



Minnesota Pollution Control Agency

520 Lafayette Road North
St. Paul, MN 55155-4194

Final Report Format

Section 319 and Clean Water Partnership Projects or Final Progress Report for TMDL/WRAPS Development and TMDL/WRAPS Implementation Projects

Doc Type: Reporting/Final Report

Grant project summary

Project title: Duluth Streams Urban WRAPS

Organization (Grantee): University of Minnesota

Project start date: 2/01/2019 Project end date: 12/31/2020 Report submittal date: 3/1/21

Grantee contact name: Jesse Schomberg Title: Associate Director of Outreach

Address: 145 Chester Park, 31 W College St

City: Duluth State: MN Zip: 55812

Phone number: 218-726-6182 Fax: _____ Email: jschombe@d.umn.edu

Basin (Red, Minnesota, St. Croix, etc.) Lake Superior Basin, Lake Superior South County: St. Louis and Carlton
/Watershed & 8 digit HUC: 04010102 and St. Louis River 04010201

Project type (check one):

- Clean Water Partnership
- Total Maximum Daily Load (TMDL)/Watershed Restoration or Protection Strategy (WRAPS) Development
- 319 Implementation
- 319 Demonstration, Education, Research
- TMDL/WRAPS Implementation

Grant funding

Final grant amount: \$116,081.30 Final total project costs: \$ \$110,025.93

Matching funds: Final cash: \$ Final in-kind: \$ Final Loan: \$

MPCA project manager: Karen Evens and Tom Estabrooks

Executive summary

This project has worked towards community engagement on watershed management for the Duluth Urban streams; specifically on helping the cities, townships, and county engage with each other and relevant agencies to identify common priorities and work together to both protect and restore these streams. Over these two years, we facilitated 21 meetings of the Duluth Urban Watershed Advisory Committee (DUWAC), with a total of 402 attendees. Meetings were divided between general body meetings, where DUWAC priorities, activities, and structures were discussed; capacity-building meetings, which focused on some aspect of knowledge or capacity that the group was interested in, and regulation ordinance and policy meetings, to focus on either options for improving local ordinances and policies or how state/federal regulations affect what they need to do. Efforts included determining the future structure and function of DUWAC, and a commitment to continue efforts past the end-date of this project, with quarterly full-committee meetings interspersed with capacity-building opportunities and meetings focused on specific watersheds, where smaller communities can participate in efforts directly relating to them.

Nearly 1,800 unique users interacted with the network of 19 CrowdHydrology gages - simple staff gages where the public reads the water height and texts the value to a national database. Most users submit data only once, yet a handful of individuals are "super-users", submitting more than 50 records since 2017. Public parks and trails are highly used in the Duluth Urban-area, and it is critical to locate monitoring stations in these areas of high foot traffic so as to encourage frequent data submissions. Frequent data submissions are critical for finer-scale stream monitoring, yet records at some of the least visited gages indicate even infrequent data submissions follow similar discharge trends as that of long-term, frequent, "scientifically-proven" flow measurements.

Problem

This project continues the total maximum daily load (TMDL) and watershed restoration and protection strategies (WRAPS) process for the Duluth Metropolitan Area (DMA). The project served as a bridge into the next phase of restoration and protection identified by the Duluth Urban Stream TMDLs and WRAPS. In the first phase of community engagement, a collaborating organization was formed to define a framework for the DMA communities including the cities of Duluth, Hermantown, Proctor, and Rice Lake; and the townships of Midway, Lakewood, Gnesen, Normanna, and Thomson; and St. Louis County. This phase focused on advancing this new watershed management collaboration to address TMDL and WRAPS needs of the Duluth area streams; specifically by maturing the civic engagement partnerships and collaboration of the Duluth Urban Watershed Advisory Committee and supporting and expanding the CrowdHydrology gage network to engage citizens in stream monitoring and protection.

Waterbody improved

Project efforts were not focused on specific watersheds, but on issues and collaboration that affects all of the watersheds in the DMA, from Mission Creek in the west to Lester River in the north.

Project highlights

DUWAC highlights include the submission of two funding opportunities, the hosting of 8 capacity-building activities for DUWAC members on a variety of important topics, and agreement on a new structure for DUWAC to continue collaborations in the future and pivot to focusing more on individual watersheds, and development of plans and projects to protect and restore them. The CrowdHydrology efforts expanded the network of gauges outside the City of Duluth to neighboring communities, and engaged nearly 1,800 individuals. Nearly 3,000 water depth records were submitted in 2019 and 2020 across 19 CrowdHydrology gages. This effort also added additional opportunities for engagement with local water resources by adding two cellphone mounting stations. Scientifically, locations with frequent data submissions are a reasonable proxy for stream height trends, and could realistically be used to monitor stream depth conditions. Engagement with these citizen science efforts across the community remain high, and local researchers are optimistic of their sustained use and engagement into the future.

Results

We hosted 21 meetings of DUWAC with over 400 total participants. Capacity-building workshops focused on relevant issues for the Duluth urban watersheds, including beavers, E. coli, flooding, watershed storage, and online tools. Regulation ordinance and policy discussions focused on construction and post-construction practices, updating local codes to promote green infrastructure, and MS4 compliance with TMDL's. In addition, presentations about DUWAC informed both local and national audiences about these efforts, and two grants were submitted, to work on projects relating to changing hydrology due to the loss of ash trees to the invasive Emerald Ash Borer and updating local codes and ordinances to promote green infrastructure. A new plan and meeting schedule is in place to continue watershed-wide collaboration, with a focus on individual watershed work, and engage all of the communities within these individual watersheds. The CrowdHydrology efforts engaged nearly 1,800 unique users in the Duluth Urban-area, submitting nearly 3,000 water depth records in 2019 and 2020. Generally, the weekends are the highest days for submission, yet at a few parks with weekday activities, such as frisbee golf tournaments, the weekdays see higher numbers of submissions. Most individuals submit only one data water depth record, with approximately 5 individuals submitting 50 or more records since 2017. Water depth records across all gages follow similar hydrograph trends in relationship to precipitation events throughout a season. Frequent data submissions are critical for finer-scale stream monitoring, as water depth trends become difficult to track if data is submitted infrequently, yet analysis of records at indicate even infrequent data submissions follow similar discharge trends as that of long-term, frequent, "scientifically-proven" flow measurements.

Partnerships (Name all partners and indicate relationship to project)

Participants in the Duluth Urban Watershed Advisory Committee include:

City of Duluth

City of Hermantown

City of Proctor

City of Rice Lake

Midway Township

Lakewood Township

Gnesen Township

Normanna Township

Thomson Township

St. Louis County

University of Minnesota Duluth

MN Pollution Control Agency

MN Department of Natural Resources (Divisions of Ecological & Water Resources and Fish and Wildlife and Minnesota's Lake Superior Coastal Program)

MN Department of Transportation

MN Board of Water and Soil Resources

South St. Louis Soil and Water Conservation District

Pictures

(L to R) Jesse Schomberg, Lindsey Krumrie (MPCA), Tom Estabrooks (MPCA) and Diane Desotelle (City of Duluth) presenting at the 2020 St. Louis River Estuary Summit. Photo Credit: Lake Superior National Estuary Research Reserve.



Gage installed in Lester River near White Pine Campground, along the Superior Hiking Trail in the City of Rice Lake, MN.



Gage installed in Lester River near Lismore Road, along the border between Normanna and Lakewood Townships, MN.



Kingsbury Creek at Carlson Park in Proctor, MN.



Keene Creek at Keene Creek Park in Hermantown, MN.



Chronolog Station at Mission Creek near the Superior Hiking Trail



Chronolog Station at Hartley Pond in Hartley Park



Body of main report

Section I – Work plan review

Objective 1: *Maturing Civic Engagement Partnerships and Collaborative Project Management.*

Task A: *Support DUWAC.*

Subtask 1: *Facilitate regular meetings.*

Over the course of this project, 10 meetings were organized and facilitated for DUWAC members and partners as “general body” meetings, with two additional special topic meetings called to focus on specific issues of interest to the group. Agendas and notes from each meeting are posted to the project website at

<https://www.lakesuperiorstreams.org/communities/DuluthWRAPS/duwacnotes.html>. General body meetings were focused on advancing the DUWAC partnership and collaborative efforts. Agenda topics varied, including brainstorming project ideas, introductions to new DUWAC participants/organizations, round robin updates from participants, organizational priorities, the 1 Watershed 1 Plan process for the St. Louis River, and updates on the TMDL and WRAPS process for the Duluth Urban watersheds. One meeting was cancelled, as it was soon after the beginning of the state shutdown in March, and online comments on project priorities were solicited in lieu of meeting that month. On average, each general body meeting had 16 people participate. After March, all meetings were held online, with participants able to join via internet or phone. We actually saw slightly higher participation after converting to virtual meetings; pre-pandemic in-person meetings averaged about 14 participants; post-pandemic online general body meetings averaged 19 participants. A summary of all meetings is in Appendix A. After meetings went online, there were no meetings expenses that we could charge for refreshments or supplies.

Subtask 2: *Host educational workshops.*

A total of 7 events were organized and facilitated that focused on capacity-building for DUWAC participants. Topics were determined through discussions with DUWAC members on topics of interest. Notes from these events are also on the website noted above. Topics covered include wetlands, flooding, Kingsbury and Amity Creek watershed project updates, E. coli research, and impacts of beaver on water temperature, hydrology, and fish passage. These events drew more participants, averaging 26 per meeting, for a total of 186 people over all 7 events. For these capacity-building events, we also saw an increase in participation after moving them to a virtual platform. Pre-pandemic in-person capacity-building events averaged 21 participants; post-pandemic online events averaged 31 participants. After workshops went online and all meetings were required to be remote, there were no workshop expenses that we could charge for refreshments, travel, or supplies.

Subtask 3: *Attend community meetings.*

Community meetings were pursued in June of 2019, to focus on outreach and education within the participating communities. Only 1 community expressed interest: the City of Rice Lake, who wanted to better understand TMDL’s and how they would impact their

community. An event was planned for July of 2019 with MPCA staff and the Watershed Game, but Rice Lake did not continue to engage, and no meeting took place. Community meetings had been again scheduled for spring of 2020, but the pandemic prevented such events, and in discussions with DUWAC participants, there was little desire or appetite for scheduling such meetings within their communities. Other conversations were organized, however, including one to focus on Tischer Creek and potential sampling locations. DUWAC facilitator Tiffany Sprague organized a meeting of interested participants, including 1854 Treaty Authority, NRRI, MnDNR, South St. Louis SWCD, and City of Duluth to discuss priority areas of study for Tischer Creek watershed with respect to Lake Superior-South WRAPS Cycle II. The group used an ArcOnline platform to identify 17 potential sampling locations of moderate to high priority for sampling with respect to stream temperature and aquatic health, and bacteria concentrations and human health. Another special meeting was organized to focus on green infrastructure codes, with additional community participants from Midway Twp and the Duluth Planning and Development, Parks and Recreation, Public works and Utilities, and Sustainability departments. See Task B Subtask 2 below for more on this. To get additional feedback on how DUWAC was functioning from the communities, we also conducted a survey in September 2019 on meeting frequency, location, and structure. This was revisited and confirmed during the September 2020 meeting as plans were made to restructure the DUWAC meetings beginning in 2021. See Appendix B for these survey results.

Subtask 4: Conference presentations.

Jesse Schomberg presented, with co-authors Tiffany Sprague and Brian Fredrickson, an oral presentation titled “Engaging with communities to develop priorities for cooperative watershed management: The Duluth Urban Watershed Advisory Committee” at the [2019 National Watershed and Stormwater Conference](#) in Charleston, SC (Apr 29-May 2).

Jesse Schomberg coordinated abstract submission and oral presentation at the [2020 St. Louis River Estuary Summit](#) in Duluth, MN, and co-presented with Diane Desotelle, City of Duluth, and Tom Estabrooks and Lindsey Krumrie, MPCA. The presentation title was: “Duluth Urban Water Quality Impairments: E. Coli Study, Stream TMDLs Revised, and Beach TMDL Progress”, which included a description of DUWAC.

We did not present at the 2020 Minnesota Water Resources Conference, as initially planned. Confusion over travel restrictions and event cancellations in May, when abstracts were due, led to no abstract being submitted for this conference.

Task B: Engage the DUWAC communities in projects to sustain and improve metropolitan water resources that are consistent with TMDL or WRAPS.

Subtask 1: The Contractor will assist the DUWAC in identifying and prioritizing projects to maximize cost effectiveness and ensure maximum impact from investment and collaboration.

An initial project priorities spreadsheet was developed in October 2018; this spreadsheet was revisited at the Feb 2020 meeting, with additional feedback solicited in lieu of the March 2020 meeting, which was canceled due to the pandemic shutdown. This project priorities spreadsheet was also directly used in determining projects for DUWAC to pursue. This project prioritization table is in the results section below, with items highlighted in yellow being activities that DUWAC worked directly on during this project period.

From this project prioritization, two projects were identified, and funding was sought, via grant applications, to work on. The first project was focused on addressing hydrological changes in the Mission Creek watershed due to the loss of black ash trees from the invasive Emerald Ash Borer (part of the Forest Management priority area). This application had matching fund support from the City of Duluth, Midway Township, Thomsen Township, and South St. Louis Soil and Water Conservation District. The second project focused on conducting a review of ordinances for DUWAC communities, and a full code audit for Midway Township and the City of Duluth, focused on green infrastructure practices (part of the Land Use Planning/Ordinances priority area). Summaries of each project are below, and the full grant application narratives are linked in the results section.

Project Title: Building watershed resilience through black ash underplanting and community engagement in Duluth, Minnesota

Funding Organization: National Fish and Wildlife Foundation

submission Date: Jan 30, 2020

Proposed Project start date: October 1, 2020

Requested amount: \$43,267

Results: Not funded

Project Title: Green Infrastructure Code Evaluations for Duluth Urban-area Communities

Funding Organization: Minnesota's Lake Superior Coastal Program

Submission Date: Nov 13, 2021

Proposed Project start date: October 2021

Grant Request: \$60,051 Applicant Match: \$60,051

Results: Under Consideration

In response to the St. Louis River watershed 1 Watershed 1 Plan project solicitation of priority issues from communities, we drafted and, after review by DUWAC, submitted a letter, outlining the priorities from the Duluth Urban Watershed communities. This letter is in the results section below.

This project had anticipated that the TMDL and WRAPS would be finalized much earlier in this project than occurred; the Duluth Urban Area Streams TMDL report (wq-iw10-11e) was approved on 11/18/2020 and the Duluth Urban Area Streams WRAPS report

(wq-ws4-42a) was approved on 10/13/2020. Though the lack of final documents didn't halt efforts, it did leave us without final documents to reference or refer to during the project.

Subtask 2: Evaluate local codes and ordinances.

Three workshops were hosted that focused on codes and ordinances (listed below, in the meeting summary document in Appendix A, and notes available [here](#)). One additional meeting was planned for June 2020, but the committee expressed interest in canceling this meeting. The committee interest in regulations, ordinances, and policies shifted towards a desire to conduct a code audit for green infrastructure, as is described in the *Tackling Barrier to Green Infrastructure* guidebook, rather than discussing their existing ordinances. It was apparent during the discussions that the communities had very different ordinance structure and enforcement mechanisms, which made selecting "best examples" not very helpful. The code audit became the 2nd grant applied for (under Task B, Subtask 1 above), and included audits of 1 city (Duluth) and 1 township (Midway), which was anticipated to provide good examples, along with a comparison table of key ordinance characteristics (as determined by the committee) among all DUWAC communities. Due to this interest, additional ordinance and code workshops were not conducted as part of this project, with efforts going to developing and writing the grant, and other capacity-building opportunities. After workshops went online and all meetings were required to be remote, there were no workshop expenses that we could charge for refreshments or supplies.

Feb 26 2019 meeting:

The group walked through *Tackling Barriers to Green Infrastructure* guidebook (WI Sea Grant) focused on construction and post-construction management. In general, conversation centered around the need for wetland buffers, tree preservation, and long-term ownership of open space. The group also acknowledged pre-planning meetings and frequent site visits are needed for success with developers. The group noted good things do take place, yet expectations are often communicated verbally with developers, and are not necessarily written into code. The most important language pieces the group highlighted can be found [here](#).

Dec 19 2019 meeting:

Rachel Olmanson and Carlee Kjeldahl, MS4 experts with MPCA, joined the DUWAC group to discuss TMDLs and MS4 compliance and reporting, [accompanied by a presentation](#). Main take-aways for the group include: compliance schedules are the BMPs your community can reasonably accomplish in the next 5 years (including modeling, monitoring, feasibility studies, on-the-ground work); can lump stream reaches across various watersheds by BMPs type(s); can also just focus on one stream reach; do not have to do a BMP on every single stream reach in each 5 year cycle; the very first time reporting, will include all activities since the baseline year (so for Duluth, since 2011); if at any point a community thinks they are meeting their load allocations, need to justify to MPCA, and if approved, a TMDL can be removed mid-permit cycle. In general, the process is constantly evolving, and MPCA has staff that can help.

October 22 2020 meeting:

A special meeting was held to discuss and prepare for a MN Lake Superior Coastal Program Annual Grant submission. The proposal outlined a workplan to conduct a full green infrastructure code audit for the City of Duluth and Midway Township, a code audit comparison chart for all DUWAC communities, and outreach and engagement on how policies and ordinances result in on-the-ground implementation. Individuals from City of Duluth Planning, Sustainability, and Park & Rec, as well as Midway Township, met with Juli Beth Hinds, the consultant who will assist with carrying-out the code audit. [Jamboard](#) was used to engage with participants and organize the efforts to be included in the grant.

Objective 2: Crowdsourced Hydrology Support

Task A. Maintain the current City of Duluth CrowdHydrology Stream Stage Monitoring Network

The sites and program encourages citizen science and public involvement in stream protection, and collects stage data on key urban tributaries.

Subtask 1. Ground truth gages and assure CrowdHydrology sites are meeting MPCA protocol, are located accurately and at correct elevations.

All fieldwork was performed under strict Covid-19 prevention controls developed specifically for this project and approved by University administration. The establishment of a reference point on land allows the gage to be replaced, stream bed accretion or scour to be measured, and a fixed point from which to measure stream datum. The gages were all surveyed to reference marks (2-4 points per gage) as per MPCA protocol (Tom Schaub, MPCA staff, pers. comm.). Markings consisted of chisel marks on bridge abutments and hard surfaces and/or spikes driven into less solid surfaces. Where no adequate solid surfaces existed, multiple locations were spiked to increase the likelihood of finding one in the future. Gage survey location information and associated data can be found in **Section II**. Survey gage elevation data can be found in **Appendix C** and the linked drive files.

Subtask 2. Clean gages and signs. Check for vandalism. Identify and carry-out any needed repairs or re-installations.

The importance of maintenance cannot be overstated, aside from being able to clearly see the gage numbering, proper maintenance projects a positive image of both the stream and the organizations involved in the CrowdHydrology network. The in-stream gages are subject to displacement through high water and the associated flow debris and/or spring ice breakup. Each spring has required 2-5 gages to be repaired after spring flows subside enough for working in the stream. To check gage and sign conditions and clean the stream gages, visits were made approximately once a month during the open water season. Most

maintenance visits required nothing more than a scrub brush and some stream water. We only had one incident of vandalism, spray painting on a sign that was replaced.

