Carver County Infiltration Monitoring

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Resilient Communities Project
University of Minnesota
Building community-university partnerships for sustainability

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Carver County

Carver County Courthouse and Audubon Road Prairies

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Introduction

Carver County admires its many natural landscapes. One of their missions is to plan for the county's growth to preserve its uniqueness and encourage rural and urban compatibility. The location of this county is southwest of the Twin Cities metro, including the city of Chaska. In this report, infiltration capacities of the soil were measured at two different sites. The sites our group used were the Carver County Courthouse Prairie and the Audubon Road Prairie. The Courthouse Prairie was seeded and plugged in 2017 and the turf was removed. At the Audubon Road Prairie, they seeded it in 2018, killed the turf, and drilled seed. This report contains data from work that was done on the two sites for the Carver County Water Management Organization who manages the county's lakes, rivers, and wetlands. They are focusing on a project for managing turf grass and different vegetation in the area, and we studied the infiltration rate of water into the soil to guide developers in making decisions about the storm water reuse. The organization is trying to figure out the best management practice regarding the waterlogged soils. We are looking to answer how different types of vegetation, like prairie grass, affect and manage infiltration, irrigation rate, and overland runoff of storm water.

Procedure

A Saturo Dual Head Infiltrometer instrument was used to measure the rate of the water going into the soil, or the infiltration rate. This instrument measures hydraulic conductivity. It goes between high and low pressure cycles, and it calculates a flux graph. We brought three infiltrometers with us to the field. First, the rings were hammered into the ground, and the covers were latched onto the rings. The three tubes were then plugged into the machines, and the settings were set considering the current conditions of the soil. The soils were wet since it had rained for a few days previous to field inspection, so the settings were set to accommodate for this. The soil was considered saturated at the time of testing. Also, the type of soil at the site was researched prior to the field day, so the settings accommodated the texture of the soils as well.

On both sites of investigation, there were two test runs and one control run to test the two different types of vegetation. The control run was turf grass which is known to have water logging effects while the test run was prairie or native grasses. The graphs were watched closely; if a graph was going off-base, we would stop it and restart the process. When we were done, the data was saved with the correct name. Everything was taken down appropriately. The data was analyzed afterward, and some of the data was inconclusive. The following table includes what each test setting was put at for each different option on the menu. The overall goal we are trying to help is to identify turfgrass best management strategies to improve storm water reuse irrigation systems. We helped this by measuring different rates of infiltration for each type of vegetation planted in these areas in order to see which has the highest rate to avoid waterlogging. Typically, the vegetation with the highest rate should be used.

Name	Settings
Pressure Head 1 (cm)	5.0
Pressure Head 2 (cm)	15.0
Soak Time (min)	15
Pressure Cycles	2
Hold Time (min)	20
Insertion Depth (cm)	10
Run Time (min)	95

Table 1: Test settings for each Saturo Duel Head Infiltrometer.

Data

The following is the data and test results that were obtained from this field work and process. These tables include the failed runs that we did, and the data we supplemented that with. The analysis section of this report will have more insight into what went wrong with our tests, and how it would be fixed with future tests. We suspect that the saturation of the soil is what made a few tests fail. We monitored different infiltration rates of the vegetation and soil. We are looking at the Kfs result from each data set and the Kfs error. We are looking at the hydraulic conductivity of each area.

Test Results (GOVCENTERCONTROL)	
Raw Records	95
First Record ID	1823
Kfs (cm/hr)	5.9292
Kfs Error (cm/hr)	0.174312

Table 2: Test results for the Government Center Prairie control test. This represents the turf grass. This Kfs result is much lower than prairie grass.

Test Results (GOUCENTERTEST1)	
Raw Records	95
First Record ID	465
Kfs (cm/hr)	35.8596
Kfs Error (cm/hr)	1.9782

Table 3: Test results for the Government Center for Test 1. This represents the prairie grass infiltration rate. This result is much higher than the turf grass for this area which means the prairie grass has better infiltration.

Test Results (G0VCENTERTEST3)	
Raw Records	45
First Record ID	3011
Kfs (cm/hr)	0
Kfs Error (cm/hr)	0

Table 4: Test results for the Government Center Prairie for Test 2. This run failed.

Test Results (AUDUBONCONTROL)	
Raw Records	23
First Record ID	560
Kfs (cm/hr)	0
Kfs Error (cm/hr)	0

Table 5: Test results for the Audubon Road control test. Note that this test failed, and Table 5 has the actual results for the control run.

