MINNEHAHA CREEK WATERSHED DISTRICT
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MEMORANDUM

To: MCWD Board of Managers

From: Kailey Cermak, Monitoring Coordinator

Date: October 7, 2019

Re: Items 4.1 - Real-time Sensor Network Discussion

Purpose:

At the October 10, 2019 Operations & Programs Committee (OPC) meeting, staff will provide a briefing on the District's proposed Real-Time Sensor Network (RESNET). This briefing will include a discussion on steps Minnehaha Creek Watershed District (District) has taken in dam operations and flood management since 2014, how RESNET will enhance those operations even further, how data collected through this network will set the stage for future District initiatives, and next steps to get the RESNET up and running.

Background – Where Have We Been:

2014 Flooding

The Minnehaha Creek Watershed District experienced record setting precipitation during the first half of 2014, which led to record flooding across the entire watershed. The District's role during the 2014 flooding was to collect data and disseminate the information to local communities and agencies, however, data collection during the flooding posed new challenges and opportunities for the District. For example, the District's monitoring equipment at the time couldn't be used during high flows, therefore, monitoring equipment needed to be rented. Additionally, the 2014 flooding provided an opportunity for District staff to identify critical flow monitoring locations during high water events and highlighted the need for a written high water monitoring plan. During and after the 2014 flooding, staff worked to develop a high water monitoring plan that memorialized protocols and procedures to implement during future flood events. This high water monitoring plan was included in the District's "2014 MCWD Flood Report" synthesis, which was accepted by the Board of Managers in 2015.

Gray's Bay Dam Partnership

The 2014 flooding also provided the District the opportunity to examine how it used data to inform operations of the Gray's Bay Dam. This examination led to a multi-agency partnership with the National Weather Service (NWS), the United States Geological Survey (USGS), and Hennepin County Emergency Management (HCEM) to improve water level management throughout the District using Gray's Bay Dam. As part of the multi-agency partnership, the District has gained the following data points:

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- Real-time water level readings on Minnehaha Creek and Lake Minnetonka (Figure 1) from the USGS
- Seven-day precipitation forecasts, in six-hour increments, for the 125-square mile area that drains to Lake Minnetonka from the National Weather Service
- Hydrologic inflow and lake level simulation models that use forecasted precipitation to predict upper watershed stream flows and the effect on Lake Minnetonka's water level from the National Weather Service
- Real-time precipitation and weather attributes from Hennepin County Emergency Management

This data allows the District to proactively create storage in Lake Minnetonka and reduce discharge from the dam ahead of rain. Reducing discharge creates storage in the Minnehaha Creek for runoff from downstream urban communities, while water from the upper watershed is held in Lake Minnetonka and released slowly into the creek. In recent years, the District has utilized data from agency partners to manage the impacts from wet weather, which has limited the duration of high water in spite of record precipitation.
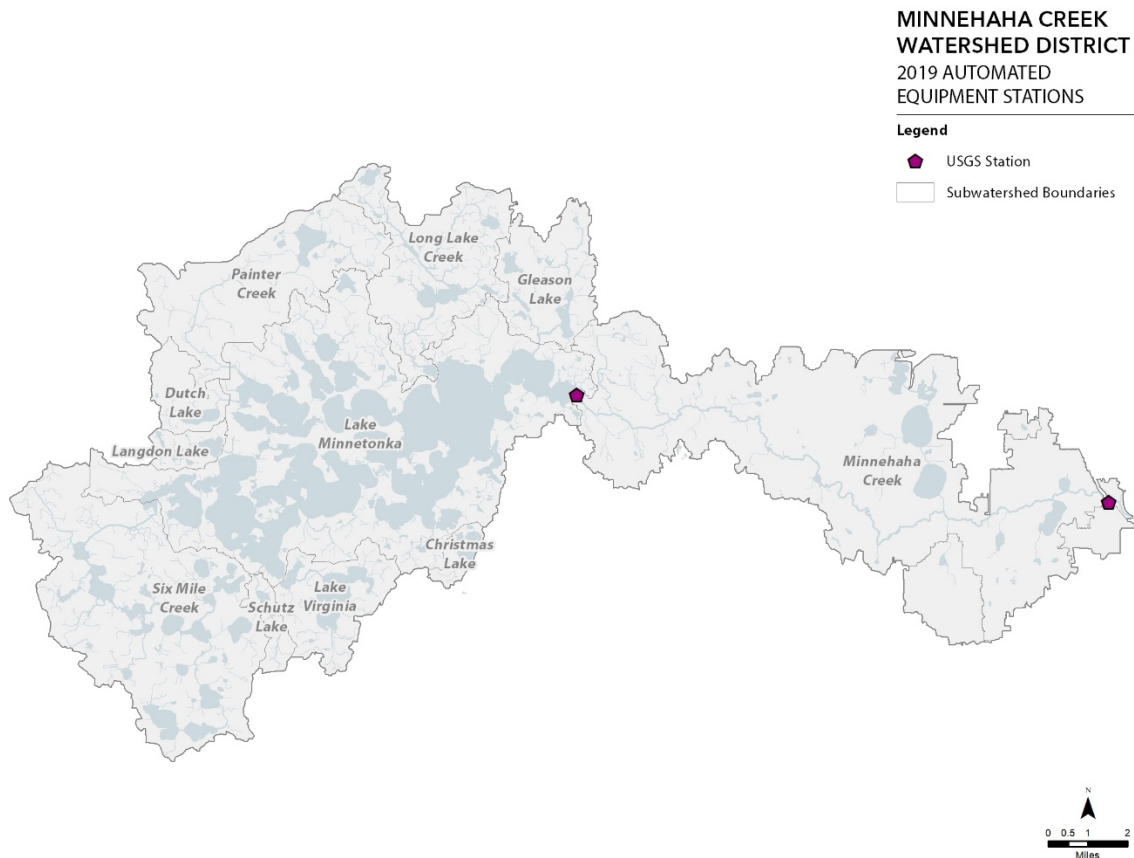