The signs also require maintenance to assure the proper image is being portrayed and the sign is legible and up to date. Other sign maintenance included updating the text and graphics on the signs to reflect user feedback, improved readability, and to decrease errors in sending data in an incorrect format. Each gage location received the updated sign. An image of the new sign can be found in **Section II**.

Task B: Expand the CrowdHydrology gage network to include up to 8 new gages in DUWAC communities where no gages exist. Engage citizens and residents of DUWAC communities in stream protection and stage data collection.

Subtask 1. Engage with the following communities on site selection: City of Hermantown, City of Rice Lake, City of Proctor, Normanna Township, Gnesen Township, Lakewood Township, Midway Township, and Thomson Township.

The City of Hermantown and the City of Proctor were receptive and interested in gage installation within their community. While Proctor took substantial time to receive approval, as a result of staff turnover, Parks Supervisor, Rick LaLonde, provided final approval to install a gage along Kingsbury Creek at Carlson Park. Approval from the City of Hermantown also took a substantial period of time, due to contract agreements between the University and the City, with final approval needed by City Council.

Gages installed in the City of Rice Lake and along the border of Normanna and Lakewood Townships were along the Superior Hiking Trail, and installation was approved by both the Superior Hiking Trail Association and the Minnesota Department of Natural Resources Parks and Trail Division.

Midway Township was supportive of a gage installation, but multiple in-field investigations of potential locations along Mission Creek proved unfruitful, as neighboring trail - stream crossings did not allow for viewing of a gage trailside; typically, the trail was elevated significantly above the stream, and vegetation along the stream was very dense. This was a similar situation for Thomson Township.

Gnesen Township approved gage installation at Eagle Lake (headwaters to Lester River), but after communicating with a local resident who would take primary responsibility for sending in stream height data, NRRRI learned many other residents in the area view Eagle Lake as a private lake, and have vandalized or removed other equipment installed by other researchers or MN DNR. As NRRRI did not want to be liable for potential long-term difficult maintenance, nor for data collection to be perceived negatively by local residents, NRRRI decided it was not in our best interest to install a gage at Eagle Lake. Other Lester River locations within Gnesen Township were not easily accessible for gage viewing and/or installation.

Subtask 2. Install gages and signs per protocol.

Type A stream gages were mounted to 2 x 4 lumber and adhered to a stable surface in the stream - a large boulder, bridge or culvert. Depending on location, visibility, stream size, and typical water depth, either a 3 foot gage or a 6 foot gage was installed.

Gages were installed at:

Kingsbury Creek in Carlson Park, City of Proctor (46.739173, -92.226455) in October 2020

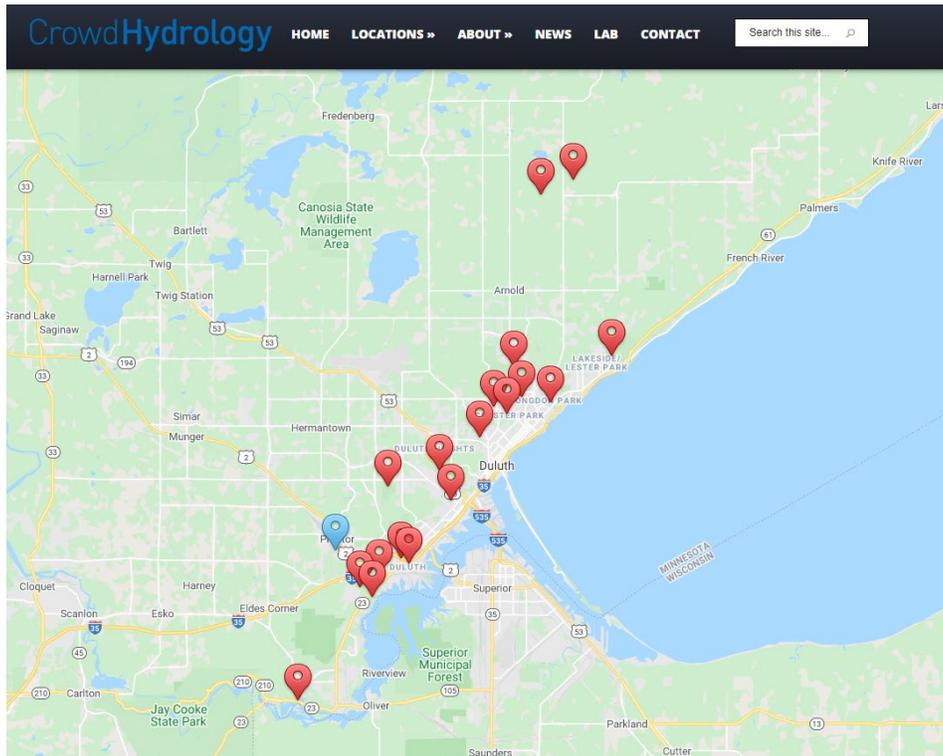
Keene Creek at Keene Creek Park, City of Hermantown (46.773628, -92.185420) in August 2019

Leser River near White Pine Campground, City of Rice Lake (46.930194, -92.065528) in August 2020

Lester River near Lismore Road, Lakewood & Normanna Townships (46.93819, -92.03993) in August 2020

All locations received an associated (newly designed) sign upon installation. Photos of gauges can be found in **Pictures**.

A map of all gage locations, previous and new, is viewable from the CrowdHydrology website (www.crowdhydrology.com), with a screenshot presented below:



Task C. Develop and manage metrics for each CrowdHydrology gage. Assess site visitation at the gages, as well as analyze the hydrographic trends at each site.

Subtask 1. Assess usage and site visits at each gage.

The usage statistics at the gages have led to some interesting results and insights into the behaviors of those submitting data. Two levels of data are available - the publically available stage height data submitted by user, with date and time, as well as the hidden, restricted access data that includes a unique code assigned by the program operators at the University of Buffalo, NY. for each cell number (not using the actual cell phone number) used to report the data.

The publically available data usage is summarized in Table 1, and Table 1 is also found again in **Section II**.

Table 1. Number of stage height records submitted per gage station, ordered by date of gage installation (records until December 28, 2020)

Station ID	Station Name	2017	2018	2019	2020	Grand Total
MN1000	Brewery Creek @ Marshall School	211	127	27	69	434
MN1001	Chester Creek @ College of St Scholastica	14		24	66	104
MN1002	Miller Creek @ Lake Superior College	24	22	18	40	104
MN1003	Kingsbury Creek @ Lake Superior Zoo	28	6	13	2	49
MN1004	Keene Creek @ Dog Park	29	8	17	20	74
MN1005	Tischer Creek @ Hartley Pond	108	61	67	133	369
MN1006	Chester Creek @ Chester Bowl Park	226	180	287	255	948
MN1007	Knowlton Creek @ Spirit Mountain	79	49	67	80	275
MN1008	Knowlton Creek @ Waterfront Trail	51	25	41	75	192
MN1011	Miller Creek @ Lincoln Park			16	183	199
MN1012	Keene Creek @ Irving Park			7	24	31
MN1013	Tischer Creek @ Congdon Park			232	385	617
MN1014	West Tischer Creek @ UMD			114	225	339
MN1015	Amity Creek @ Lester Park			91	138	229
MN1016	St Louis River @ Perch Lake			32	20	52

MN1018	Keene Creek @ Keene Creek Park			11	65	76
MN1019	Lester River nr Pine Campground				17	17
MN1020	Lester River nr Lismore Road				20	20
MN1021	Kingsbury Creek @ Carlson Park				1	1
Grand Total		770	478	1064	1818	4130

Notable observations from the above records show a drop in reportings in 2018 relative to 2017. Conversely, most sites show an increase in reportings in 2020 relative to 2019, likely as a result of the COVID-19 pandemic, and more individuals spending time in nature.

There are also notable observations regarding specific sites. The decrease in reports for MN1000 Brewery Creek at Marshall School is likely a result of COVID-related school closures. MN1003 Kingsbury Creek at Lake Superior Zoo is on a now dead-end walking path, which was not the case when the gage was installed in 2017. MN1006 received local press in 2019 potentially accounting for the increase in readings (a photo of the gage appeared on the front page of the Duluth News Tribune).

Based on the sites with more than two years of data, the locations that would be visited to hike or spend time outdoors at, appear to have an increase in 2020 over 2019, some of them significant; notably Amity Creek at Lester Park, Tischer Creek at Hartley Pond, Knowlton Creek at the Waterfront Trail, and Tischer Creek at Congdon Park. This correlates with the reported national trend of greater participation in outdoor activities following the COVID-19 pandemic.

Most surprising is the steady volume of reports for both MN1020 and 1021. These two sites are located rather remotely with the only access via the Superior Hiking Trail and were installed late in the year, yet still saw sustained visitation. Interestingly, when looking at the private usage data, with the exception of one user (who submitted data twice), all other water depth records submitted at MN1020 and MN1021 are from a unique (different) individual.

When looking at the time when data is submitted, most data is submitted between 10 a.m. and 4 p.m., as seen below in the distribution graph.

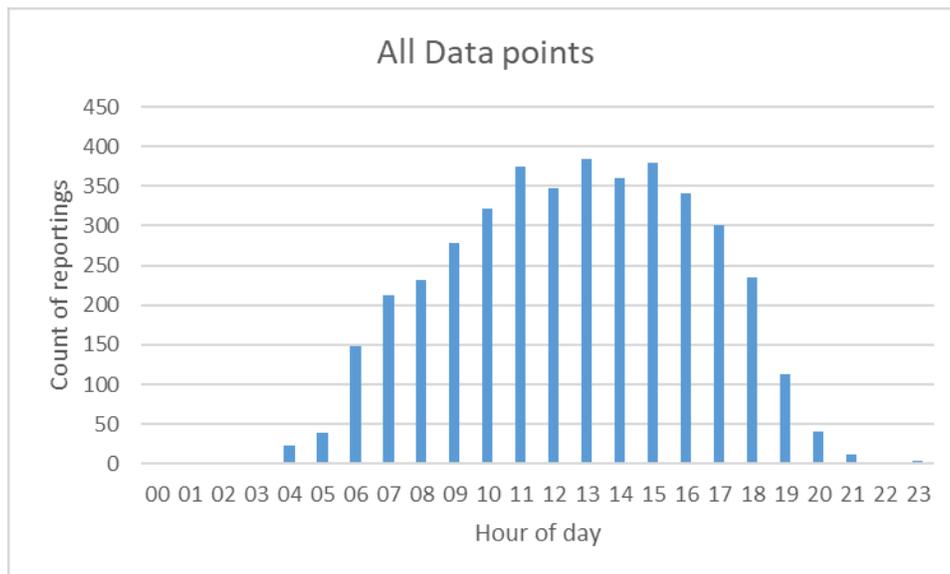


Figure 1. The number of water depth records submitted in relation to the time of day for all data across 19 gages.

As expected, the weekends are typically when users submit data most frequently, as noted in Figure 2 below. On average, Thursdays had the least number of water depth records submitted.

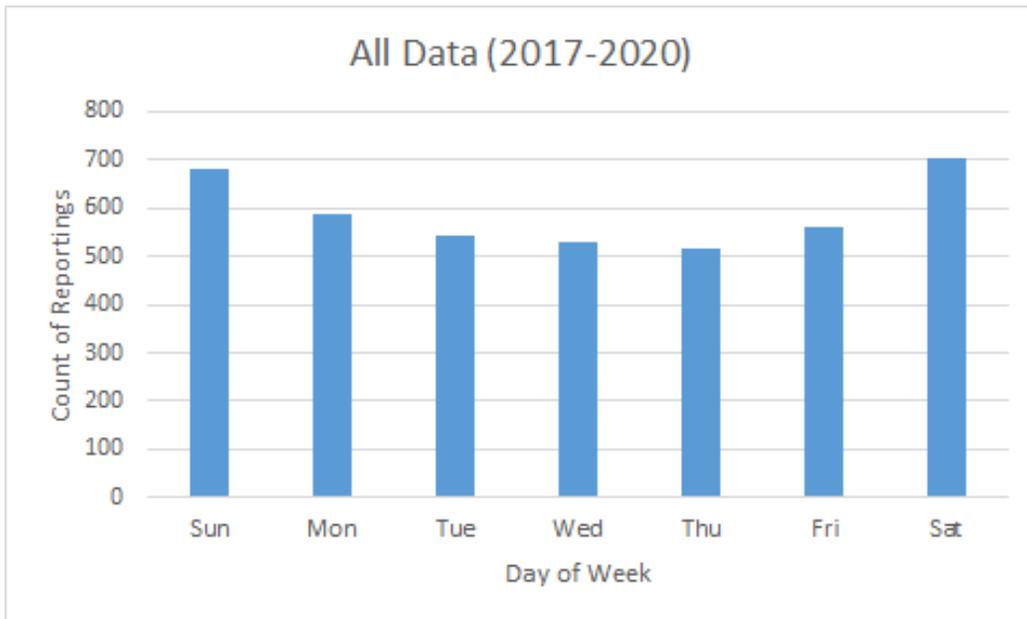


Figure 2. The number of water depth records submitted in relation to the day of the week for all data across 19 gages.

The reporting patterns changed slightly in 2020 (during COVID restrictions) from the pattern seen during the 2017-2019 time period. While Thursday remained the day with the lowest number of reports, the difference between mid-week reports and weekend reports diminished.

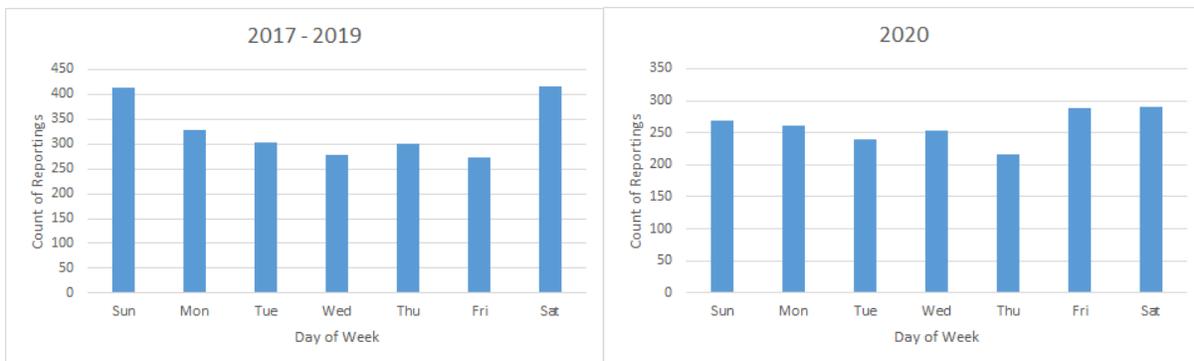


Figure 3. The 2020 data separated from the 2017-2019 data displaying the change in reporting pattern.

There are some notable exceptions to this pattern. Miller Creek at Lincoln Park and West Tischer Creek at the University of Minnesota Duluth (UMD) had an inverse pattern with more reporting midweek and fewer on the weekend. The drop off on weekends may be explained at West Tischer by its location at the University, where weekend activity is lower than midweek. Miller Creek at Lincoln has no such explanation. Yet, further investigations through internet searches and Facebook, indicate disc golf league play typically takes place on Thursday nights, with reschedules taking place on Tuesday and Wednesday evenings. Lincoln Park hosts a popular disc golf course, and may explain the increase in water depth records submitted mid-week for this Miller Creek gage.

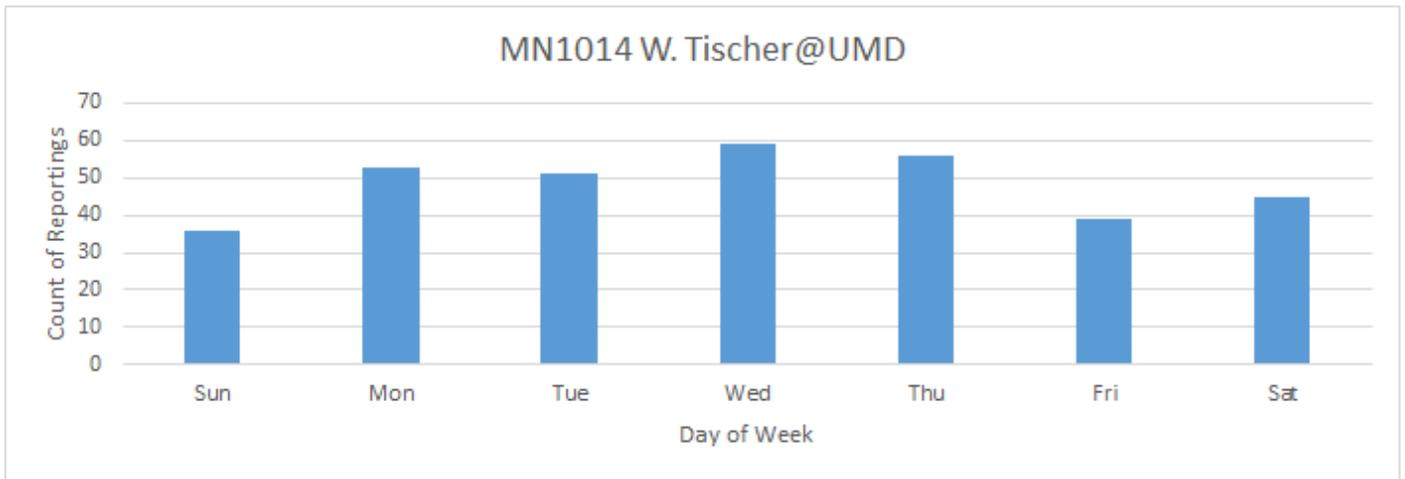


Figure 4. The number of water depth records submitted in relation to the day of the week for West Tischer Creek at UMD.

