Carver County Infiltration Monitoring

Prepared by
Owen Anderson, Hannah Henricksen, & Megan Walkenhorst

Students in ESPM 3111:
Hydrology & Water Quality Field Methods
Instructor: Professor Joe Magner
Department of Bioproducts and Biosystems Engineering

Prepared in Collaboration with
Tim Sundby, Water Resource Program Analyst, Carver County Planning and Water Management

Carver County
Water Management Organization

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

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The contents of this report represent the views of the authors, and do not necessarily reflect those of RCP, CURA, the Regents of the University of Minnesota, or Carver County.

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Resilient Communities Project
University of Minnesota
330 HHHSPA
301—19th Avenue South
Minneapolis, Minnesota 55455
Phone: (612) 625-7501
E-mail: rcp@umn.edu
Web site: http://www.rcp.umn.edu

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Building Community-University Partnerships for Resilience

ESPM 3111

Carver County: Improving Stormwater Reuse Irrigation Systems

By: Owen Anderson, Hannah Henricksen, & Megan Walkenhorst

I. Introduction

Our project for EPSM 3111 was part of the Resilient Communities Project. Our sites were in Watertown, Minnesota at Peace Lutheran Church and the Sculpture Garden. These sites both had different land uses from which to obtain data. In this project, we utilized information protocol. Therefore, the objectives we discuss in this report include our purpose, our collaborative process design, our interpretations, our reporting mechanisms, and our conclusions. The purpose of this project was to assess the infiltration capacity and irrigation rates for different types of vegetation in order to motivate the switch from turfgrass to prairie grass. The hypothesis in question was that prairie grass was better than turfgrass in terms of infiltration capacity and irrigation rates, as well as stopping water logging from occurring. The long-term goal of this project is to improve stormwater irrigation. It was therefore important for our group to take an overall systems approach to this problem. It is important to think about all factors that influence infiltration. Through this project we were able to utilize our skills learned in class and gain knowledge on working in the field.

II. Peace Lutheran Church

A. Planning our Visit

The first site we visited was the Peace Lutheran Church in Watertown, Minnesota. In preparation for our field day, we visited the site with the project lead, Tim Sundby, to learn more about the history and information surrounding our sites. This collaboration was very helpful in the design process. Tim told us that there were three different land covers in this area we wanted to evaluate: turfgrass, prairie, and former agricultural land. We decided to make the turfgrass our control. During the initial site visit, we also learned about where our water source would be and what days would be appropriate for us to collect data. With this knowledge we were able to plan our visit. We decided to complete the data collection on a Saturday to not disturb their church services and also to complete one run for each of the three different vegetation types. The runs were all done as similarly as possible to ensure accurate and comparable results. The method used to support the purpose of this project was using a SATURO dual head infiltrometer to collect data. The graphs obtained from this device will help in our understanding of this watershed system. A successful field day would result in data to prove switching from turfgrass to prairie grass is a

good idea. The collaborative design process helped us make a successful field day plan which we hoped would turn into a successful data collection to support our purpose.

B. Field Day

During our field day we were met with many challenges. When we arrived, we began to conduct another analysis of the site to confirm locations we would select for data collection. Once the three areas were decided we began to set up our infiltrometers in their respective zones. We began with two devices in the turf control area, but soon discovered both infiltrometers would come across issues. After all data collections had begun, the process of monitoring their progress became essential. This is when we first recognized the problems occurring with our turf control. One infiltrometer was reporting an error with the Sensor Connection port, and when we went to investigate, its attachment became loose and was pushed within the device's housing. This rendered the device useless to us on our field day and we were forced to rely on our one remaining control infiltrometer. In the meantime, we continued ensuring water levels were appropriate in our buckets and all tests were still running. At first, we did not recognize any issues with the outputs being displayed. However, as time passed, the flux graph being reported from our second control device appeared to be skewed. After all runs were completed, we sought advice from Phil Margarit, a more experienced hydrologist, to offer his opinion on our graph outputs. Phil confirmed that our turf control flux graph had encountered an issue, but as we thought, our remaining test plots resulted in meaningful data. Unfortunately, we were not able to re-run our failed tests because of time constraints with traveling to the next site for more data collection.