Figure 1. Locations of automated level monitoring sites established after the 2014 high water events

There are presently two locations in the watershed collecting and transmitting real-time level and flow (Figure 1). The District's Research and Monitoring (R&M) staff currently measure creek flows across the watershed once every two weeks, however, these instantaneous flow measurements are only representative for a brief moment in time since streamflow is extremely dynamic.

In an effort to better assist Gray's Bay Dam operations, R&M staff have been making special trips to collect flows and record water elevations during high water periods. In record precipitation years such as 2019, these trips have becoming time consuming and still only provide staff with a snapshot in time.

Background - Where We Are Now:

2019 Spring Flood Preparation & Future Real-Time Monitoring Discussions

Prior to the snowmelt in early March 2019, MCWD staff convened a meeting with the NWS, USGS, and HCEM, to discuss the high likelihood for localized flooding. During that meeting the agencies discussed spring flooding preparation plans. At the conclusion of that meeting the agencies began to brainstorm future real-time water level information that could be helpful for all the agencies in their decision making.

Staff from MCWD, NWS, USGS, and HCEM held another meeting in May 2019 to have a focused discussion on future real-time monitoring locations. At the conclusion of that meeting partner agencies identified the desire to have more real-time water level data across the watershed to improve emergency warnings, emergency response, and dam operations.

After this meeting, District staff offered to take the lead and worked with each partner agency and District creek communities to understand where data gaps existed, what the needs of the communities are along Minnehaha Creek were, and what internal District staff needs were for dam operations. MCWD gleaned several insights from meeting with local partners and internal staff, which included:

- Cities along Minnehaha Creek take staff time to document water levels in their jurisdiction multiple times a week.
- Hennepin County Emergency Management staff were planning to deploy real-time level sensors on Minnehaha Creek in many of the same locations as MCWD
- Recent stakeholder surveys found that one of the most frequent desires from MCWD is to display more data on the web site.

District staff have taken time to reflect upon monitoring improvements implemented since 2014, which have greatly improved our ability to inform management during high water. However, through our discussions with agency partners, communities, and internal District staff, it is clear that there is an opportunity to keep making improvements and that there are many benefits to be gained from adding real-time level sensors to upper watershed tributaries and along Minnehaha Creek. By creating this higher resolution of real-time watershed conditions, staff can:

- Eliminate trips for discrete flow monitoring
- Better operate Grays Bay Dam

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- Provide water levels for emergency planning
- Better understand the District's water budget

In early 2019, R&M staff allocated $200,000 for new equipment in the District's 2020 budget based on internal needs and discussion with our partner agencies and communities, which the Board of Managers preliminarily approved on September 12, 2019. Additionally, the District partnered with HCEM to identify an opportunity to apply for a FEMA grant to cover a portion of the monitoring equipment costs. R&M staff worked with HCEM staff to identify equipment that would best suit the needs of MCWD and HCEM for the grant application. Presently, HCEM is expecting approximately $42,000 in grant funding from FEMA's Hazard Mitigation Grant Program, which will be used towards the District's purchase of water level sensors and loggers. The opportunity to cost-share the sensors will allow for a higher resolution of sensors along Minnehaha Creek.

When deciding where to place new sensors, it was important to consider what locations would enhance our existing forecasting for dam operations and what locations would improve our ability to communicate high water levels with communities and agency partners along the Minnehaha Creek. District staff coordinated with staff from Minnetonka, Hopkins, St. Louis Park, Edina, Minneapolis and the Minneapolis Park and Recreation Board to identify desirable sensor locations along Minnehaha Creek for communicating current water levels. Conversely, monitoring locations at the outlet of minor subwatersheds draining to Lake Minnetonka are to inform dam management. Figure 2 below shows the proposed 2020 data sensor locations.