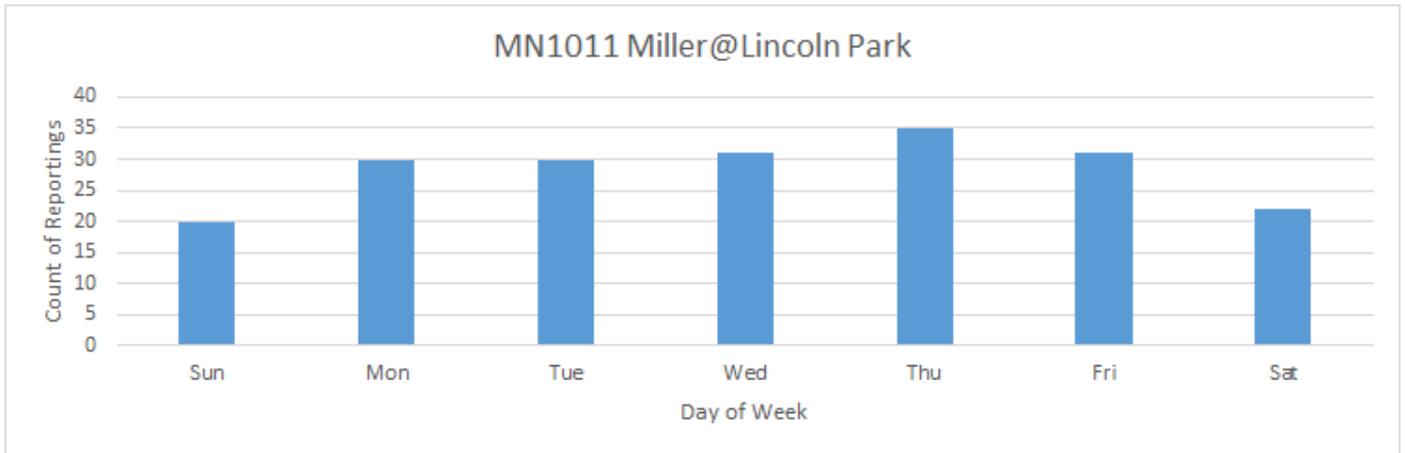
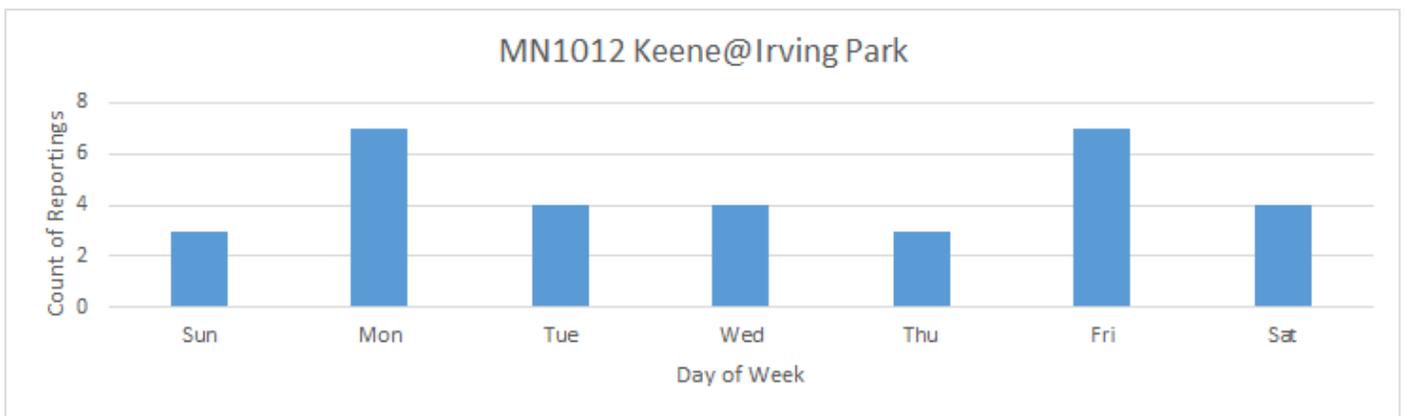


Figure 5. The number of water depth records submitted in relation to the day of the week for Miller Creek at Lincoln Park.

Both Keene Creek at Keene Creek Park in Hermantown and Keene Creek in Irving Park also show more submitted water depth records during the week. Additional investigations would be needed to understand how this relates to visitation to these parks. Both parks support ball and soccer fields, so one speculation is timing may correlate with youth league sports. Another speculation could be organized adult outings, such as group fitness networks that walk or run trails together.



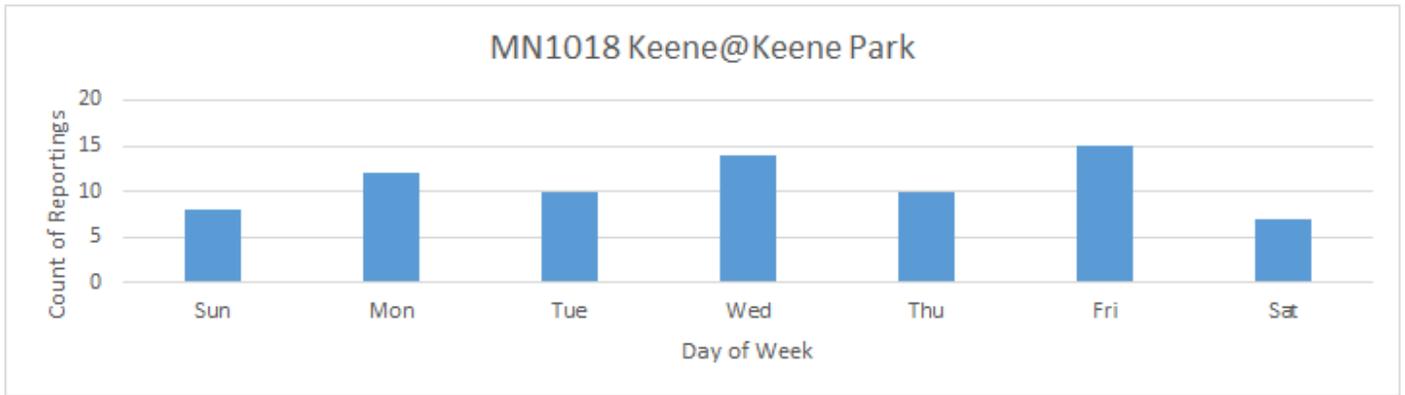


Figure 6. The number of water depth records submitted in relation to the day of the week for Keene Creek at Irving Park (top) and Keene Park (bottom).

Confidential user data was provided by the CrowdHydrology organizers from Buffalo, NY, and submitted water depth records were compared against unique users. In total, 1,822 unique users (aka different individuals) submitted water depth data. Most users submitted only one water depth record, with a few individuals submitting more than twenty water depth records; see Table 2. In general, high record users submit all of their data from one gage location.

Table 2. Number of water depth records submitted per unique user identification number from initial gage installation in 2017 through October 23, 2020.

Number of Water Depth Records Submitted	Number of Unique User IDs
1	1,463
2	171
3 - 5	97
6 - 10	51
11 - 20	24
21 - 30	5
31 - 40	4
41 - 50	1
51 - 100	4
> 101	2

For the seven unique user identifications submitting 41 or more water depth records, additional investigations indicate these may not actually be seven different individuals. One identification number is tied to 130 water depth records, all on Brewery Creek at Marshall School, and taking place between 2017 and 2018. We will label this unique ID as B1. This is likely Dave Montgomery, the middle school science teacher at Marshall School who originally advocated for installation of CrowdHydrology gages in Duluth. Previous communications with Dave note he also lives near the school, and frequently walks his dog, Annie, along the school’s trails, likely leading to the high number of submissions. But, the records for that unique ID stop in 2018. Yet, in 2019 and 2020, a new unique ID number is tied to Brewery Creek water depth submissions (62 in total), likely indicative of Dave getting a new cell phone. This ID is labeled as B2.

A similar story seems to hold true for Chester Creek at Chester Park. 63 records are submitted by one unique ID in 2017 and 2018 (C1), with 85 records submitted from a different unique ID in 2019 and 2020 (C2), and also 63 records submitted from yet another unique ID in 2019 and 2020 (C3). Interestingly, the last data submitted in 2018 by C1 corresponds with the stream freezing over, and the first data point submitted in 2019 by both C2 and C3 corresponds with ice out (with C2 submitting a couple of weeks earlier in April than C3). It is likely this individual received a new phone over the holiday season, a very popular time for folks to purchase or receive new technology, yet is unclear if user C2 or C3 is connected with user C1. Additional investigations into time of day or day of week between C1 and C2/C3 do not reveal a clear pattern that would readily link C1 with either C2 or C3.

Interestingly, one user did submit data exclusively (59 water depth records submitted) at the Brewery Creek gage between 2017 and 2018 (B3). Speculations include a teacher or a student who frequents the trail past the gage, but it is hard to know who, and

why they stopped submitting data in 2018. The last data record they submitted was in October 2018, so it does not correlate with a student who would graduate in June.

The super-user award easily goes to T1, a user who submitted 155 water depth records for the Tischer Creek gage located in Congdon Park. This individual submits nearly daily, and is responsible for 25% of all Tischer Creek data submissions!

Knowing new cell phones are correlated with new user identification numbers, it is likely that the actual number of unique users is less than 1,822, but it is unlikely this fact would skew the general trend in which most users send only one data point. Compared to CrowdHydrology gages across the nation, this trend is similar to gages in other states (Chris Lowry, University of Buffalo, pers. comm.).

In general (yet not all instances), it seems users who submit two data points either submit the same data point back-to-back, likely concerned their first data point was not accepted, or submit what appears to be a correction to a typo. In other instances, two water depth record submitters appear to submit a data point within a month of submitting their first data point, and at the same gage location. It appears they are encouraged enough to submit data again, yet are not interested in sustaining long-term or repeated data submission.

Subtask 2. Analyze meteorological data in conjunction with stream height data, and develop relationships between meteorological patterns and stream hydrologic responses for the DUWAC community.

Using Chester Creek at Chester Bowl in Chester Park (MN1006) as an example gage location and stream, for it has the most reports (954): of 319 rain events during the reporting period (2017-2020), 116 showed an increase in reported stage height. That also means for 203 rain events in which the reported gauge height did not go up, means these rain events were missed by citizen submitted water depth records. Correlation to rain is not necessarily the most important consideration, for good timing on the falling tail of a hydrograph can be just as important as capturing the peak, and measurements taken immediately after a peak are helpful for defining the curve.

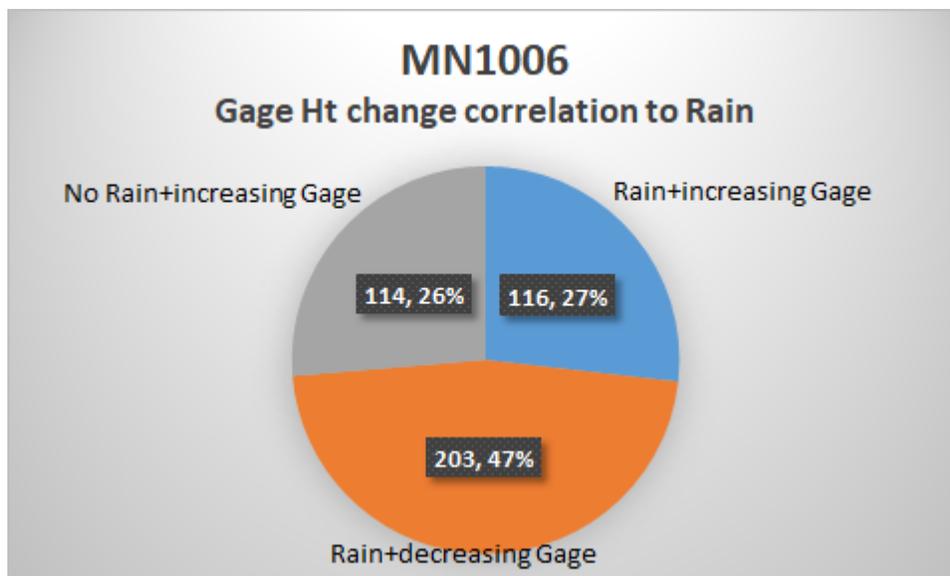


Figure 7. Correlation of rain with direction of stage height for site MN1006, Chester Creek at Chester Bowl.

Conversely, there were 114 reports of the gauge going up that were not directly associated with rain. This lack of a correlation between rain events and reported gauge height increases may be the result of several factors. In the spring, the increasing gage height could be a result of snow melt. We know from working with the LakeSuperiorStreams.org data and other sources, that the streams respond to snowmelt/ice-off differently than a summer rain, and a summer rain with high evapotranspiration rates responds differently than a fall rain. Some of the rain events may have simply been too small or too short in duration to have had a measured impact on the stream. Splitting out the snowmelt period from the remainder of the data did not result in much change as too few reports occurred during the difficult-to-define snowmelt period. Each of the streams will melt-out at different times depending on a myriad of factors. Streams generally melt out in March and freeze over for the winter in late December to early January, depending on the amount of snow.

During a summer rain, the stream response is dependent on the antecedent rain and the current soil moisture content, neither of which were measured for this project. Placing a one and two day buffer around the rain event improved the relationship but this also expanded the number of rain event days to an artificially and unrealistically high number. Rain events in 2017 between March and December numbered 120 of the possible 290 days. Applying a one day buffer after the event results in 240 of the 290 days being considered as a rain event. Experience has shown that these small Duluth streams respond rapidly to rain events, generally on the scale of hours. Therein lies another source of error: infrequent reporting can miss significant portions of the flow duration curve and,

sometimes, whole events. When it rains and no one is reporting and the stream has already receded by the next report, the rain event would not be recorded as an increase in stage height and would be missed, even with a relatively high frequency reporting. For the streams with lower reporting frequency, many rain events are likely missed. Additionally, some of the 114 occurrences of the reported stage height increasing without rain may be the result of reporting errant values. The gross decimal shift errors stand out fairly obviously but an unknown number of reading and reporting errors are the cost of citizen science.

A compilation of 18 of the stream gage sites in 2020 shows the seasonal changes in rain responses clearly. Though the individual responses to precipitation may be varied, the general response portrayed is strikingly similar when viewed together.

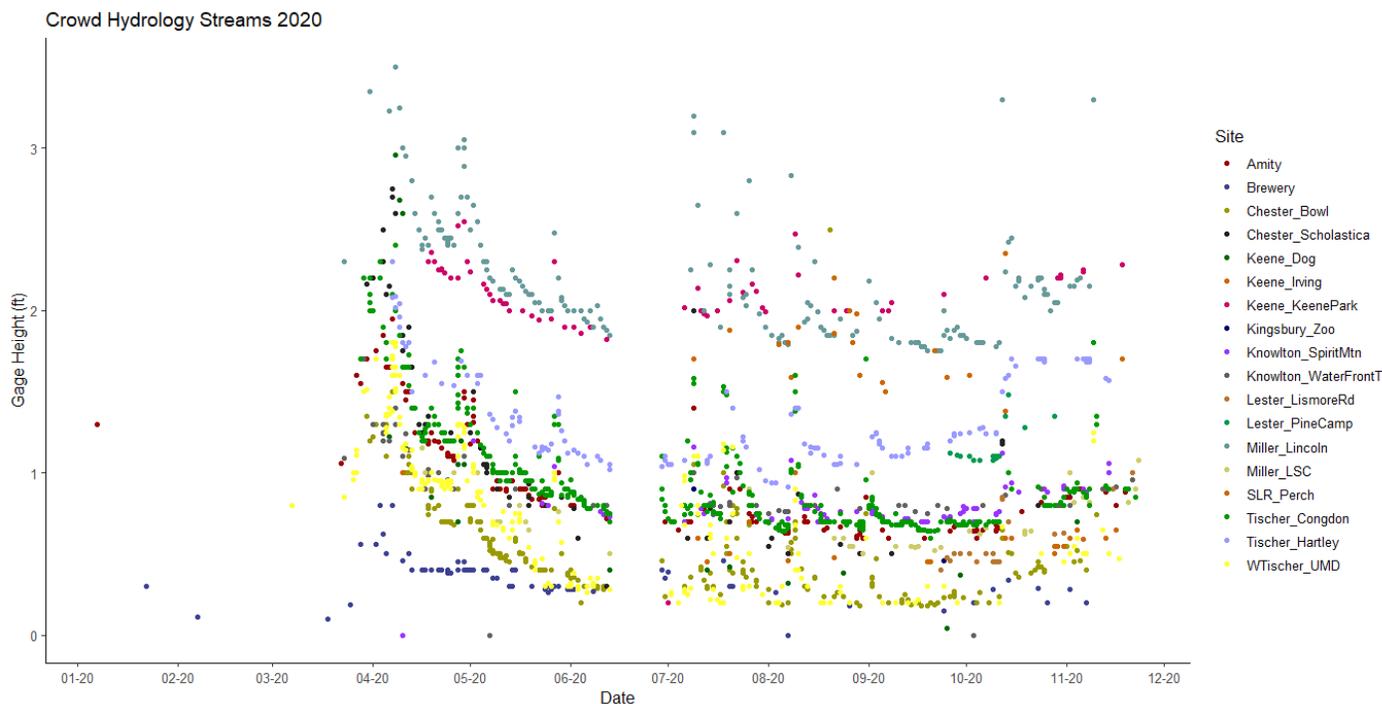


Figure 8. A compilation of citizen-submitted water depth records in 2020 for 18 CrowdHydrology gages.

While measuring stage height is a simple method conducive to citizen science, discharge responses are more relevant as they remove the variation in stream heights resulting from form and slope allowing for more direct comparisons between streams. The MPCA guidance on developing stream rating curves involves multiple time intensive site visits spanning the range of stage heights over two years, something that was not possible on this project with so many locations. An alternative to developing a rating curve for each stream is to calculate discharge based on a number of parameters such as cross section dimension, longitudinal slope and channel material. The Reference Reach Spreadsheet developed by Dan Mecklenburg, Ohio Department of Natural Resources, is a widely used spreadsheet to make these calculations.

A crew of two, measuring channel cross section, longitudinal slope, and bed material surveyed the streams over the summer of 2020. The cross sectional profile was measured by surveying in approximately 20 points across the stream from bankfull height to bankfull height. The substrate composition was categorized at each of those sites to determine channel material and roughness. We did not perform a full pebble count, instead, we used 6 categories rather than the 24 used when measuring each substrate sample due to budget and time constraints. Measuring the longitudinal slope of the stream segment consisted of surveying upstream a distance of 20-30 bank widths (60-80 points) from the gage site.

The Reference Reach Spreadsheet has taken the Manning equation and incorporated it into an Excel spreadsheet to calculate a variety of stream properties based on the inputs of cross section, slope and channel material. We used the spreadsheet-calculated slope, velocity, and cross sectional area to determine discharge for bankfull conditions and took slices downward to calculate a synthetic rating curve. Several sources of error are included in this method and should be recognized including: the abbreviated pebble count is not as reliable as the complete count; only the cross-section immediately upstream of the gage was used but the gage was placed for view-ability and not for the ideal location to measure cross sectional profile or stream discharge; the Manning equation is idealized and may not accurately represent in-stream conditions; calculating the slope at low flows may not represent the conditions present under higher flows; and likely others.

A bit of confidence in the synthetic flow curve derivation can be found in a comparison between the discharge of LakeSuperiorStreams.org stream monitoring unit immediately upstream from the CrowdHydrology site on Chester Creek at St. Scholastica College (MN1001), and those derived from the CrowdHydrology gages on Chester - MN1001 at St. Scholastica and MN1006 at Chester Bowl. The stream monitoring unit logs data every 15 min and is plotted as the daily average discharge. Figure 9 shows the impact of low-frequency data such as MN1001, Chester Creek at St. Scholastica College, but it is notable that even these infrequent water depth record submissions trended along with the stream discharge from the continuous monitoring log station. The highest frequency site, Chester Creek at Chester Bowl (MN1006), is also plotted. This site is ~1/2 mile downstream of

the St. Scholastica gage. The higher frequency improves the fit and generally follows the stream flow curve. The CrowdHydrology gage sites are showing discharges at the peaks greater than those from the stream monitoring unit, and are likely the result of the errors listed above.