Test Results (AUDUBONCONTROL1)	
Raw Records	95
First Record ID	583
Kfs (cm/hr)	20.7396
Kfs Error (cm/hr)	0.60768

Table 6: Test results for the Audubon Road control test. We suspect there was an issue with this site since the Kfs is so high. The saturated conditions could have influenced this. We are not taking this information into consideration.

Test Results (AUDUBONTEST1)	
Raw Records	95
First Record ID	3056
Kfs (cm/hr)	0.80928
Kfs Error (cm/hr)	1.73412

Table 7: Test results for the Audubon Road Prairie for Test 1.

Test Results (AUDUBONTEST2)	
Raw Records	39
First Record ID	2972
Kfs (cm/hr)	0
Kfs Error (cm/hr)	0

Table 8: Test results for the Audubon Road Prairie for Test 2. Note that this run failed, and we had to do it over. The results for this test are actually in Table 7.

Test Results (AUDUBONTEST2)	
Raw Records	95
First Record ID	1918
Kfs (cm/hr)	1.29996
Kfs Error (cm/hr)	0.220212

Table 9: Test results for the Audubon Road Prairie for Test 2.

Analysis

Our analysis is that for the turfgrass at the Courthouse Prairie, the kfs (hydraulic conductivity) value is smaller than the vegetation installation or test run. What we are looking for is a higher infiltration rate. A higher kfs means a higher infiltration rate and that water will infiltrate through the soil faster. Fewer rain gardens would be needed for an area with a higher kfs. For the Audubon Prairie, the turf grass had a much higher kfs value, which contradicts the data from the county courthouse site, where the prairie grasses had a higher infiltration rate. The data from the Courthouse means that the native grasses or vegetation installation result in higher infiltration rates, which is good for waterlogged soils. For the Audubon Road Prairie, the infiltration rate was much higher for turf grass than the vegetation installation, but the group agrees this data is inconclusive. We could not declare a correlation between infiltration rate and vegetation type at the Audubon site. There may be errors as the soil was rather saturated when the team went out and did the measurements. The equipment we used does not get very good data when used on waterlogged soil. This could have affected the infiltration capacity where we measured depending on the terrain of the area. These conditions likely resulted in inaccurate data. If we could do this again, we would go out on a day where it has not rained for a while, or we would try it at a higher elevation.

Our conclusion based on the usable data is that the installed vegetation has better infiltration than the turf grass. Some turf grass challenges are that they cause saturated and waterlogged soils. We experienced this issue, as the ground was very wet the day we tested. Therefore, we believe the data may be skewed, and that this is why the kfs for the Audubon Prairie turf grass was higher than the vegetation installation when the opposite was expected. The data for the Audubon Road is inaccurate. After consulting other sources of expertise, we concluded on recommendations. We would recommend a general preferred mixture because this offers the best transpiration rate. We also recommend that irrigation should not occur after

rainfall or a precipitation event. More native prairie plants should be added as they can be used as borders between the different land uses of the area. Lastly, we suggest removing or replacing turf grass and installing more native plants as a replacement. The higher infiltration rate associated with the native vegetation is good for waterlogged soils because they drain and absorb water faster and reduce the need for rain gardens. Turf grass has management challenges because the water is not being absorbed fast enough by the soil. Only small amounts of water can infiltrate; excess water will run off into other water bodies with sediments and nutrients which are harmful to the environment.

Conclusion

Through our field work at the Carver County Courthouse Prairie and at the Audubon Road Prairie, we collected data on the infiltration rate into soil with turf grass and soil with prairie grasses in order to compare these rates. This report is written for Carver County Water Management Organization who would like data for infiltration rates of different types of vegetation. A Saturo Duel Head Infiltrometer instrument was used to collect this data. We had some issues with data collection, possibly due to the soil being oversaturated. The Courthouse site data showed that the infiltration rate for native grass was higher while the Audubon Road data showed skewed results for the turf grass run. We were able to supplement the needed data to create a complete report, but the data itself may not be representative of the true infiltration rate at the Audubon site. Analysis of the data shows that the vegetation type (turf grass or native grass) does not correlate closely with the irrigation rate of soil on the Audubon site. Due to the soil being water logged we will refrain from making any conclusions on that site. There were no issues with collecting accurate data at the Courthouse, and it was found that native grass on the site does have a better infiltration rate than the control turf grass. Based on this analysis we recommend refraining from irrigating after rainfall events, using a general preferred mixture of prairie and native vegetation, and possibly removing the turf grass. In conclusion, native plants are better for waterlogged soils because they have a higher infiltration rate than turf grass.