C. Interpretations

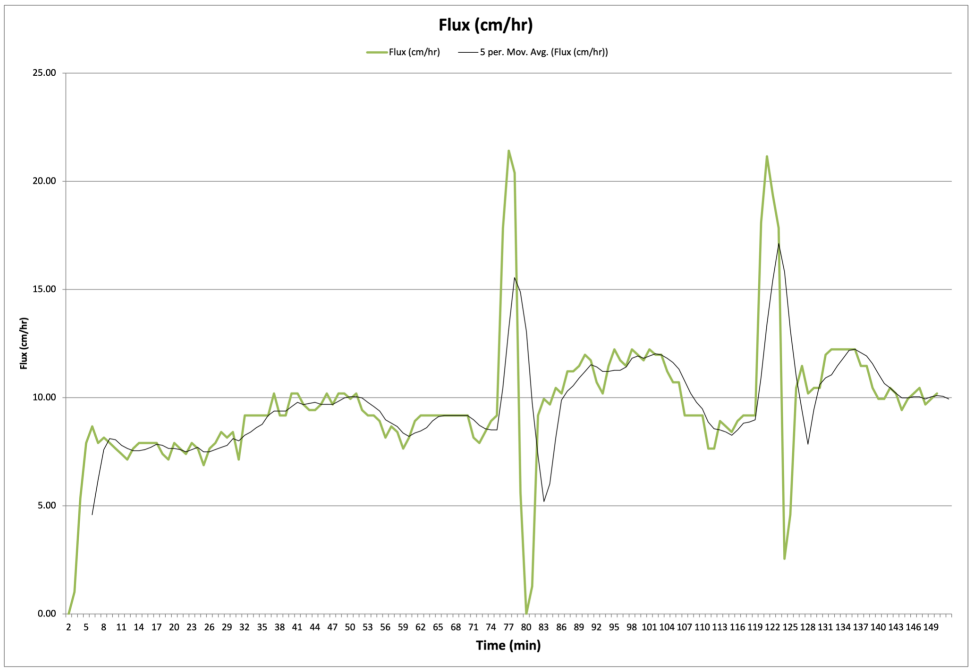

Figure 1: Turfgrass (control) flux in cm/hr from infiltrometer data.

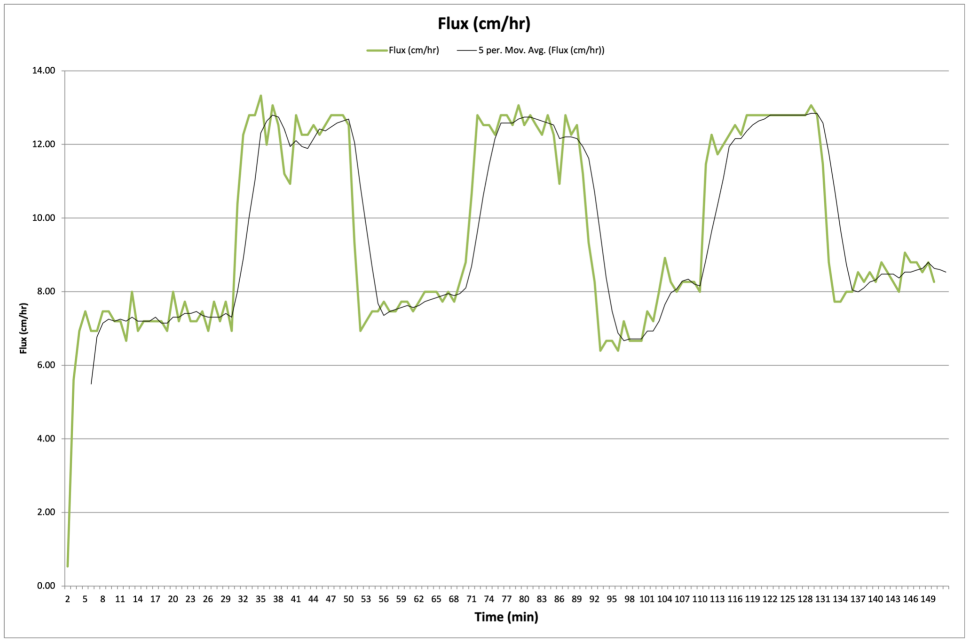

Figure 2: Prairie flux in cm/hr from infiltrometer data.