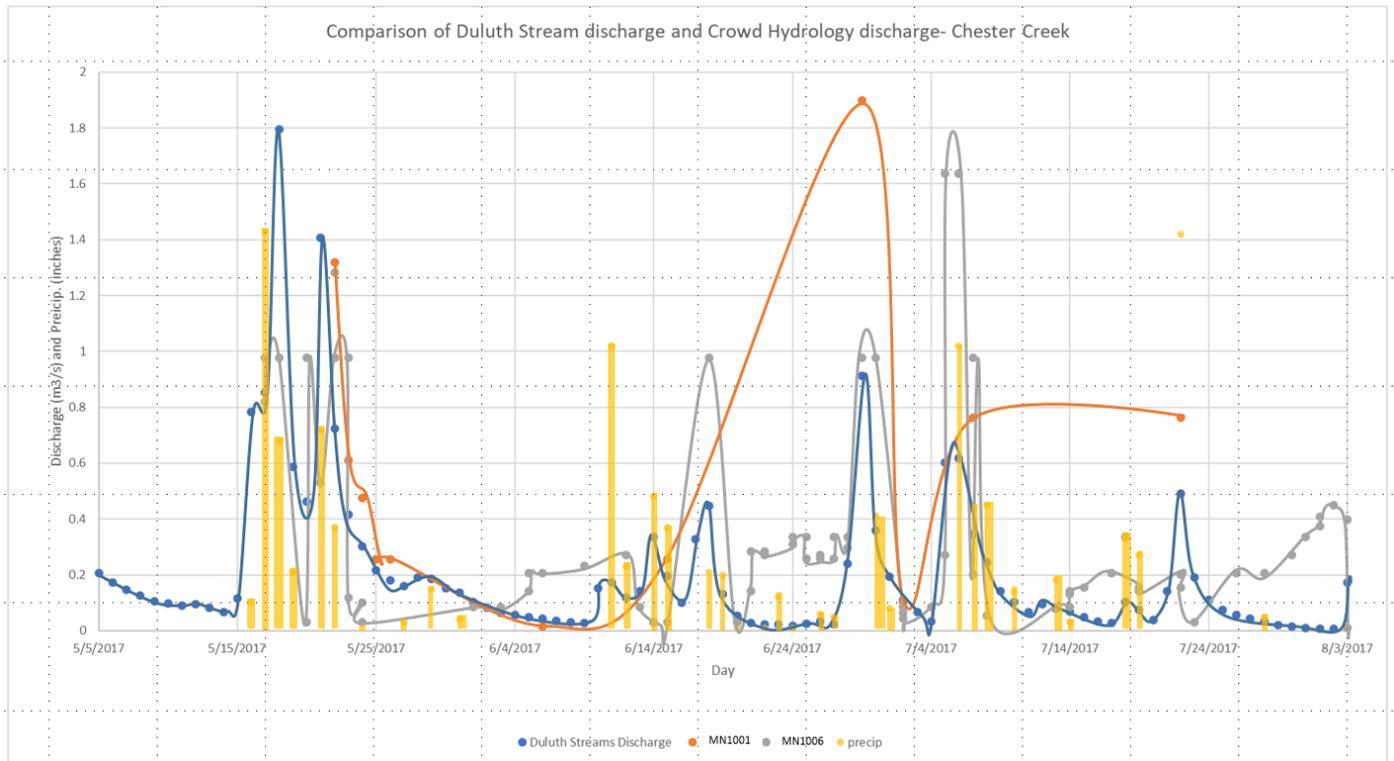


Figure 9. A comparison of averaged daily discharge from the LakeSuperiorStreams monitoring site with calculated discharge from MN1001 (immediately adjacent) and MN1006 (½ mile downstream) with rain events.

Using the discharge derived from this method is not adequate for regulatory purposes but does allow the stream responses to be compared between streams eliminating the differences in stage. This is an example of the ability to build upon the information provided by the citizens at relatively low cost.

Task D. Promote and share CrowdHydrology program, metrics, community engagement and stream response insights at multiple venues. Expand visibility of the CrowdHydrology program, highlighting its value in public engagement and its capability to be used as a model of citizen-based scientific inquiry across the state and Lake Superior region.

Subtask 1. The Contractor will give poster or oral presentations at multiple events including two meetings of the St. Louis Estuary Summit (2019 and 2020), one meeting of the Minnesota Water Resource Conference (October 2020), two meetings of CitSciMN (2019 and 2020), other local and statewide conferences, summits, and/or workshops as appropriate, as well as various opportunities with Duluth-area Master Naturalists or Citizen Science programs in order to promote use of the CrowdHydrology network.

Contractor Sprague gave a conference presentation at the 2019 St. Louis River Estuary Summit (March, Superior, WI) and a 5-minute lightning talk at the 2019 CitSciMN meeting (November, St. Paul, MN). Links to these presentations can be found below in **Section II**.

A presentation for the 2020 St. Louis River Estuary Summit was deemed to be too close in time to the 2019 presentation, for we wished to present user statistics and wanted another year of data submissions. As a result, an abstract was submitted, and accepted, for a ten minute presentation at the 2021 St. Louis River Estuary Summit. Abstract below:

Title: Unlocking the Secrets to Citizen Science: When and Where Folks Want to Study Streams

Abstract: We're back! You may remember us from such classics as "scientists heart big data...but dislike social interactions..." and "we like to give our gauges a monthly sponge bath to keep them clean for our citizens." Rest assured, since the 2019 Summit, we still like data, actively avoid communication, and are routinely sponging down gauges (well, the undergrads are at least). For those just now joining us - welcome - Duluth was the first city in Minnesota to participate in CrowdHydrology, a nationwide crowd-sourced citizen science stream depth monitoring program. Anyone with a cell phone can submit a text message of water depth data observed from a staff gage (think giant ruler) placed in a nearby stream or lake. In the meantime, we've expanded the network of

gauges into communities surrounding Duluth, and have finally started to look at the number one requested analysis - gauge usage and visitation statistics. Are Tuesdays after 5 p.m. a prime time to measure stream depth? Is Dorothy a rockstar data-submitter, whereas Mike, well Mike left their phone back at the house the last 365 days... Are city parks really all they're cracked up to be? Join us as we provide the magical formula for getting folks to your citizen science monitoring locations and submitting the data of your dreams. Disclaimer: true magic is reserved for the fortunate few; we're still waiting on our letters.

A MNCitSci meeting was not held in 2020, as it seems these meetings will not be taking place every-other-year; thus, we were unable to present.

Due to the COVID-19 pandemic, a presentation was not submitted for the 2020 MN Water Resources Conference. Due to uncertainties surrounding if the conference was to be held in person, which contradicted with work restrictions to not travel, an abstract was not submitted for a presentation. The contractors look forward to the opportunity to present at future MN Water Resources Conferences.

As a result of work from home restrictions starting in March 2020 as a result of the COVID-19 pandemic, many meetings were either moved online or cancelled, which limited opportunities for communicating with local stakeholders regarding CrowdHydrology efforts. DUWAC and the Regional Stormwater Protection Team were frequently updated on the progress of the project, and when new gauges were installed.

Subtask 2. The Contractor will develop two public service announcements, to air on local media and suitable for sharing on social media, informing Duluth urban-area community members of the CrowdHydrology program and how they can participate.

As a result of the COVID-19 pandemic, communication staff at both NRRI and MN Sea Grant were unable to dedicate extra effort towards the creation of a formal PSA. Even so, NRRI communications staff did assist with promoting CrowdHydrology through various social media posts.

NRRI re-shared news coverage regarding CrowdHydrology to Twitter on April 7, 2020:



The first original post by NRRI was to Instagram on May 14, 2020:



A second post took place on June 5, 2020 to Instagram:



And a third post took place on August 30, 2020 to Twitter:



On April 8, 2020, University of Minnesota Duluth posted a news brief titled “Cooped up for COVID?”, highlighting local activities folks could do to get outside - CrowdHydrology was one of the citizen science opportunities highlighted.

Tiffany Sprague was interviewed in early April by local news outlets regarding CrowdHydrology, encouraging the public to participate and send in water depth data:

- Fox21: [Researchers need help collecting stream data](#)
- KBJR: [How scientists are looking for community help to track spring watershed](#)
- WDIO: [Help Duluth scientists with stream flow data](#)

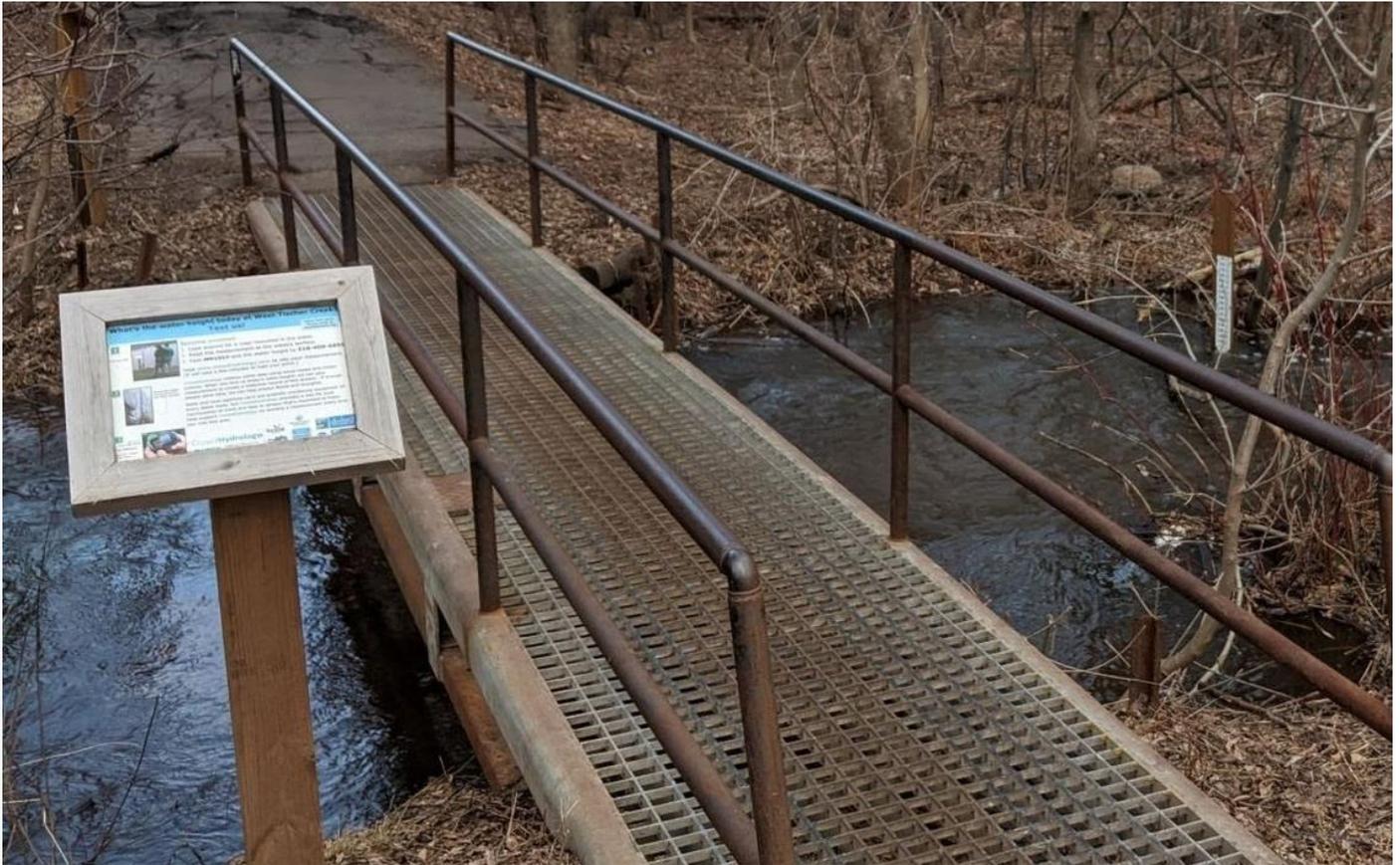
The Duluth News Tribune also published an article in early April 2020, which is included below:

Volunteers needed to monitor stream flow in Twin Ports

Researchers can use the data to understand how streams respond to weather and climate.

Written By: [John Myers](#) | Apr 6th 2020 - 11am.

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Researchers are looking for volunteers to take river flow observations and text in the numbers. Each site, like this one on West Tischer Creek at the University of Minnesota Duluth, has a plaque and a stream height measuring ruler, seen here on the right. It's easy and you may already be walking by these stations during neighborhood walks. (Photo courtesy of the Natural Resources Research Institute)

Researchers who need help monitoring the flow of Lake Superior tributaries in and around the Duluth-Superior area are seeking volunteers to text in their observations. Local scientists set up a crowd-sourcing application a few years ago that allows folks out on a walk to look at a water gauge and send the measurement by text. No science skills are required; the gauges look like giant rulers; and anyone with a cellphone can do it — no smartphone required.

There are 17 water depth gauges in eight streams that feed into Lake Superior, mostly in Duluth and one in Superior; find locations at lakesuperiorstreams.org/citizen/crowdhydrology.html. They are all part of the lakesuperiorstreams.org effort. There's no limit to how many people can be involved or send data. The more, the better.

Streams have just about peaked in the region due to snowmelt but can "flashy" high after heavy rain events.

"Snow melt can be as much as 25-50% of the water that gets in the streams — like a big pulse — and all that water needs to move through the system," explained Chris Filstrup, limnologist at the Natural Resources Research Institute. "In Duluth, we understand big floods, so we want to be prepared for the quantity. We use these measurements to calculate flow and estimate pollutant loads, like phosphate and chloride that wash in from the landscape."

Scientists, researchers and natural resource managers can also use the data to understand how streams respond to weather and climate. This information can help scientists and researchers build better flood models, as well as help managers and planners make better informed decisions.

The Duluth News Tribune article was picked up by the Great Lakes Commission, and sent out in their daily news email on April 7, 2020.

Subtask 3. Pilot enhanced outreach and engagement opportunities for citizens and residents at highly visited CrowdHydrology sites. Potential opportunities include cell phone camera mounts similar to those used by the National Park Service, and weather monitoring through National Weather Service CoCoRaHS.

Two cell-phone camera mount stations were installed in the fall of 2020 - one at Hartley Pond in Hartley Park, and one along Mission Creek near the Superior Hiking Trail and 131 Ave West in Duluth. It took many virtual and in-person reconnaissance efforts to locate suitable camera mounting locations. It was desirable for one location to be in the “east” end of town, and another in the “west” end of town, so as to ideally allow opportunities for folks in different neighborhoods to participate. Additionally, it was preferred for the photos to provide an aesthetic background, and have the potential to double as additional monitoring efforts (i.e. phenologic, or change of season, records).

Tischer Creek at Hartley Pond in Hartley Park was an ideal location due to the high visitation and frequent data submission. The pond area provides opportunities for wildlife, as well as to track ice-in, ice-out, leaf-out, and leaf-fall records over time. Additionally, it was possible to angle the camera mount station so as to capture both the pond in the background and the CrowdHydrology gage in the foreground.

Due to the difficulties in placing a CrowdHydrology gage along Mission Creek, it was desirable to place a photo mount station along Mission Creek. South St. Louis Soil and Water Conservation District recently oversaw major stream restoration efforts in the lower portion of Mission Creek, as a result of the notable 2012 flood. This situation provided an ideal area to track post-stream restoration changes through photo documentation.

Once locations were identified, the second challenge was to identify the method for which photos would be documented, managed, and recorded. The initial plan was to use social media platforms, with NRR staff downloading photos as they were posted. But, in the spirit of using pre-developed crowdsourced platforms similar to CrowdHydrology, we opted into a program known as Chronolog (www.chronolog.io). Chronolog is an international program, and was originally developed monitor succession at ecological restoration sites. Chronolog operates similarly to CrowdHydrology: a user approaches the cellphone mount; they place their phone into the mount and snap a photo; the user then emails the photo to the email listed on the sign, with the subject line containing the identification number of the cell phone mount (also listed on the sign). Unlike CrowdHydrology, Chronolog is \$200/year/mount to participate in the program, but as we were the first program in Minnesota, we received a \$200 discount.

Once a photo is submitted, it is uploaded onto the website for anyone to view. All photos are compiled together into a timelapse. This timelapse video is formatted as a GIF, so can be easily used on a website or social media platform. On the back-end, the photos can be downloaded by the contractors.

The [Hartley Pond camera mount](#) is located at 46.83785, -92.08625. The [Mission Creek camera mount](#) is located at 46.66894, -92.27451. Due to the late-season installs, these locations currently have limited submissions. We are interested to analyze usage statistics over 2021.

Pictures of these cellphone camera mounts can be found above in ***Pictures***.

Section II – Grant results

Objective 1 Deliverables:

Task A:

Subtask 1: Regular meetings of the DMA urban watershed group and record keeping. Six meetings per year, with meeting notes available on the project website.

Appendix A includes a summary of all meetings of DUWAC coordinated and facilitated by U of MN. A direct link to the full meeting notes is here: <https://www.lakesuperiorstreams.org/communities/DuluthWRAPS/duwacnotes.html>. Ten meetings were general body meetings, with two additional special meetings were called to focus on specific topics or issues from the group, for a total of 12. These meetings had a total of 183 participants.

The March 19 2020 meeting was a few days after the shutdown from the COVID-19 pandemic, and was cancelled. Three other meetings were cancelled as well, including August meetings both years and June 2019, as committee participants did not want to meet.

Subtask 2: Targeted DUWAC group trainings associated with TMDL/WRAPS strategies. Three workshops per year, with meeting notes available on the project website.

Seven events were organized and facilitated that focused on capacity-building topics for DUWAC participants (see Appendix A); these meetings had a total of 186 attendees. Notes and copies of presentations from these events are also on the [website](#) listed above. Topics covered (along with relevant WRAPS strategies addressed) included:

1. Beaver Dams along Knife River
 - a. addresses WRAPS Strategies for Chester Creek relating to streambank stabilization and riparian management; WRAPS strategies for all watersheds relating to storage, under stormwater management and wetland management
2. NRRI Web Tools
 - . The tools described help address WRAPS strategies in a variety of topics, including wetland management, forest management, land use planning and ordinances, and stormwater management, in all watersheds.
3. Watershed Storage
 - . Addresses WRAPS strategies for all watersheds, and individual watersheds of Kingsbury and Miller Creeks, relating to storage, under stormwater management, wetland management, land use planning and ordinances
4. Amity & Kingsbury Creeks Watershed Projects
 - . addresses WRAPS strategies for Kingsbury Creek (specifically for TSS under the streambank stabilization and riparian management, stream crossing and culvert improvements, and stormwater management strategies) and Amity Creek (specifically for TSS under the streambank stabilization and riparian management strategy)
5. Skunk Creek E. Coli Presentation
 - . Addresses all strategies relating to E. coli bacteria for all watersheds, and specifically for all E. coli-impaired watersheds (Miller Creek, Chester Creek, Tischer Creek, Keene Creek, Sargent Creek, Stewart Creek, Merritt Creek) and E. coli-impaired beaches.
6. Bacteria Study in Keene & Tischer Creek Watersheds
 - . Addresses all strategies relating to E. coli bacteria for Tischer and Keene Creeks.
7. Fish Movements and Beaver Dams
 - . Addresses WRAPS strategies for all watersheds, and individual watersheds of Kingsbury and Miller Creeks, relating to storage, under stormwater management, wetland management, land use planning and ordinances

Subtask 3: Individual community meeting presentation and summary, to be available on project website.

Difficulties organizing community meetings were discussed above. Deliverables for this subtask include:

1. DUWAC facilitator Tiffany Sprague organized a meeting of interested participants, including 1854 Treaty Authority, NRRI, MnDNR, South St. Louis SWCD, and City of Duluth to discuss priority areas of study for Tischer Creek watershed, resulting in information for a [Surface Water Assessment Grant](#).
2. Community participants from Midway Twp and the Duluth Planning and Development, Parks and Recreation, Public works and Utilities, and Sustainability departments participated in a grant-development meeting focused on green infrastructure and ordinances. See Task B Subtask 2 below for more on this.
3. For additional feedback on how DUWAC was functioning from the communities, we conducted a survey in September 2019 on meeting frequency, location, and structure. This was revisited and confirmed during the September 2020 meeting as plans were made to restructure the DUWAC meetings beginning in 2021. See Appendix B for these survey results.

