that a quick-release fertilizer requires.

Table 6. Acredale and Powder Mill Parks: product, pricing, and amounts[1]

Product Name	Type	Product Amount	Price	Amount/2 acres
Pendulum 2G	Herbicide	40lbs	$86.31	120lbs
Synatek 19-2-6	Slow-release fertilizer	50lbs	$68.31	100lbs

Riverdale Baseball Field is one of M-NCPPC's top fields; it is rented by Dematha Catholic High School and used by the UMD Club Baseball Team. Because of the high level of play, there is an expectation that the field is in prime condition.

The management practices on this playing field are top notch. For the most part, the culture practices used on the field meet the turfgrass needs. The maintenance crew use the recommended amount of nitrogen allowed by the State, along with applying potash fertilizer at the proper time. Proper mowing height encourages turfgrass growth and reduces weed pressure. The use of Bermuda grass and Kentucky

[1] Table 6: Product pricing table shows one application at a high rate. A secondary application may be necessary 4 to 8 weeks after initial application. It assumes an area of approximately 2 acres per site.

bluegrass (“Bluemuda”) are great options, offering winter color and requiring very low amounts of inputs of fertilizers and pesticides. In fact, Bluemuda allows four-season play on the field.

Although the field is well-maintained, some slight modifications would improve the playing surfaces. As at Acredale and Powder Mill Parks, an irrigation system would allow a healthier and safer turfgrass field. Also, with the field mostly planted in improved Bermuda grass varieties, its growth and quality would drastically improve with aggressive de-compacting every three weeks during the summer’s peak growing months, which would help the field thrive into the fall. This would create a strong and safe playing surface.

With the high quality of turf present in the outfield, the infield skin (the dirt portion) and infield grass should be addressed. Drainage issues for the infield dirt and grass require more labor and materials to maintain the field at a proper level. A modest field renovation to remove the raised grade (due to the infield conditioner being pushed into the edge) would allow the infield skin to recover more rapidly after rain, resulting in less maintenance and material use.

The regrading renovation would consist of removing the grass edges, returning the grade to its original level, downloading infield dirt that would get laser graded, and resodding the edges with Bermuda grass. We also recommend adding back the six-foot wide base paths and the turn cut-outs to reduce wear on the grass edges and to allow quick reapers due to damage during an on-field event. Re-grading the infield grass edges and the infield skin and the addition of base paths and cut-outs would improve the quality of the field drastically at a relatively low-cost.

These recommendations are made after thorough research and field studies. The University of Maryland believes these improvements and renovations are the best options for field improvement and player safety with respect to cost and maintenance budget.

Appendix

Analysis of Variance (ANOVA) for Acredale Park

VWC

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	3	170.2	56.7	4.7	0.04
Error	8	96.5	12.1		
Corrected value	11	266.6			

Clegg Hammer

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	3	3346.3	111.5.4	5.9	0.02

Error	8	1514.7	189.3		
Corrected value	11	4860.9			

Shear Strength

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	3	212.2	70.7	6.4	0.02
Error	8	88.0	11.0		
Corrected value	11	300.2			

ANOVA for Powder Mill Park

VWC

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	3	18.5	6.2	0.3	0.8
Error	8	164.1	20.5		
Corrected value	11	182.6			

Clegg Hammer

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	3	9257.1	9257.1	28.24	0.0002
Error	8	3933.7	327.8		
Corrected value	11	13190.9			

Shear Strength

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	3	7.2	2.4	0.3	0.8
Error	8	56.3	7.0		
Corrected value	11	63.5			

ANOVA for Riverdale Park

VWC

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	4	453.1	113.3	5.3	0.03
Error	8	170.3	21.3		

Corrected value	12	623.4			

Clegg Hammer

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	4	197.6	49.4	0.69	0.62
Error	8	575.2	71.9		
Corrected value	12	772.8			

Shear Strength

Source	df	Sum of squares	Mean squares	F value	Pr > F
Model	4	15.1	3.8	1.0	0.5
Error	8	29.7	3.7		
Corrected value	12	44.8			