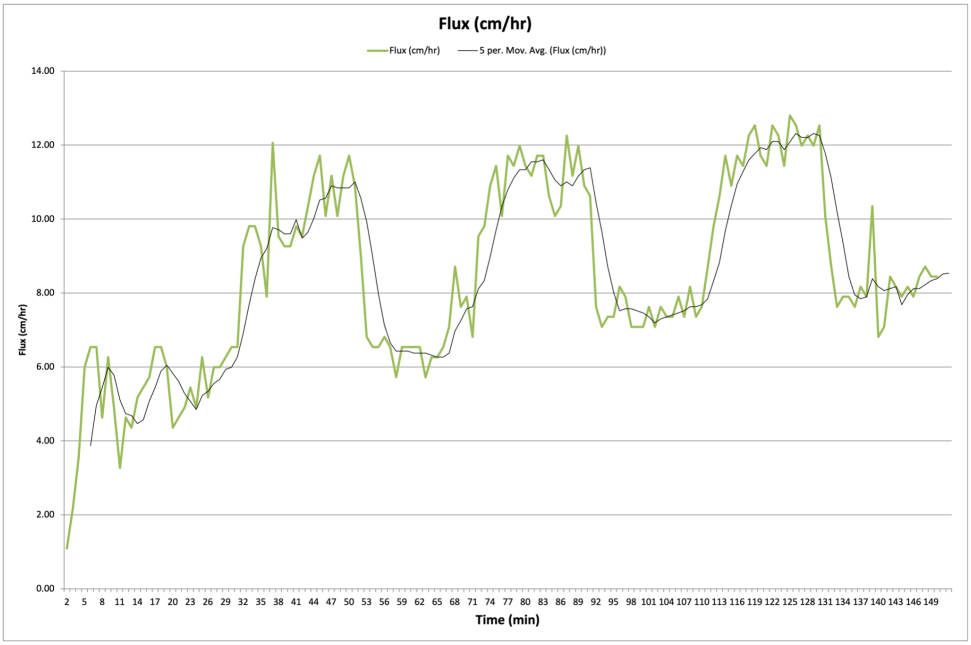

Figure 3: Conservation Area (former agricultural land) flux in cm/hr from infiltrometer data.

In the graphs shown above it can be seen how Figure 1, from our turf control, resulted in an unusual flux graph that signaled an unsuccessful test without the three characteristic plateaus. The remaining successful test runs show relatively similar results between Figure 2 and Figure 3, showing the prairie site and conservation areas respectively. This is somewhat expected because, despite the different technical classifications, the land covers were very much alike. The conservation area represented in Figure 3 is being more closely managed by Carver County WMO, but its vegetation on the ground and soil type below resulted in strong commonality with the prairie site.

III. Sculpture Garden

A. Planning our Visit

The second site we visited was the Sculpture Garden also in Watertown. We also visited this site about a month before with Tim Sundby to obtain more information. Tim told us that there were two different land covers in this location: prairie and turfgrass. The turfgrass was also our control group for this site. This site's water was a bit further away, but we could collect data at any time. This first site visit helped us to formulate a plan for our field day. We decided to collect data on the same Saturday as our first site and to have two different runs to compare the two different land uses' infiltration rates. We also planned to complete both runs as similarly as possible at this site to ensure accurate results. A SATURO dual head infiltrometer was again the device used to

collect data. The graphs created from data collected from this device will help in our understanding of this watershed system. Success again will be determined if we can prove that switching from turfgrass to prairie grass is a good idea. This plan using collaborative design via the information protocol process helped us to be prepared for our field day.

B. Field Day

Our field experience for this site went better than at Peace Lutheran Church. Upon arrival, we assessed that one infiltrometer would be placed in the turfgrass as a control and a second would be placed in the prairie vegetation area. The main challenge at this site was the placement of the infiltrometer on the turfgrass. We hit a macropore, so the device needed to be moved roughly 10 feet away from the original placement. Once data collection on both devices began, we monitored their progress. While the devices were collecting data, we periodically checked the water levels of each device, adding more as necessary. We also consulted with Phil after the first pressure cycle on each device, to ensure that the data being collected looked as it should. Both devices' data collection went smoothly and produced the expected looking graphs.

C. Interpretations

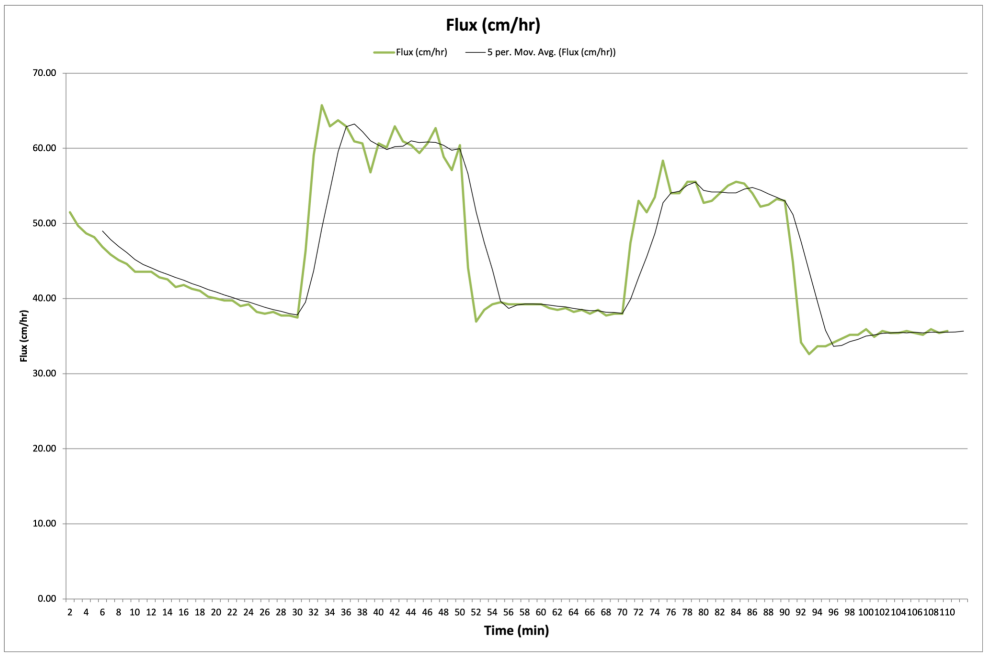

Figure 4: Turfgrass (control) flux in cm/hr from infiltrometer data.