Subtask 4: Presentation at the 2020 MN Water Resources Conference.

Presentations were given at two conferences, but not at the MN Water Resources conference for the reasons presented above. Jesse Schomberg presented, with co-authors Tiffany Sprague and Brian Fredrickson, an oral presentation titled “Engaging with communities to develop priorities for cooperative watershed management: The Duluth Urban Watershed Advisory Committee” at the [2019 National Watershed and Stormwater Conference](#) in Charleston, SC (Apr 29-May 2). Jesse Schomberg coordinated abstract submission and oral presentation at the [2020 St. Louis River Estuary Summit](#) in Duluth, MN, and co-presented with Diane Desotelle, City of Duluth, and Tom Estrabrooks and Lindsey Krumrie, MPCA. Abstracts for both are included below, and PDF’s of each presentation are available at the links below.

2019 National Watershed and Stormwater Conference title and abstract:

[Engaging With Communities To Develop Priorities For Cooperative Watershed Management: The Duluth Urban Watershed Advisory Committee](#)

The 10 communities around Duluth, MN have been working together since 2015 to develop a collective watershed management strategy for the urban watersheds in this area. An advisory committee consisting of representatives from all communities included within these watersheds (5 rural townships, 4 cities, 1 county), as well as other agencies and organizations, was created in 2015 to not only inform watershed assessment and development of TMDL’s and restoration and protection strategies, but to also provide recommendations for how these communities can work together to manage

these watersheds more holistically. During 2015 and 2016, representatives from these communities and organizations met to explore the benefits and drawbacks of different watershed management models for this area, including a watershed district, joint powers board, and voluntary cooperation. After in-depth consideration and individual community meetings, a voluntary cooperation model was developed. As part of the process, the communities identified 5 priority areas where they see the greatest need for cooperation: 1) Regulation, Ordinances & Policies, 2) Community Training & Capacity Building, 3) Project Identification, Tracking & Prioritization, 4) Restoration/Protection/Preservation, and 5) Agency Cooperation & Engagement. Formalization of this organization through a Memorandum of Understanding was completed in 2018.

2020 St. Louis River Estuary Summit title and abstract:

[Duluth Urban Water Quality Impairments: E. Coli Study, Stream TMDLs Revised, and Beach TMDL Progress](#)

The Duluth Urban Area Streams Watershed is a focused geographic area designed to recognize the complexity and challenges in an urban center with a water-rich environment. It is defined by a series of small watersheds that are portions of three major watersheds: the Cloquet River, St. Louis River and Lake Superior South. All converge in Duluth and drain into the headwaters of the Great Lakes. The Duluth Urban Watershed Advisory Committee (DUWAC) consists of the 10 local governing communities that lie within Duluth’s Urban Area Streams Watershed and is focused on creating a regional approach to urban watershed management that recognizes its inherent shared nature. DUWAC has been actively involved with the Minnesota Pollution Control Agency (MPCA) on several impaired streams and beaches in which E. coli and/or total suspended sediment loads have reached levels that require a Total Maximum Daily Load (TMDL). Due to concerns raised by several communities, the TMDLs were revised over the past year to include nearchannel sources of sediment and also additional information on E. coli sources within the impaired watersheds.

This talk will provide updates on the Duluth-area impaired waters projects. One project includes an MPCA-funded E. coli source assessment in the Keene and Tischer Creek watersheds, two of the seven streams impaired for E. coli, to better understand the sources and opportunities to address these impairments. The other project currently underway is the development of TMDLs for five impaired beaches within the Duluth Harbor and along the North Shore of Lake Superior. These beaches have aquatic recreation impairments due to high concentrations of E. coli. Several of the beaches are also listed as impaired for beneficial use (due to fecal bacteria) as part of the St. Louis River Area of Concern. The project provides an opportunity to evaluate the water quality impairments, complete pollutant source assessments with microbial source tracking and determine reductions needed to meet water quality standards for the impairments. Come learn about the current work being conducted and the resources available to protect the Duluth Urban Area Streams Watershed!

Task B:

Subtask 1: Ongoing review of the TMDL/WRAPS strategies to identify the best collaborative projects. Compile, organize and maintain a project list. Select one project per year for a funding opportunity. Complete all necessary applications and agreements to ensure a successful funding outcome.

An updated list of project priorities has been maintained as a google doc, available [here](#). This list was reviewed at DUWAC meetings on January 17, 2019, February 20, 2020, and May 21, 2020. A copy of the list is pasted below, with the categories highlighted in yellow showing areas where either capacity-building efforts focused on, or grant applications were submitted.

DUWAC PROJECT PRIORITIES LIST

	Waste Management	Stormwater Management	Stream Crossing/Culvert Improvements	Wetland Management	Stream bank Stabilization	Land Use Planning/Ordinances	Forest Management
Just Do It!	Review county septic systems efforts - database development and current inspections process - identify gaps/needs, including inspection program needs (Jim	Status of FEMA maps - due end of 2020	Culvert Inventory Training Via state ID -precursor to filling culvert Inventory gaps	Training/awareness on NRR1 tool for restoration Share positive experiences with the use of tool Move toward funding watershed planning project to use tool as a scoping plan	Prioritize projects by watershed for those that have TSS TMDLS	Develop ordinance database to encourage/expand inter-community standardization	Education/V-tree special climate resili-planting and planning for conditions

	Gangl - contact)						
		As MS4's share highlights of the annual reports, note innovative work, discuss research needs (especially pollution prevention) to help MS4's to continue to make progress. Annual sharing day with MPCA stormwater staff?	Evaluate status of culvert and stream crossing data (including parameters) for DUWAC area - identify gaps, data needs.	Atlas by NRRI Info on mapping priority headwater areas for protection	To find funding for stream crossing prioritization based on highest community need compared with highest eco-service benefit		Forestry edu -Value of tre stormwater
				GIS layer NWI filtering vs tax forfeited lands and have a selection process for proximity to streams (very fast analysis)			
DUWAC Project - need \$		DUWAC area climate change vulnerability assessment	Inventory / GIS layer of streams that currently have fish passage enhancements. E.g Chester, Knowlton, Etc as a guide for future restoration efforts	Restorations and added protections in upper watersheds (e.g Tom Johnson's Farr Par ideas for Amity)	Consolidate the stream-walk assessments in one place (i.e) the LSS.org Str Restoration websection The Amity walks had >600k in GLRI money	Technical development guidance for townships	Community focus on climate adaption for management emphasis on diversity(bio services)
		Stormwater re-use evaluation for golf courses / implement Lk Superior college stormwater plan to water Enger Park Golf Course	Workshop of tools methods considerations (MESBOAC)			\$\$ - investigate fundraising structure to help secure project dollars via grants, matching funds	

		Evaluate, pilot ditch detention project to reduce downstream flooding	Complete Culvert/Stream Crossing Inventory for DUWAC, share data, and implement plans for future culverts/replacement			Is there value to developing reported cards for each watershed? As a way to inform the public and policy-makers?	
Research (Duwac supported)	Source tracking for e-coli at priority TMDL streams	Tischer Creek/Hartley pond with and without the dam is it doable?		Update Wetland inventory Map - Make available	Tree canopy cover over trout streams -existing - potential	Study: evaluate value of undeveloped land for hydrology control -Priority protection areas	Implement F inventory of that need ac trees.
		BMP effectiveness assessment			Inventory Stream Bank Health for potential restoration -low level planting -erosion control	Help with ranking of open space areas for preservation for natural resources, climate adaptations+restorations -include areas for best to develop	Black ash in as part of a general) tree inventory
		Scenario Modeling to evaluate and prioritize areas of wetland preservation or implementation of Green Infrastructure/BMP's for hydrology and water quality purposes				Formal Code audits for Green infrastructure for all communities	Buffer evalu local stream integrated w veg program Tree planting water forest climate adap resilience
						Assess ordinance deficiency -consider ecosystem services on system level (watershed)	
Not Sure...		Incentivize system that promotes landowners to maintain trees. Stormwater credit for number of trees on property				Model ordinances for common cross-jurisdictional issues	

						Establish baseline ordinances for protection of water resources - A starting point for townships/city to discuss and move forward	
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This list was used, in conjunction with group discussion at the May 21, 2020 meeting, to write a letter outlining DUWAC priority concerns for the St. Louis River One Watershed One Plan project, and is included below.

Duluth Urban Watershed Advisory Committee
c/o Minnesota Sea Grant
31 West College Street
Duluth, MN 55812

June 25, 2020

Kate Kubiak
South St. Louis Soil and Water Conservation District
215 N. 1st Avenue East, Room 301
Duluth, MN 55802

RE: St. Louis River One Watershed, One Plan - Priority Concerns

Dear Ms. Kate Kubiak,

On behalf of the Duluth Urban Watershed Advisory Committee (DUWAC), we appreciate the opportunity to provide comments on the planning and prioritization phase of the St. Louis River One Watershed, One Plan (1W1P) process. DUWAC is comprised of ten communities - Cities of Duluth, Hermantown, Proctor and Rice Lake, and Gnesen, Midway, Normanna, Lakewood and Thomson Townships, as well as Saint Louis County - and was borne out of the desire for comprehensive watershed management across political boundaries, as a result of the Duluth Urban-area Watershed Restoration and Protection Strategies (WRAPS) process with Minnesota Pollution Control Agency.

DUWAC has a vested interest in the management, protection and restoration of watersheds spanning from Mission Creek to Lester River, which comprise just a fraction of the planning area for the St. Louis River 1W1P. DUWAC acknowledges many challenges faced by Minnesota watersheds are not unique across the state - expanding urbanization, excess nutrient pollution, warming waters, increased frequency of extreme rainfall events, and accelerated rates of shoreland erosion - all of which are compounded by shifting weather patterns associated with climate change. Even with these similarities, DUWAC also acknowledges the Duluth Urban-area watersheds encompass a unique suite of factors which compound the complexities of successful watershed management: urbanization along Lake Superior's North Shore with flat, wetland-dominated uplands and steep bedrock-dominated lowlands, in addition to unique geologic landforms consisting of glacial till, clay soils and bedrock outcrops.

To this end, DUWAC assisted in creation of a comprehensive list of watershed restoration and protection priorities as part of the WRAPS process to accelerate comprehensive watershed management goals for the region, and is committed to engagement with the 1W1P planning and prioritization process. With regards to the St. Louis River 1W1P planning process, DUWAC has outlined the following priorities for the Duluth Urban-area watersheds:

High Level Priorities	Priority Concerns & Opportunities
Stormwater Management	<i>Due to the urban and ex-urban composition of the Duluth Urban-area watersheds, effective management of stormwater is critical to maintaining the balance between development, ecosystem services and ecological functions. Priorities for maintaining this balance include:</i>

	<ul style="list-style-type: none"> • Reduce pollutants, particularly excess sediment, bacteria, warm waters and chloride • Remove stream impairments and meet TMDL requirements • Current and future storage capacity needs relative to projected increases of frequent, large storm events (including opportunities to pilot ditch detention projects) • Research, monitoring and modeling to understand Best Management Practice (BMP) effectiveness, including opportunities for reuse • Integration of green infrastructure practices, both built and through floodplain, wetland and forest management, to address water quality and quantity impairments • Explore opportunities for homeowner and land owner incentive programs, i.e. rain gardens and forest stand management
Floodplain & Wetland Management	<p><i>The connection of streams with their floodplains and associated wetlands is critical for maintaining high quality ecosystem health, particularly in the Duluth Urban-area watersheds, where wetlands dominate the headwater reaches. To balance expanding development with watershed health needs, priorities include:</i></p> <ul style="list-style-type: none"> • Define impairments to hydrologic and ecologic functions, and develop plans and/or strategies to remove impairments at the sub-watershed scale • Efforts to protect and restore headwater wetlands critical to maintaining hydrologic flows, ecological function and critical habitat (particularly for sensitive species such as Brook Trout) • Protection of floodplains along unimpaired streams and reconnection of streams and floodplains along impaired streams • Use of tools, technology and models to produce high resolution, detailed maps of wetlands and first-order tributaries to assist in prioritization of land areas for protection and restoration • Maintain updated flow and runoff models on priority trout watersheds to determine effective strategies for retention and infiltration • Inventory of existing tree canopy cover over trout streams and identification and planting in floodplains where cover is insufficient
Forest Management	<p><i>Holistic watershed management integrates various ecosystem services, with forests acting as buffers, filters, shade and habitat. Fortunately, the Duluth Urban-area is dominated by forests, but encroaching development continues to pressure valuation and protection of remaining forested areas. Forest management priorities and opportunities include:</i></p> <ul style="list-style-type: none"> • Inventory and planting in areas where vegetation cover is sparse, including black ash stand inventory and preemptive underplantings • Integrate climate change projections in identifying and planting resilient species • Ecosystem service valuation of forest stands for preservation, with emphasis on biodiversity, resilience and planning for future climatic conditions • Education and outreach focused on the value of trees in stormwater management, climate resilience, adaptation and ecosystem services
In-Stream Management	<p><i>While management, protection and restoration of the surrounding landscape is critical for maintaining healthy waters, in-stream studies and projects are also needed to achieve clean water objectives and provide essential habitat and hydrologic connections. Many streams within the region are identified as impaired, which is a result of both landscape and in-stream conditions. Thus, priorities and opportunities for in-stream management include:</i></p> <ul style="list-style-type: none"> • A comprehensive culvert inventory at the sub-watershed scale across the region, including stream crossings and ditches • A process for communities to collaboratively prioritize and implement culvert replacement/enhancement work, balancing community need, available funds, stream impairment status, and ecosystem benefits • Evaluation of fish passage in each stream (Brook Trout and other fish), including inventory of current fish passage enhancements to guide future restoration efforts • Inventory of stream bank health for stream reaches across the region, prioritizing those reaches in need of restoration to address impairments, and with particular focus on ditched streams
Land Use Planning	<p><i>Successful on-the-ground protection and restoration relies on well-developed models, processes and plans. DUWAC has spent the past five years focused on community collaboration resulting in</i></p>

<p>Land Use Planning Con't</p>	<p><i>improved communication, processes and plans for managing local watersheds and natural resources, and would like for this cross-community collaboration to continue into the future. To build off this momentum, continued efforts improving land use planning include:</i></p> <ul style="list-style-type: none"> • Use of models and research to identify the value of undeveloped lands for hydrologic controls, water quality and ecosystem services, and thus lead to creation of priority protection areas • Assess codes and ordinances across communities, conduct code audits for green infrastructure, create model ordinances focused on protection of ecosystem services and ecological function of water resources, and support standardizing ordinances across communities • Investigate opportunities and establish connections with existing programs for support and formal fundraising for watershed management in the Duluth Urban-area watersheds • Supporting watershed managers, land use planners, and cross-community collaborations across the Duluth Urban-area through an organizational format such as the Duluth Urban Watershed Advisory Committee, or similar • Subwatershed-scale planning, with prioritization on watersheds with TMDLs and those supporting Brook Trout populations, and including protection to prevent additional impairments • Identify the process and opportunities for project in-lieu of on-site treatment, such as a banking and crediting option, with an emphasis on wetlands, carbon sequestration and restoration funding opportunities • Catalog, reference and make accessible all relevant Duluth-stream studies, research and monitoring efforts to minimize unnecessary reproduction of effort and to advance planning and on-the-ground implementation efforts
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Two grants were submitted based on these DUWAC priorities.

In 2019, we identified a project to focus on the expected altered hydrology due to the loss of ash trees from the invasive Emerald Ash Borer (though the project was identified in 2019, the grant due date was in Jan of 2020). This project included community engagement in tree planting in the Mission Creek watershed in the City of Duluth, Midway Township, and Thomsen Township. All communities submitted letters of support with matching funds identified.

In 2020, we identified a project to focus on identifying barriers to the use of green infrastructure in local community ordinances. This project would have completed a full audit for two communities: the City of Duluth and Midway Township, and created a comparison of key ordinance characteristics between all DUWAC communities.

Project summaries are below, with a link to the proposal narratives for each project.

Project Title: [Building watershed resilience through black ash underplanting and community engagement in Duluth, Minnesota](#)

Funding Organization: National Fish and Wildlife Foundation

submission Date: Jan 30, 2020

Proposed Project start date: October 1, 2020

Requested amount: \$43,267

Results: Not funded

Project Title: [Green Infrastructure Code Evaluations for Duluth Urban-area Communities](#)

Funding Organization: Minnesota's Lake Superior Coastal Program

Submission Date: Nov 13, 2020

Proposed Project start date: October 2020

Grant Request: \$60,051 Applicant Match: \$60,051

Results: Under Consideration

Subtask 2: Three workshops per year on water resource related ordinances/community codes. Maintain the list of "best local examples" and develop a method for archiving and sharing the list.

Three workshops were organized to focus on regulations, ordinances, and policies, which are listed below. One additional meeting (June 2020) was planned to focus on this topic, but was cancelled due to participant request. Discussions with communities led to focus on applying for funding to perform an evaluation of local codes to identify barriers to green infrastructure; this effort became the focus on efforts relating to local codes and ordinances, in lieu of additional ordinance-related workshops. Archived notes from these ordinance meetings contain the examples and practices highlighted by the participants as "best examples". A total of 43 people participated in these workshops.

Feb 26 2019 workshop:

The group walked through Tackling Barriers to Green Infrastructure guidebook (WI Sea Grant) focused on construction and post-construction management. In general, conversation centered around the need for wetland buffers, tree preservation, and long-term ownership of open space. The group also acknowledged pre-planning meetings and frequent site visits are needed for success with developers. The group noted good things do take place, yet expectations are often communicated verbally with developers, and are not necessarily written into code. The most important language pieces the group highlighted can be found [here](#).

Dec 19 2019 workshop:

Rachel Olmanson and Carlee Kjeldahl, MS4 experts with MPCA, joined the DUWAC group to discuss TMDLs and MS4 compliance and reporting, [accompanied by a presentation](#). Main take-aways for the group include: compliance schedules are the BMPs your community can reasonably accomplish in the next 5 years (including modeling, monitoring, feasibility studies, on-the-ground work); can lump stream reaches across various watersheds by BMPs type(s); can also just focus on one stream reach; do not have to do a BMP on every single stream reach in each 5 year cycle; the very first time reporting, will include all activities since the baseline year (so for Duluth, since 2011); if at any point a community thinks they are meeting their load allocations, need to justify to MPCA, and if approved, a TMDL can be removed mid-permit cycle. In general, the process is constantly evolving, and MPCA has staff that can help.

October 22 2020 workshop:

A special meeting was held to discuss and prepare for a MN Lake Superior Coastal Program Annual Grant submission. The proposal outlined a workplan to conduct a full green infrastructure code audit for the City of Duluth and Midway Township, a code audit comparison chart for all DUWAC communities, and outreach and engagement on how policies and ordinances result in on-the-ground implementation. Individuals from City of Duluth Planning, Sustainability, and Park & Rec, as well as Midway Township, met with Juli Beth Hinds, the consultant who will assist with carrying-out the code audit. [Jamboard](#) was used to engage with participants and organize the efforts to be included in the grant.

Measurements:

Objective 2, Task A, Subtask 1. *Ground truth gages and assure CrowdHydrology sites are meeting MPCA protocol, are located accurately and at correct elevations.*

Description of reference gage location(s) for each CrowdHydrology citizen science monitoring location, with date of installation, listed from west to east across the Duluth Urban area (elevation measurements can be found below in **Appendix C**):

St. Louis River @ Perch Lake (11/18/20) - Reference (RF) point 1 is the lower hinge of the yellow metal barrier. RF point 2 is the ash tree in the ditch behind the metal barrier (JRH, ZCW [initials indicating NRRRI staff responsible for survey]).

Knowlton Creek @ Western Waterfront Trail (8/24/20) - The surveyor was placed on the bridge just to the left of the CrowdHydrology (CH) sign. RF point 1 is on a tree on the same side as the CH sign, next to bridge. RF point 2 is in the stream on the opposite side of the bridge from CH sign. Laser rod placed touching the bridge. RF point 3 is staff gauge (KES, BJP).

Knowlton Creek @ Spirit Mountain (8/24/20) - RF point 1 is at staff gauge. RF 2 point is off to the right of trail on the right of the bigger birch of the trees. RF point 3 (pt 1 in Excel doc) is on the left bank when facing downstream. It is close to the edge of the bank and close to stream gauge position. Both trees marked with stake (KES, BJP).

Keene Creek @ Keene Creek Dog Park (8/24/20) - RF point 1 is on the left side of the culvert when looking down stream and is marked with an X. RF point 2 is staff gauge. RF point 3 (pt 2 in excel doc) is small tree across the stream from CH sign and is marked with stake (KES, BJP).

Keene Creek @ Irving Park (8/24/20) - RF point 1 is staff gauge. RF point 2 is across the culvert from the staff gauge and marked with an X. RF point 3 (pt 1 is excel doc) is a large tree on the right of bank downstream on the left of small path and is marked with a stake (KES, BJP).

Miller Creek @ Lincoln Park (8/24/20) - RF point 1 is the tree that currently holds the CH sign and is across the staff gauge marked with a stake. RF point 2 is current staff gauge. RF point 3 (pt 2 in excel doc) is about 2 meters upstream of the staff gauge on the right (downstream) side of bank and is marked with an X (KES, BJP).

Miller Creek @ Lake Superior College (8/24/20) - RF point 1 is the birch tree off to the right side of the bridge when standing on the bridge and is marked with a stake. RF point 2 is staff gauge. RF point 3 (pt 2 in excel) is a large rock on the far side of the bridge on the left (downstream) bank and marked with an X (KES, BJP).

Brewery Creek @ Marshall School (10/23/20) - RF point 1 is staff gauge. RF point 2 is large cottonwood downstream of trail R.L. RF point 3 (pt 1 in excel) is the steel I-beam corner (NW corner of bridge) (JRH, ZCW).

Chester Creek @ Chester Bowl (10/23/20) - RF point 1 is top of the rock the staff gauge is attached to at its highest point, marked with an X. RF point 2 is the ash tree upstream from the sign about 20 meters with two trunks (JRH, ZCW).

Chester Creek @ St.Scholastica College (10/23/20) - RF point 1 is the emergency phone pole case, marked on SE corner. RF point 2 is rock with the drill hole up the bank from the staff gauge. Use the lower edge of the top of the hole (JRH, ZCW).

West Tischer Creek @ University of Minnesota-Duluth (10/23/20) - RF point 1 is the top of the rock on the west bank. RF point 2 is the East most trunk of the large cottonwood on the inside of the bend on the east bank (JRH, ZCW).

Tischer Creek @ Congdon Park (10/23/20) - RF point 1 is the top of the concrete footing which gauge is attached to, marked with X. RF point 2 is the large cottonwood tree SE of the gauge (stake) (JRH, ZCW).

Tischer Creek @ Hartley Pond (10/23/20) - RF point 1 is the outer edge of the concrete apron on the dam. RF point 2 is the red pine up pond of the sign (JRH, ZCW).

Amity Creek @ Lester Park (10/23/20) - RF point 1 is the pedestrian bridge corner closest to the gazebo (SE corner). RF point 2 is the large spruce tree next to the sign, marked with spike (JRH, ZCW).

Keene Creek @ Keene Creek Park (City of Hermantown) (11/18/20) - RF point 1 is a spruce tree downstream on the left bank of floodplain, marked with a spike. RF point 2 is the top of the culvert opening (JRH, ZCW).

Lester River near White Pine Camp (City of Rice Lake) (10/28/20) - RF point 1 is a fir tree up the trail from the left bank about 90 meters (JRH, ZCW).

Lester River near Lismore Rd (Normanna/Lakewood Townships) (10/28/20) - RF point 1 is the top of the concrete bridge support on the stream right bank downstream. RF point 2 is the cedar tree downstream right bank of the bridge overhanging the stream (spike on stream bank). JRH, ZCW

Note: Kingsbury Creek @ Carlson Park (City of Proctor) was not surveyed due to the delayed gauge installation as a result of prolonged installation approval.

Objective 2, Task C, Subtask 1. Assess usage and site visits at each gage.

Table 1. Number of stage height records submitted per gage station, ordered by date of gage installation (records until December 28, 2020)

Station ID	Station Name	2017	2018	2019	2020	Grand Total
MN1000	Brewery Creek @ Marshall School	211	127	27	69	434
MN1001	Chester Creek @ College of St Scholastica	14		24	66	104
MN1002	Miller Creek @ Lake Superior College	24	22	18	40	104
MN1003	Kingsbury Creek @ Lake Superior Zoo	28	6	13	2	49
MN1004	Keene Creek @ Dog Park	29	8	17	20	74
MN1005	Tischer Creek @ Hartley Pond	108	61	67	133	369
MN1006	Chester Creek @ Chester Bowl Park	226	180	287	255	948
MN1007	Knowlton Creek @ Spirit Mountain	79	49	67	80	275
MN1008	Knowlton Creek @ Waterfront Trail	51	25	41	75	192
MN1011	Miller Creek @ Lincoln Park			16	183	199
MN1012	Keene Creek @ Irving Park			7	24	31
MN1013	Tischer Creek @ Congdon Park			232	385	617
MN1014	West Tischer Creek @ UMD			114	225	339
MN1015	Amity Creek @ Lester Park			91	138	229
MN1016	St Louis River @ Perch Lake			32	20	52
MN1018	Keene Creek @ Keene Creek Park			11	65	76
MN1019	Lester River nr Pine Campground				17	17
MN1020	Lester River nr Lismore Road				20	20
MN1021	Kingsbury Creek @ Carlson Park				1	1
Grand Total		770	478	1064	1818	4130

Subtask 2. Analyze meteorological data in conjunction with stream height data, and develop relationships between meteorological patterns and stream hydrologic responses for the DUWAC community.

All surveyed reference points are attached electronically in the Reference points folder. The cross sectional profiles, longitudinal surveys, pebble counts, and Reference Reach Spreadsheets are attached in the Crowd Hydrology Profiles folder.

Products:

Objective 2, Task A, Subtask 2. Clean gages and signs. Check for vandalism. Identify and carry-out any needed repairs or re-installations.

Updated gage sign (decreased resolution due to converting original Word document into a JPEG).

What's the water height today at Kingsbury Creek? Text us!

Learn more about
Kingsbury Creek at
DuluthStreams.org

1

Find the ruler



Become involved:

1. Look around for a ruler mounted in the water.
2. Read the measurement at the water's surface.
3. Text **MN1021** and the water height to **218-409-6858**.

Example: MN1021 0.40

Visit CrowdHydrology.com to see your measurement.

2



What's the height measurement at the water surface?

CrowdHydrology collects water data using social media and citizen science. When you text us today's water height, we use *your* measurement to create a historical record of this stream. If enough people send data, we can help predict floods and droughts.

State and local agencies can't put scientific monitoring equipment on every water body, but CrowdHydrology provides a way for local communities to track any stream or lake that's important to them.

Help support CrowdHydrology by sending a measurement every time you visit this area.

3

Send to:
218-409-6858

Text **MN1021**
and the height
from Step 2

For example:
MN1021 0.40



CrowdHydrology



Natural Resources
Research Institute
UNIVERSITY OF MINNESOTA DULUTH



Objective 2, Task D, Subtask 1. The Contractor will give poster or oral presentations at multiple events including two meetings of the St. Louis Estuary Summit (2019 and 2020), one meeting of the Minnesota Water Resource Conference (October 2020), two meetings of CitSciMN (2019 and 2020), other local and statewide conferences, summits, and/or workshops as appropriate, as well as various opportunities with Duluth-area Master Naturalists or Citizen Science programs in order to promote use of the CrowdHydrology network.

2019 St. Louis Estuary Summit [Conference Presentation](#) & [Script](#)

2019 CitSciMN 5-Minute [Lightning Talk Presentation](#) & [Script](#)

Public Education & Outreach:

In total, approximately 1,800 individuals have engaged with the CrowdHydrology citizen science stream monitoring program. Most outreach has taken place through word of mouth, signs located at gages, conference presentations, and through limited media and social media engagement. Given the high value placed on outdoor recreation for Duluth-area residents, it seems fitting a number of individuals have interacted with the CrowdHydrology gages. While participation is diffuse, sustained engagement seems more challenging, for only 2% of users have submitted ten or more water depth records. As the nature of this citizen science project is through crowdsourced efforts, and thus relies on a large network of individuals by project design, it is not necessarily concerning to see the limited number of frequent water depth record submitters. Even so, it is an interesting consideration to eventually better understand how to increase sustained engagement among individual users over the long-term.

Long-Term Results:

Duluth Urban Watershed Advisory Committee

MN Sea Grant has committed to facilitating DUWAC through 2022, even without additional funding, though at a reduced effort. With the Duluth Urban-area TMDLs for sediment and bacteria officially approved by EPA, the next two years will focus on a rotation of watershed specific conversations and meetings, identifying projects, funding sources and collaborations, and developing proposals to address stream impairments and improve surface water quality.

Increasing awareness and knowledge of watershed functions and water quality challenges maintains a key element for the group, and presentations and discussions on related topics will also continue through 2022. Additionally, auditing codes and ordinances, if funded by MN Lake Superior Coastal Program, will begin in fall 2021, and will utilize a substantial portion of DUWAC membership time and effort. If not funded, a different alternative will be sought. These meetings are in addition to quarterly all-member meetings where updates to- and from-group members are a key element of the meeting, which have shown many times over to be a critical for future project collaborations.

Already in 2021, DUWAC members met with MPCA staff to discuss the Miller Creek Temperature TMDL and their options for MS4 reporting, as well as to alleviate any concerns and to get their questions answered. With only two temperature TMDLs in the state, this is uncharted territory for both MPCA and local communities. DUWAC members also met with other MPCA staff to discuss snow storage and management practices. This has resulted in a larger statewide conversation, with MPCA stormwater staff now focused on acquiring funds for development of suggested management practices and regulations, with eventual incorporation into the MN Stormwater Manual in late 2022.

DUWAC continues to be a driving force for the northeast MN region with regards to collaborative watershed management, identifying unique opportunities to protect our unimpaired waters and utilizing a variety of distinctive tools to address impaired waters throughout the Duluth Urban-area. The extent to which progress is made is dependent on the capacity of leadership to coordinate membership and drive projects and proposals forward. With recent tandem efforts through the City of Duluth working towards a Natural Resources Management Plan, MN DNR working on a Watershed Roadmap for Tischer and Keene Creeks, and South St. Louis SWCD (and others) moving forward with a 319-funded Amity Creek project, now more than ever is a critical time to maintain a trusted, established network for communities and agencies to come together and create cohesive watershed management strategies for the Duluth Urban-area.

CrowdHydrology

Since starting this CrowdHydrology effort, additional interest across northern Minnesota has been garnered, particularly from North St. Louis Soil and Water Conservation District, in coordination with Becca Reiss. As such, four additional CrowdHydrology gauges have been installed outside the Duluth Urban-area. As a result of the various lessons-learned along the way during our installation of 19 CrowdHydrology gages over the years, we were able to help Becca problem-solve, trouble-shoot, and avoid making the same mistakes we did along the way. Our efforts have served as a model for others in the region.

This project will continue into the future, for routine maintenance, while critical, is likely manageable. Given that, gages which receive little visitation may be removed, as the network of gages has grown, and NRRRI staff need to be cognizant of the time and people resources available for the future. As such, Kingsbury Creek at the Zoo, Keene Creek at Irving Park, Keene Creek at the Keene Creek Dog Park, and the St. Louis River at Perch Lake will likely be decommissioned in 2020. St. Louis River at Perch Lake also faces many installation challenges, and is frequently reinstalled due to winter ice conditions; it is typically lying at the bottom of the river come spring - we feel fortunate we've been able to locate its whereabouts each year.

As for the cellphone camera mounts through Chronolog, it will depend on usage statistics and the ability to identify a funding source for the nominal yearly fee (\$400 total), as to if we will maintain these mounts beyond 2021. Currently, we are enthused about this portion of the project, and feel optimistic we can secure another 3 - 5 years of funding for these cellphone camera mounts.

Presentations were made at MNCitSci and the St. Louis River Estuary Summit. Another presentation will be made at the 2021 St. Louis River Estuary Summit to present user statistics. Results from the CrowdHydrology effort will be drafted into a manuscript during 2021, with the goal to publish a journal article in 2022. NRRRI is supporting Sprague's efforts to accomplish this task. Additional presentations will likely be made at various conferences, seminars and meetings in the coming years, and social media will be used to recruit members of the public to participate in sending in data.

In general, we learned folks recreating in the Duluth Urban-area utilize many public open spaces and trails, and are interested in engaging with citizen science monitoring activities. Yet, many individuals are not interested in long-term or continued engagement, and thus it is critical to locate monitoring stations in areas of high foot traffic so as to garner sustained data submissions. Frequent data submissions are critical for finer-scale stream monitoring, as water depth trends become difficult to track if data is submitted infrequently, yet records at Chester Creek indicate even infrequent data submissions follow similar discharge trends as that of long-term, frequent, "scientifically-proven" flow measurements. Thus, while a crowdsourced citizen science effort is bound to result in data errors, the water depth records submitted are an applicable proxy for monitoring stream depth, and while may not help answer critical ecological-based questions, can be used to identify hazards, such as flooding potential.

- **Long-term results:**

- Do the results of this project build capacity that can increase the likelihood of long-term outcomes, such as:
 - environmental problems identified or understood
 - land use changes in the watershed
 - recommendations created
 - consensus for action created
 - increased ability to solve similar problems in the future, etc.?
 - if so, how?
- Did you form new partnerships or alliances as a result of the project? If so,
 - What longer-term impact will this have on the project?
 - What future efforts are anticipated as a result of the partnership(s)?
 - Describe any activities you are aware of by others that benefited from the results of your project and/or resulted in implementation of similar projects in other locations.
- Is there a plan to continue the project beyond the end date of the grant agreement or contract? If so, explain.
- Describe how you shared the results of your project. List any information or technology transfer and dissemination (newsletters, web sites, training, reports, disseminated project activities, accomplishments, and lessons to the general public). Where and to what audiences have you made presentations?
- What other audiences (media, businesses, other agencies, etc.) would be most interested in the results of this project?
- Please describe any lessons learned during this project that would be valuable for future projects, even if the project didn't succeed as expected. What other recommendations or advice would you make for future activities related to this priority project area?
- Please provide any feedback or suggestions that you would like to share with the MPCA to improve their grant programs.

Section III – Final Expenditures

Projects should use the format they used in their work plan for the budget to report on the final expenditures. This should list the tasks or activities outlined in their original (or amended) work plan.

See Attached spreadsheet: DUWAC Final Report Expenditure2019-2020.xls

Appendix A: Summary of all DUWAC meetings

Meeting Date	Meeting Topic	Meeting Type	No. of Attendees	Meeting Summary
January 17, 2019	Review Areas of Agreement & Brainstorm Project Ideas	General Body	15	The group kicked off a new two-year MPCA contract to review the MOU Areas of Agreement and brainstorm project ideas/potential grants. Discussion focused on wetland and wetland assessments, and ID where wetlands overlap with tax forfeit lands. Group would like to mainly focus on 3 of the 5 Areas of Agreement: capacity building, regulations and ordinances, and agency engagement.
February 26, 2019	Construction & Post - Construction Management	Regulations, Ordinances & Policies	10	The group walked through Tackling Barriers to Green Infrastructure guidebook (WI Sea Grant) focused on construction and post-construction management. In general, conversation centered around the need for wetland buffers, tree preservation, and long-term ownership of open space. The group also acknowledged pre-planning meetings and frequent site visits are needed for success with developers. The group noted good things do take place, yet expectations are often communicated verbally with developers, and are not necessarily written into code. The most important language pieces the group highlighted can be found here .
March 21, 2019	Culverts, Guidebooks, Resources & Water Storage	General Body	18	Group discussed desire for all DUWAC-area culverts to be mapped in one place, secure funding to fill in any data gaps, and get it into the DNR culvert database; would be useful for regional modeling and identifying key watershed storage areas. Group would like to see a revival of Community Guidebooks, but in a simplified one-page format (note: to be included in Green Guide for Homeowners published by MN Sea Grant, spring 2021), highlighting water-focused state regulations for things like setbacks, e.g. Group discussed best way to save resources shared at meetings, and would like a better catalog to access these resources. Regarding watershed storage, the group noted it would be nice to strive towards regional stormwater planning and alternate ways to pool funds to preserve open space.
April 18, 2019	NRRI Web Tools	Capacity Building	14	NRRI researchers demonstrated the Minnesota Natural Resource Atlas and the Restorable Wetland Prioritization Tool .
May 16, 2019	Watershed Storage	General Body	17	Erin Loeffler gave a presentation to the group on what is BWSR, her role in BWSR and a background on One Watershed, One Plan. Jesse Schomberg gave a presentation to the group highlighting the importance of water

				storage across a watershed.
June 2019	No Meeting	N/A	N/A	The focus of June 2019 was a regulations, ordinances and policy meeting focused on community outreach and education. Rather than meet as a group, the intention was to conduct outreach in each community for community leaders. City of Rice Lake expressed interest in learning more about how TMDLs would impact their planning priorities. The watershed game and a conversation with MPCA staff were planned for early July, yet Rice Lake did not follow-through with solidifying a time. No other community expressed final interest in a meeting with leaders.
July 25, 2019	MN DNR Forestry Legacy Program & Priorities for Fall Funding	General Body	13	Christine Ostern with MN DNR Forestry Legacy Program presented to the group on the Forestry Legacy Program and the Minnesota Forests for the Future Program. The main role of this program is to conduct outreach to forest land owners, buy properties to add to state forest lands, help folks with easements, and do annual monitoring of easements. The group then discussed the two main topic areas for seeking external grant funding: a green infrastructure code audit for DUWAC communities and a project focused on watershed storage. The group is unsure if the project should focus on identifying areas where storage may exist and highlighting those for protection or to identify where storage is most needed, or some combination. The group also discussed how to choose storage over in-stream work, and how to balance flood hazard vs. stormwater mitigation. The group decided it would like to move forward with applying for funds in fall 2019 for a code audit, which will also include community engagement.
Aug 2019	No Meeting	N/A	N/A	Meetings have not been typically held in August due to vacation schedules of members.
September 12, 2019	Meeting Frequency & Grants Follow-Up	General Body	14	Round-robin updates took up a large portion of the meeting discussion, which is common at most of the general body meetings where the goal is for members to share topics related to their community and surface water management. Round-robin updates often lead to follow-up conversations between specific members, and are a great networking tool. For example, Carol Andrews informed the group St. Louis County, SSL SWCD and the City of Hermantown collaborated on a stream-culvert-road crossing-channel redesign project along Keene Creek and Morris Thomas Rd. as a result of DUWAC collaboration. Diane Desotelle updated the group on a dry-weather bacteria study taking place on Keene and