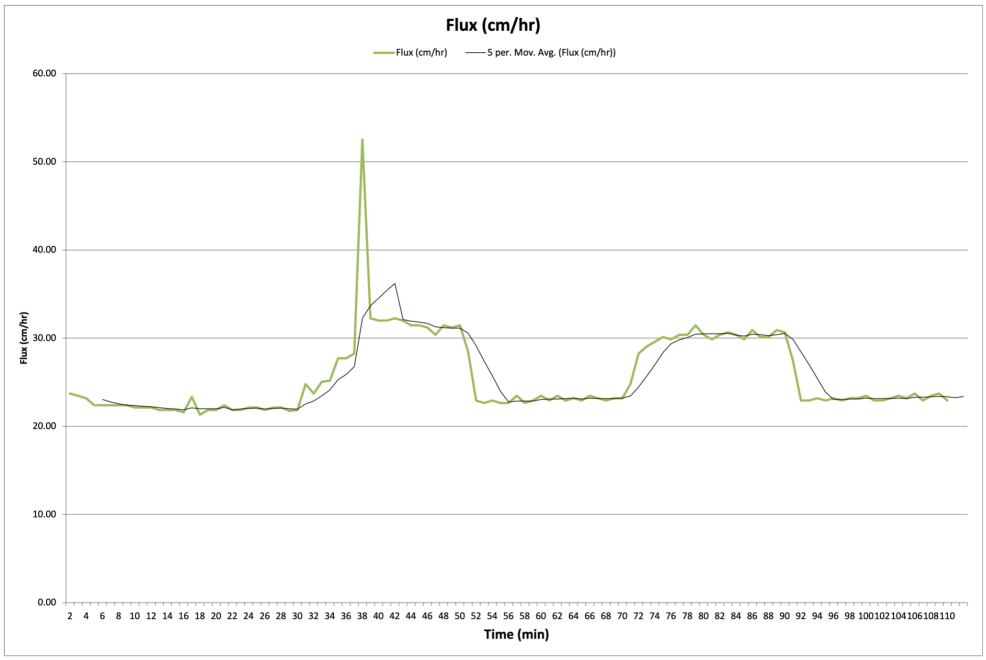

Figure 5: Prairie flux in cm/hr from infiltrometer data.

When looking at the data obtained from the Sculpture Garden, we can clearly see the difference present between the two land cover types. In Figure 4 we observe the flux of water beginning at a much higher rate of around 50 cm/hr versus in Figure 5 where it displayed a starting point of around 20 cm/hr on the prairie grass. In the case of turfgrass we see that more water infiltrates during cycles as the spikes in Figure 4 are much larger in magnitude than Figure 5. However, we expected that the flux for prairie grass should be higher than turfgrass if all soil characteristics were equal. Our tests indicate that water passes more easily through the turfgrass. Factors that influence could be largely due to both soil conditions and plant material on the surface. Turfgrass is able to move quickly through the topsoil layer and then may sit on a compacted soil layer causing water logging to occur. This, however, depends on soil type and other soil characteristics. Dead vegetation in the prairie grasses was lining the ground making a thick layer of biomass water would have to seep through before moving underground. We are also aware that soil conditions are not consistent underneath the turfgrass as evidenced by our first failed test that hit a macropore nearby. This could mean that the higher infiltration flux shown in Figure 4 may be explained by a lower soil bulk density near the surface which then gives way to more compacted areas deeper in the profile that led to the waterlogging reported at developer's sites.

IV. Conclusion

Our site visits to Peace Lutheran Church and the Sculpture Garden were both successful in that we completed a first set of analyses testing this hypothesis. We were able to obtain good and complete data for every type of vegetation except one at one site. This data helped us come to similar conclusions at both sites. As discussed in the interpretation sections of this report, that conclusion is that more data needs to be collected on the soil of these areas. With that knowledge, we would be able to determine if the soil is causing water logging to occur or if there is a large difference between the turf and the prairie grass in terms of flux and irrigation capacity. Based on prior knowledge, we would expect a higher infiltration flux in prairie grass but since our data does not reflect this, further investigation will be needed. The data collected so far shows that the two vegetation types do differ in terms of flux but not in the way we initially expected. Therefore, the data we collected is the first step in understanding the infiltration and stormwater management for these two sites.