				<p>Tischer Creeks, funded by MPCA, managed by City of Duluth, as a result of frequent MPCA-community engagement during the Duluth TMDL (sediment and bacteria) process thanks to DUWAC providing additional opportunities for engagement. Group members completed an online Google Form addressing meeting times and frequency for 2020. Generally, most felt monthly meetings were too frequent, and hoped for every-other-month meetings, with in-between months focused on specific topics. The majority were also interested in a grants subcommittee. Regarding the grant topics discussed at the June meeting, City of Duluth is on-board for a full green infrastructure code audit of their codes and ordinances, and the group is interested in forming a subcommittee focused on watershed storage.</p>
October 22, 2019	Watershed Storage Pt. 2	Capacity Building	24	<p>Brandon Krumwiede, GIS contractor for NOAA Office for Coastal Management presented to the group on a Chester Creek 2.0 NOAA model. This model was an update to a previous model. Generally, this more detailed model showed that flooding gets more nuanced at higher details, meaning damage and severity at each particular location may not be as severe as previously modeled, but damage across the watershed is projected to be more widespread, so overall costs are still very high. Bill Herb, research association with UMN St. Anthony Falls Laboratory, gave a presentation on his recent work modeling storage capabilities across Miller Creek watershed. Bill's work shows that storage in forested areas may be higher than predicted based on soil maps, and it seems tree composition may impact storage capabilities. Previous work by Herb indicates BMPs do not do nearly as good of a job as existing natural landscapes, so need to value these natural landscapes. Kyle Magyera from Wisconsin Wetlands Association joined the group to provide insight on the work he is doing in the Marengo Watershed (WI) regarding watershed storage; Kyle has been working with EPA and FEMA to conduct a high-resolution model of the watershed and carry-out BMPs throughout the watershed, including looking at unique opportunities to model and increase watershed storage by increasing stream capacity.</p>
November 14, 2019	TMDL Update & Green Guide Pocket Resource Sheet	General Body	9	<p>As the Duluth Urban-area TMDLs (sediment and bacteria) are moving forward and addressing community concerns (following a few contested cases), MPCA continues to actively engage with DUWAC members during meetings to let them know the current timeframe and what action MPCA is carrying out. At this point, conversation is focused on</p>

				<p>moving the baseline year from 2016 to 2011, load allocations are moving to being based on only impervious surfaces (not including green spaces), and how MPCA is going to address railroad areas and getting them into compliance. The group discussed needs for upcoming meetings, and would like to hear how other communities are reporting on their TMDL (Dec 2020) and what positive projects are taking place throughout the DUWAC watersheds which already start addressing TMDLs (Jan 2020). With regards to the Green Guide MN Sea Grant is publishing (spring 2021), the group would like to see additional information regarding sump pumps and snow removal in the pocket resource sheets.</p>
December 19, 2019	TMDLs and MS4 Compliance & Reporting	Capacity Building	23	<p>Rachel Olmanson and Carlee Kjeldahl, MS4 experts with MPCA, joined the DUWAC group to discuss TMDLs and MS4 compliance and reporting, accompanied by a presentation. Main take-aways for the group include: compliance schedules are the BMPs your community can reasonably accomplish in the next 5 years (including modeling, monitoring, feasibility studies, on-the-ground work); can lump stream reaches across various watersheds by BMPs type(s); can also just focus on one stream reach; do not have to do a BMP on every single stream reach in each 5 year cycle; the very first time reporting, will include all activities since the baseline year (so for Duluth, since 2011); if at any point a community thinks they are meeting their load allocations, need to justify to MPCA, and if approved, a TMDL can be removed mid-permit cycle. In general, the process is constantly evolving, and MPCA has staff that can help.</p>
January 16, 2020	Amity & Kingsbury Creeks Watershed Projects Presentations	Capacity Building	24	<p>Rebecca Eiden from BARR Engineering presented on their feasibility study for sediment reduction in Kingsbury Creek; Ann Thompson with SSL SWCD presented on their assessment and stressor ID work on Amity Creek and other local watersheds. Kingsbury Creek study went through 3 phases: lit review & GIS; rapid field assessment (stream walk); detailed in-stream assessments. Found tributaries are large source of sediment; erosion from trails; few notable slump failures; upstream sources generally from urbanization. Funding was result of: lots of dredging in estuary - where is sediment coming from? Upstream question: how to increase groundwater storage? SSL SWCD is focused on creating a mini-master watershed plan for Amity with goal of removing TSS impairment. SWCD has completed 9 stream assessment for Duluth Urban WRAPS!</p>
February	LS South Cycle 2	General Body	14	<p>Karen Evens from MPCA updated group on LS</p>

20, 2020	Update & DUWAC Project Priorities Revisit			South Cycle 2, looking to partners to help drive sampling and locations. Revisited DUWAC project priorities with group to begin discussion on where the group would like to focus in 2020.
March 19, 2020	Project Priorities	General Body	N/A	Due to the onset of the COVID-19 pandemic, this meeting was cancelled; members provided feedback/input on project priority matrix via email.
April 16, 2020	Skunk Creek <i>E. Coli</i> Presentation & LS-South WRAPS Cycle II Sampling Convo	Capacity Building	30	Chan Lan Chun (NRRI Researcher) presented on E. Coli research along Skunk Creek funded by Lake Co SWCD. Highlights include: <i>E. coli</i> appeared to be correlated with stormwater; human markers were present; Agate Bay is a bacteria hotspot; and follow-up televising of lines were to take place to monitor storm - sanitary connections. Stagnant water is an issue, and winters do not kill bacteria as previously expected. For WRAPS Cycle II, Tischer a popular choice, and there is value in getting streams marked as exceptional value for protection.
April 26, 2020	LS-South WRAPS Cycle II: Tischer Creek	Special Meeting (Watersheds)	16	DUWAC facilitator, Tiffany Sprague, organized a meeting of interested participants, including 1854 Treaty Authority, NRRI, MnDNR, SSSLWCD, and City of Duluth to discuss priority areas of study for Tischer Creek watershed with respect to Lake Superior-South WRAPS Cycle II. The group used an ArcOnline platform to identify 17 potential sampling locations of moderate to high priority for sampling with respect to stream temperature and aquatic health, and bacteria concentrations and human health.
May 21, 2020	One Watershed, One Plan & Project Priorities	General Body	19	Kate Kubiak (SSL SWCD) spoke with group on St. Louis River One Watershed, One Plan (1W1P) initial planning process; official solicitation for comments on priority areas and specific concerns; DUWAC submitted comment letter . Concern expressed from group regarding small scale of DUWAC watersheds compared to entire St. Louis River watershed. Request for DUWAC rep on 1W1P advisory. Regarding DUWAC project priorities, group looks to DUWAC to figure out collaboration opportunities with steps: ID, plan, prioritize, then sequence projects. Group discussed protection vs. restoration priorities from project matrix and WRAPS document. Protection = better maps (wetlands, small tribs, tax forfeit, streamside veg); educate public on value of trees; research needed to understand value of open space on hydrology control; use of planning tools to increase conservation easements, LID, urban trees; apply buffer law, streamside veg. Restoration = TMDL tied to all projects; move from models

				to implementation; understand where we need more models vs. have enough data; need stormwater plans for each community; when to use banking; revitalize ditched streams and stabilize streams; ultimate goal is healthy, resilient watersheds; health = reduce infrastructure damage potential and restored flow regimes.
June 18, 2002	Beaver Dams along Knife River	Capacity Building	17	Hannah Behar and Emma Burgeson, MS Candidates in UMD's Water Resources Science grad program (adv. Karen Gran) provided an updated presentation to their study of beaver dams along Knife River. Emma's research focused on how beaver dams impact stream flow. Difficult to study, yet generally found removing beaver dams increases the flow at lower thresholds, and decreases the flow at higher thresholds. Hannah's research focused on how beaver dams impact stream temperature. Found surficial geology plays a large part on how water flows through a dam and how heat moves between the stream and streambed, for streambed heat flux is an important component to stream temperature. In general, dams do impact stream temp ~100m downstream, but are not noticeable by ~300m downstream. Saw dams along Knife didn't really increase downstream stream temperature, yet freestanding dam did see warmer temps.
July 16, 2020	Bacteria Study in Keene & Tischer Creek Watersheds	Capacity Building	35	Steve Gruber from Burns & McDonnell presented the findings of their bacteria assessment in Keene and Tischer Creek Watersheds (projected funded by MPCA, managed by City of Duluth). Their dry-weather study involved the following approach: stream-walk to characterize watershed, initial monitoring, test for human and non-human markers, and conduct a microbial community analysis. For Keene Creek, they found the downstream reach to have the highest bacterial concentrations, with degraded habitats areas providing the most sediment-based bacteria (this aligned with SSL SWCDs stream assessment study). Storm drains and the papermill also large sources, as are stagnant water and areas where sediments accumulate. Stream restoration likely best option. In Tischer Creek, stagnant water seems to be the largest source, yet more monitoring needs to be done; need better surveys of habitat and sewers. Bird and human markers present.
Aug 2020	No Meeting	N/A	N/A	Meetings have not been typically held in August due to vacation schedules of members.
September	Future of DUWAC	General Body	20	Members answer a number of Zoom polls

24, 2020	Membership Questionnaire			regarding the future of the group. In general: 79% preferred quarterly meetings moving forward; 83% want to focus on individual watersheds; 79% indicated DUWAC's role is to augment work already taking place in the watersheds and to pick up where things are not taking place (TMDL streams prioritized; DUWAC helps with project prioritization, balance protection and restoration); 70% noted education topics should be presented as needs arise and these meetings should be stand-alone meetings, taking place once a quarter to twice a year; and, 50% said writing a newsletter article would be a helpful way to engage with their community.
October 22, 2020	GI Code Audit: Grant Proposal Meeting	Special Meeting (Grants & Funding) / Regulations Ordinances and Policies	10	A special meeting was held to discuss and prepare for a MN Lake Superior Coastal Program Annual Grant submission. The proposal outlined a workplan to conduct a full green infrastructure code audit for the City of Duluth and Midway Township, a code audit comparison chart for all DUWAC communities, and outreach and engagement on how policies and ordinances result in on-the-ground implementation. Individuals from City of Duluth Planning, Sustainability, and Park & Rec, as well as Midway Township, met with Juli Beth Hinds, the consultant who will assist with carrying-out the code audit. Jamboard was used to engage with participants. Proposal application was submitted at the end of November; if successful, project will start September 2021.
November 19, 2020	End of Current MPCA Contract & Next Steps	General Body	18	The group did the last round-robin member update of 2020. Tom Estabrooks updated the group re: MPCA beach TMDL monitoring. All beach samples had human presence; followed-up monitoring is now taking place. A 2021-2022 schedule was presented to the group and input was sought as to timing of meetings and meeting topics. A finalized schedule was emailed to the group.
December 17, 2020	Fish Movements and Beaver Dams	Capacity Building	42	Josh Dumke (NRRI Fish Biologist) presented his research on fish movement past low-head dams in Knife and French Rivers. This meeting was open to anyone. While the study faced a lot of difficulties with regards to recapture analysis, generally smaller dams experienced more fish movement than larger dams; more fish movement was present during periods of dam overtopping; no difference in movement between active or inactive dams; did see adult brook trout pass upstream and rainbow trout pass downstream of dams - both of which are ecologically significant movements. Other lessons learned included: fish tagging is not easy, and the cheek seems the best place to put tags. Remote cameras helped to study

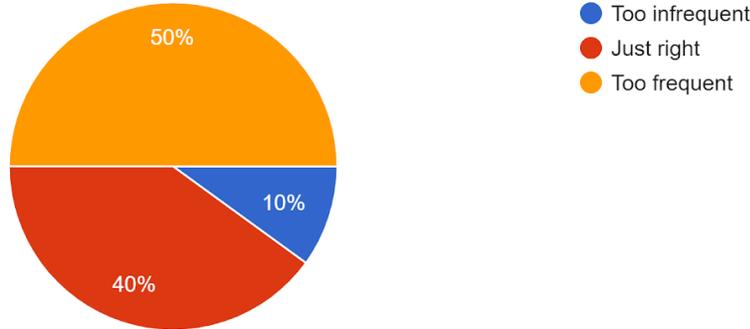
				stream hydrology and dam overtopping when not in the field. Presentation faced many technical difficulties due to internet outages, but a recording was captured .
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Appendix B: Survey results on DUWAC Meetings and structure

Results from survey sent to all communities in September 2019:

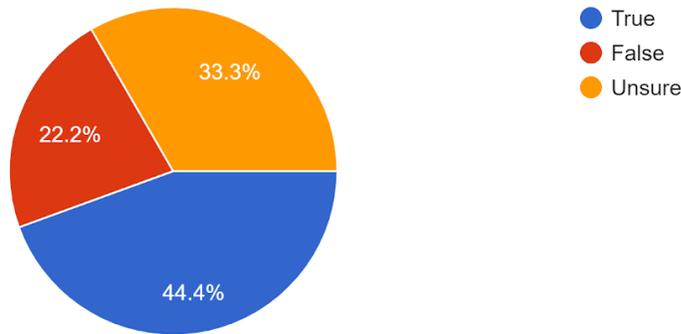
Monthly meetings are

10 responses



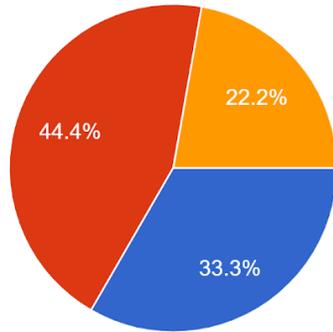
I wish meetings were less frequent

9 responses



Meetings every other month would be

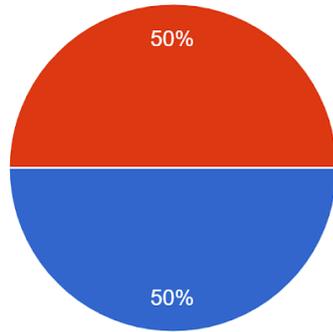
9 responses



- Too infrequent
- Just right
- Too frequent

Meetings every quarter would be

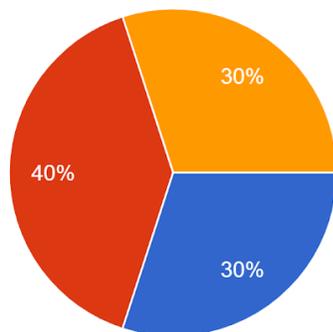
10 responses



- Too infrequent
- Just right
- Too frequent

My community/agency would be interested in a grants subcommittee

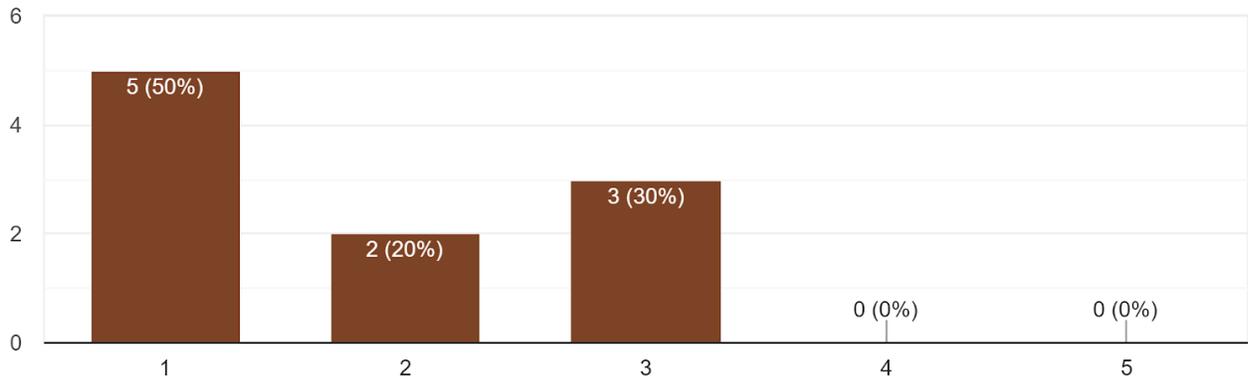
10 responses



- Yes
- No
- Maybe

Getting to MPCA for meetings is

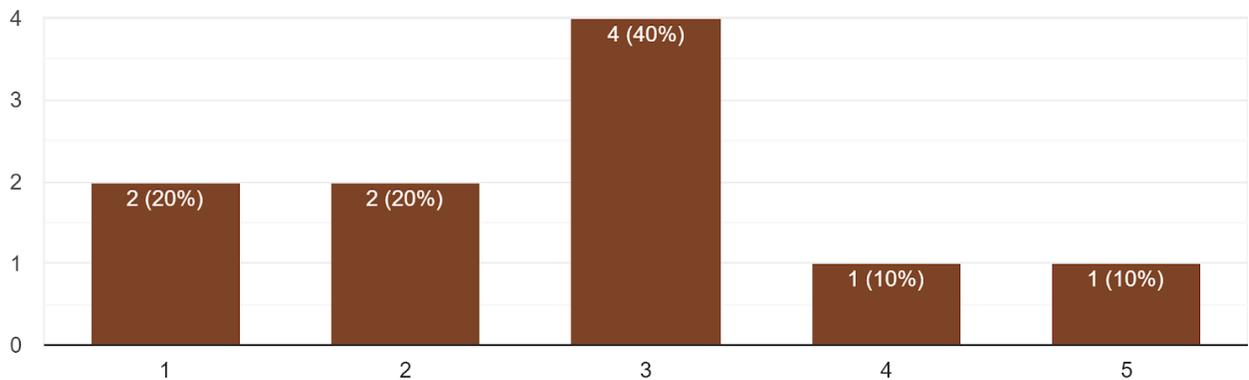
10 responses



1 = very easy; 5 = very difficult

Getting to NRRI for meetings is

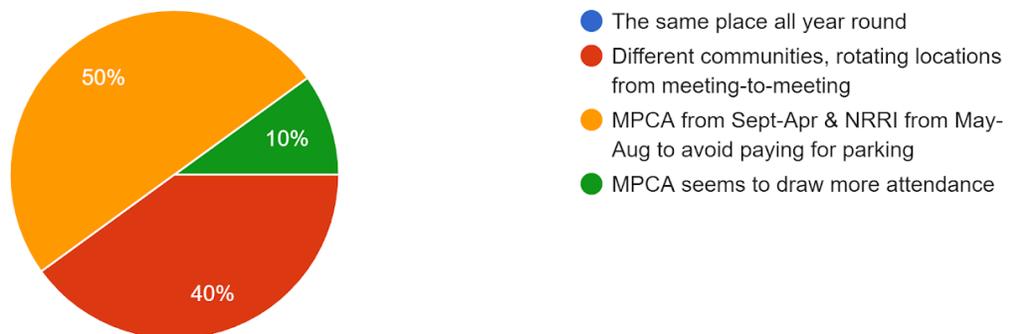
10 responses



1 = very easy; 5 = very difficult

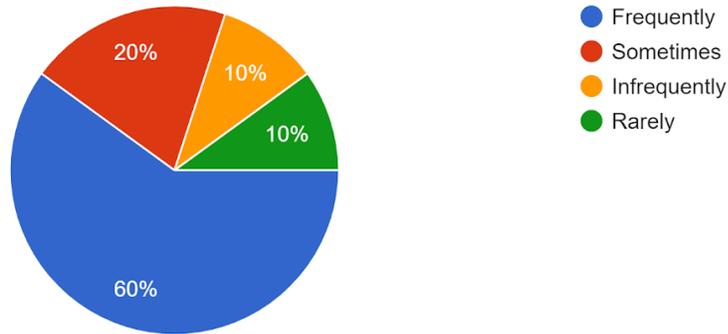
I wish meetings were held at

10 responses

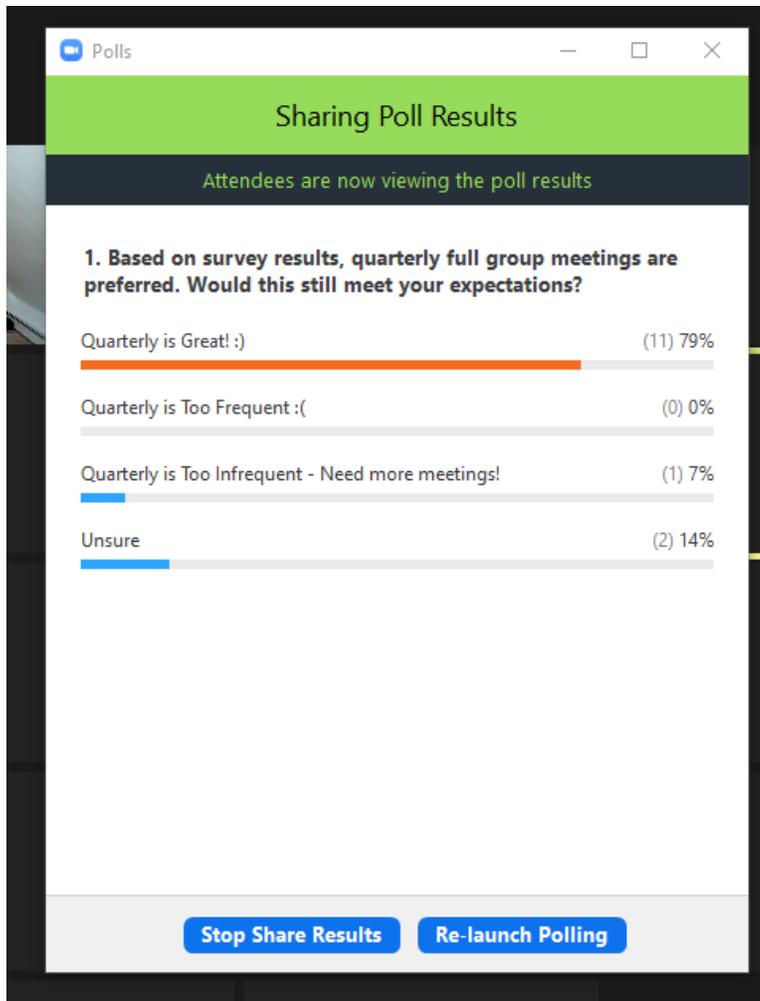


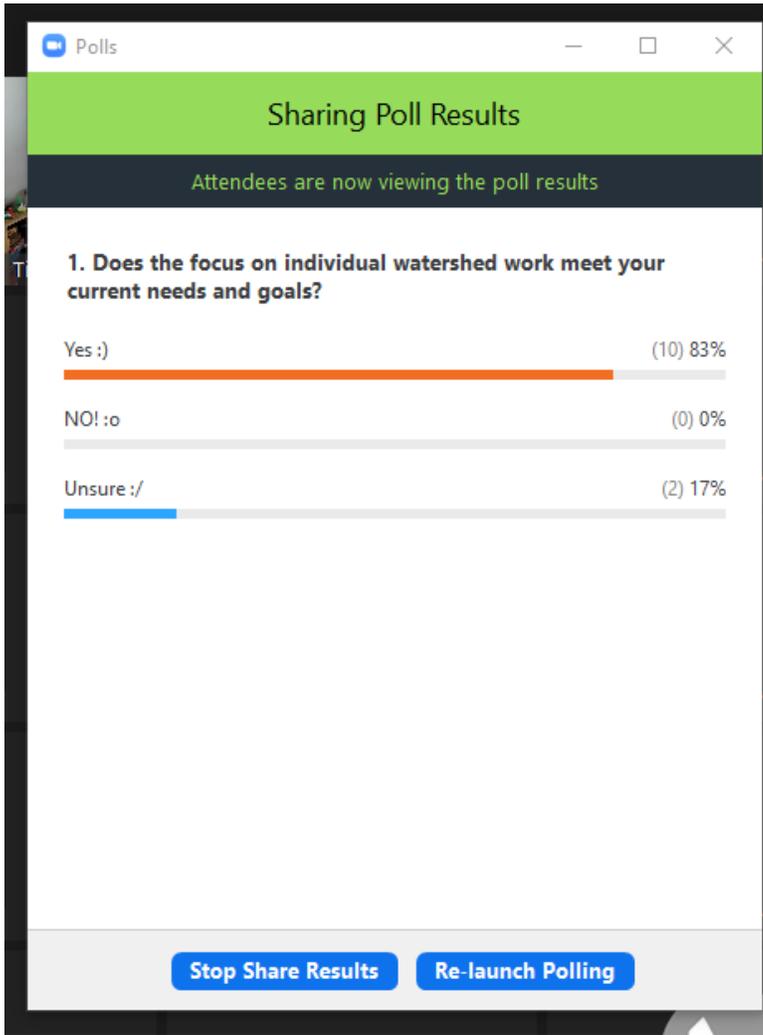
Myself, or someone from my community/agency, attends DUWAC meetings

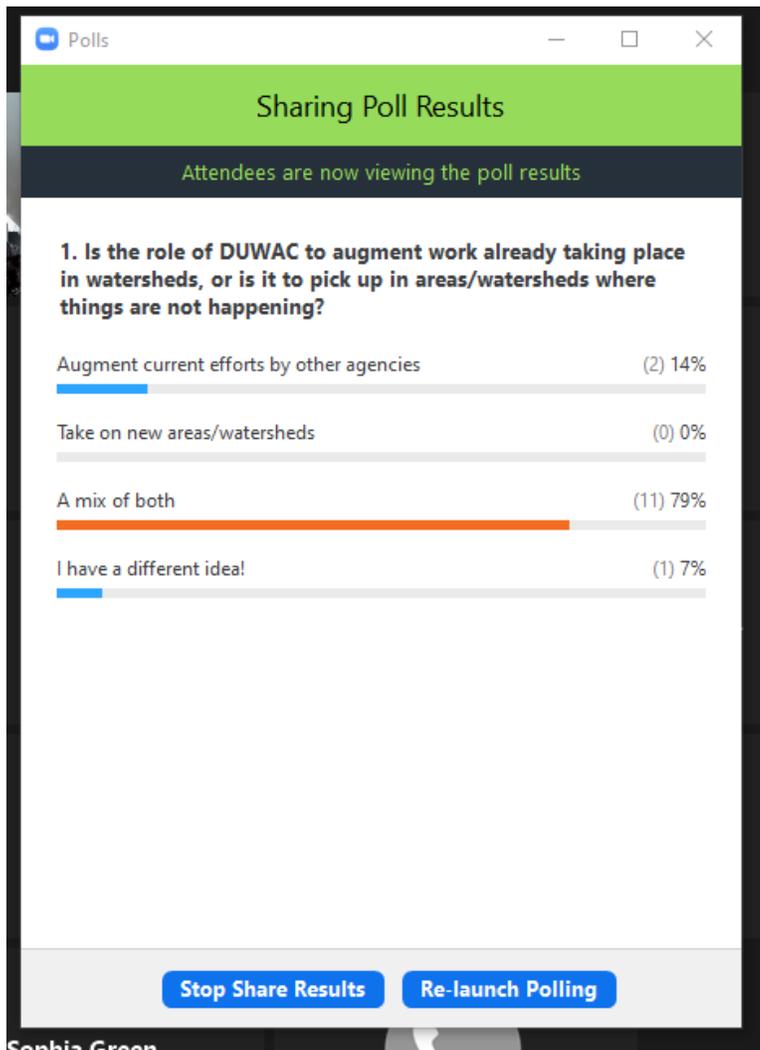
10 responses



Results from survey at Sept 2020 DUWAC meeting:







Sophia Green

Comments:

Strategize together; duwac help the group understand how everything fits into whole; help the group prioritize

Mike Kline - Vermont - help with habitat restoration and how to holistically implement across a watershed

City of Duluth doesn't have stormwater management plan; but maybe it isn't about doing it for the city; but focus on a watershed and look at it in a system that way - what can tie into 1W1P planning and implementation process

TMDL streams should be a focus

Amity b/c of 319

Urban cold water brook trout fisheries

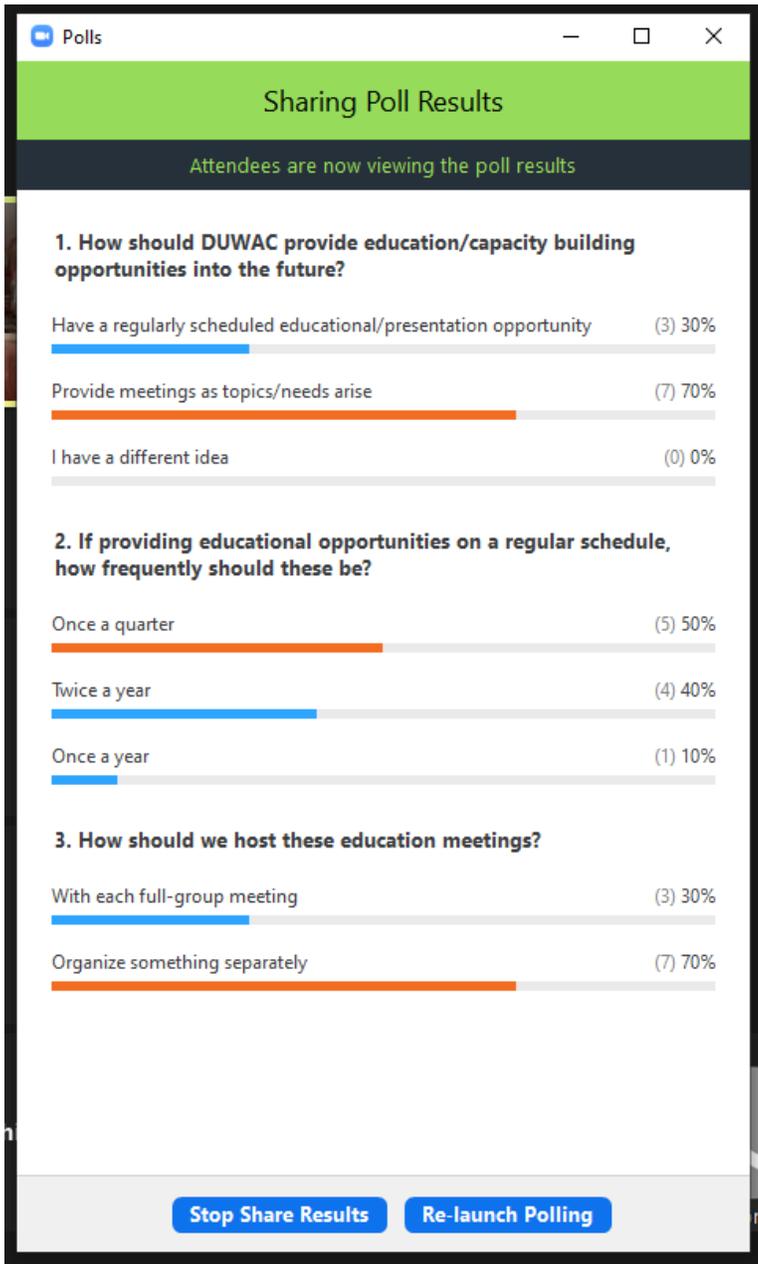
How do we make sure we are encompassing protection in these strategies?

Protection in impaired watersheds?

How to still allow for successful development?

-Understanding of overall water management and storage across the entire watershed

-LiDAR data to help with understanding storage



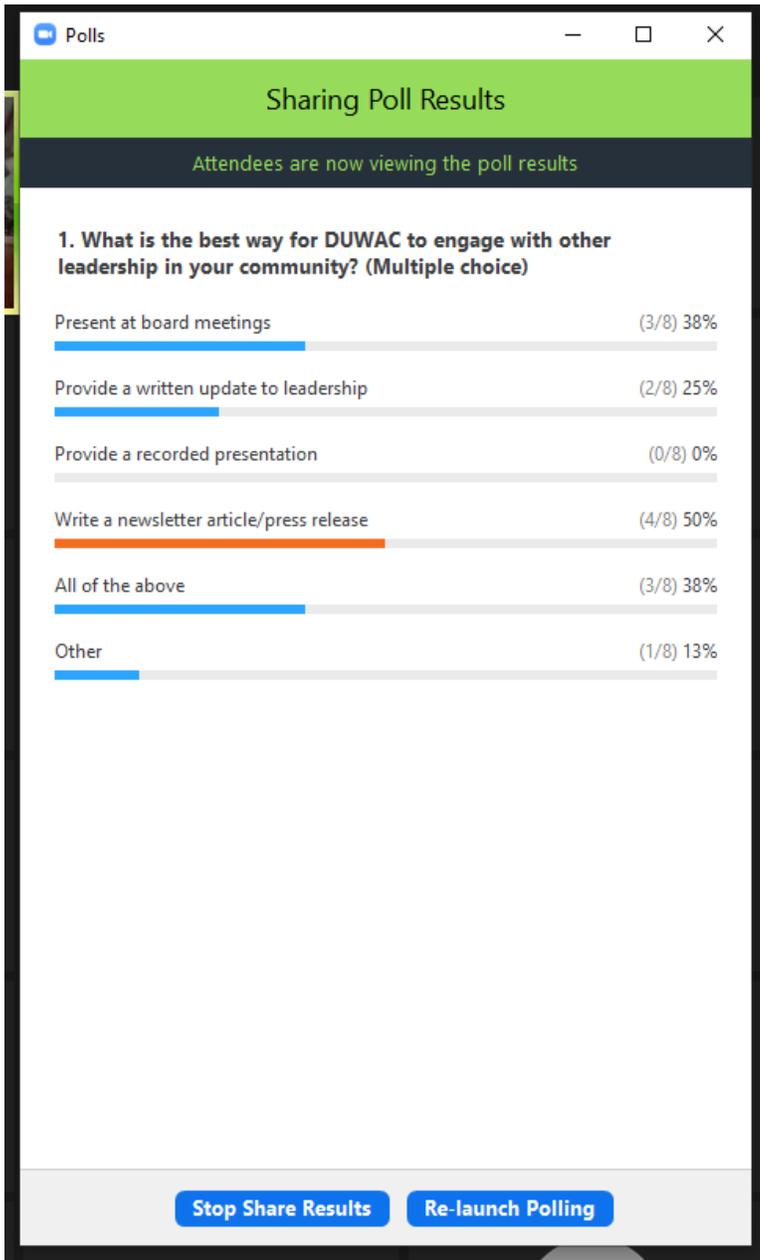
Comments:

Offering information that can be presented to our commissions

Thinks it is important for the Cities to go to the townships to communicate how important they are to the cities and how important it is to work together

-We need to figure out a way to do some better talking to each other at a leadership meeting

-Joint commission meetings??



Appendix C: Survey gage elevation data (Objective 2, Task A, Subtask 1).

Site Name	Date	Lat	Lon	Surveyor		Elevation (m)	Point 1		Elevation (m)	Point 2		Elevation (m)	Gauge		Elevation(m)
				Lat	Lon		Lat	Lon		Lat	Lon		Lat	Lon	
SLR @ Perch Lake	11/18/2020	46.658837	92.254738	46.65912	92.25645	1.2	46.65913	92.25645	0.9	46.65913	92.25645	1.26	46.65903	92.25645	2.87
Knowlton @ Waterfront Trail	8/24/2020	46.714685	92.198809	46.71429	92.19821	1.05	46.71428	92.19825	2.32	46.7143	92.19829	3.06	46.71437	-92.1983	3.21
Knowlton @ Spirit Mt	8/24/2020	46.714685	92.216181	46.71985	92.20751	1.11	46.71987	92.20763	0.85	46.71971	92.20766	0.88	46.71986	92.20768	2.915
Keene @ Dog Park	8/24/2020	46.735637	92.175752	46.73518	-92.1751	1.055	46.73519	92.17498	1.32	46.73522	92.17506	1.07	46.73516	92.17506	1.585
Keene@ Irving Park	8/24/2020	46.732232	-92.16911	46.73235	92.16901	1.02	46.73231	92.16893	0.36	46.73239	92.16901	1.01	46.73236	92.16901	1.2
Miller@ Lincoln Park	8/24/2020	46.771399	92.142133	46.76611	92.13602	1.07	46.7661	92.13599	0.49	46.76611	92.13598	2.66	46.76609	-92.1359	2.53
Miller @ LSC	8/24/2020	46.783919	92.146511	46.78215	-92.1453	0.995	46.78216	92.14529	0.19	46.78217	92.14532	1.19	46.78213	92.14535	1.78
Brewery @ Marshall	10/23/2020	46.799695	92.115362	46.79994	92.11374	1.55	46.79994	-92.1136	1.96	46.79994	92.11376	0.69	46.79994	92.11362	3.68
Chester @ Chester Bowl	10/23/2020	46.812741	92.092025	N/A	N/A	1.06	46.81267	92.09222	1.25	46.81277	92.09243	0.85	46.81267	92.09222	2.07
Chester@ St Scholastica	10/23/2020	46.816481	92.102391	46.81653	92.10239	1.2	46.8165	92.10242	1.225	46.81658	92.10258	0.475	46.81658	92.10254	3.35
W Tischer @ UMD	10/23/2020	46.821297	92.080933	46.82159	92.08037	1.07	46.82157	92.08055	0.54	46.82162	92.08047	1.04	46.82153	92.08045	2.38
Tischer @ Congdon	10/23/2020	46.818859	92.060322	46.81878	92.05795	1.18	46.81879	92.05801	0.73	46.8188	92.05796	0.71	46.81879	92.05801	1.66
Tischer @ Hartley	10/23/2020	46.837569	92.085964	46.83796	92.08621	1.03	46.83784	92.08605	0.9	46.83795	92.08653	1.65	46.82787	92.08633	2.78
Amity @ Lester	10/23/2020	46.841	92.009612	46.84393	-92.0097	1.125	46.84364	-92.0097	1.08	46.84393	92.00976	0.49	46.84393	92.00979	2.23
Keene@ Keene Park	11/18/2020	46.773542	92.185467	46.77359	92.18537	1.37	46.7735	92.18553	2.02	46.77364	92.18538	1.16	46.77364	92.18538	2.99
Lester near White Pine Camp	10/28/2020	46.81258	-92.09232	46.93813	92.03999	1.14	46.93812	92.03893	1.05	N/A	N/A	N/A	46.93813	92.03998	3.03
Lester near Lismore Rd	10/28/2020	46.93819	-92.03993	46.93021	92.06559	1.14	46.93009	92.06564	1.265	46.93015	-92.0655	3.06	46.9302	-92.0656	3.73