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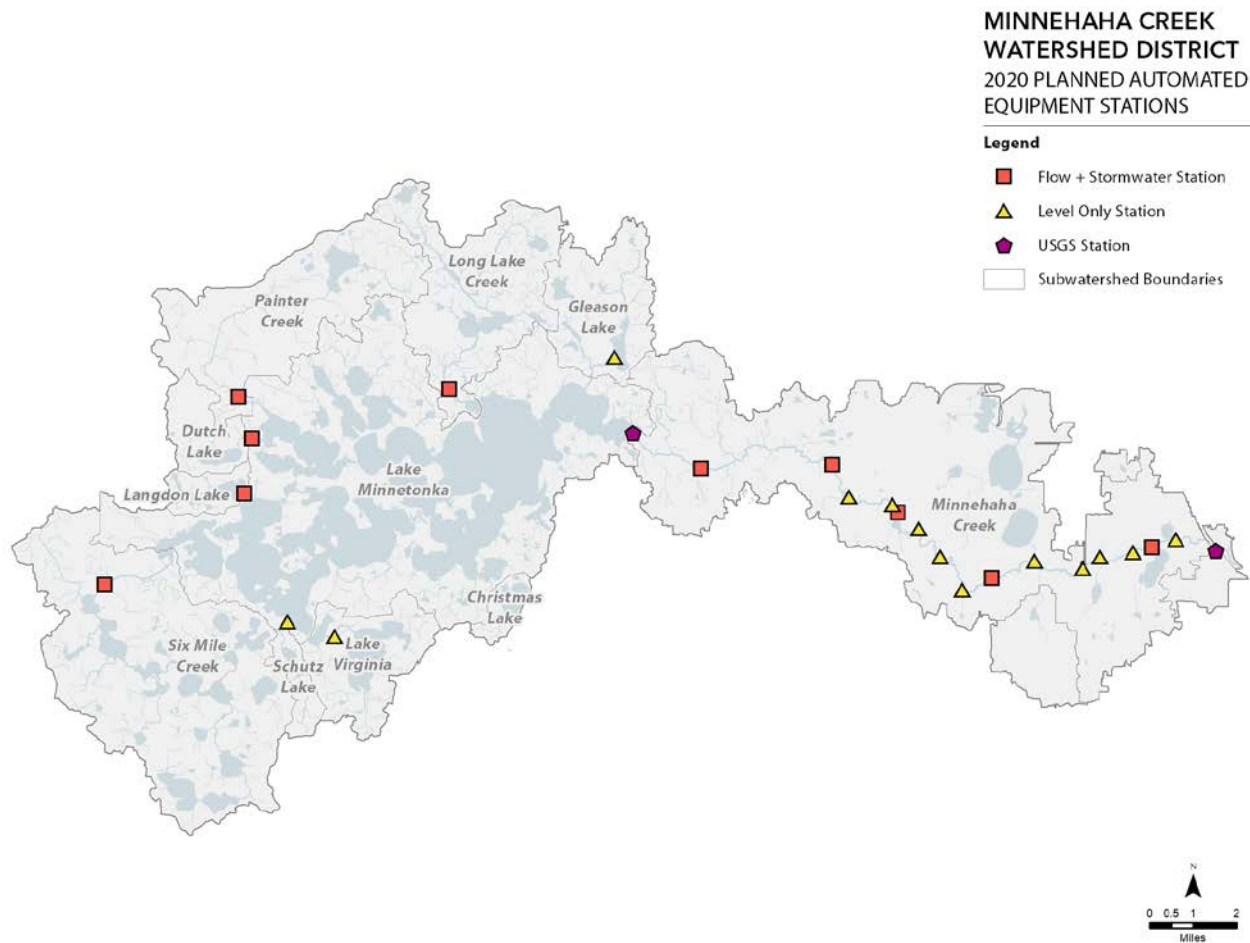
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Figure 2. Locations of automated level monitoring sites proposed for 2020.

Near Term Benefits and Action Steps

As discussed in the sections above, District staff have identified the benefits to be gained from adding real-time sensors across the watershed. Those benefits are discussed in more detail below.

1. Emergency Planning and Communication.

   While the District does not play an active role in emergency management, it is our goal to provide cities updated communication and information on watershed conditions. Giving our creek communities access to real-time water levels will allow cities to better prepare for flooding events and understand the current stream conditions.

2. Refined Dam Management.

   The District already has access to real-time precipitation on a subwatershed scale thanks to HCEM's Mesonet stations. The District will gain a better understanding of each subwatersheds water budget and can improve the accuracy of the District's hydraulics and hydrology model by layering in data gathered from RESNET. Paired with the NWS modeled forecast information, the

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addition of seven real-time sensors in the upper watershed and 14 along Minnehaha Creek, the District will work to fine-tune dam operations.

Staff currently utilize the NWS watershed forecasting and inflow model to inform operations of the Gray's Bay Dam. RESNET will add another important layer of data, allowing staff to see real-time inflows into Lake Minnetonka and have 14 more real-time data points along Minnehaha Creek which will allow staff to track water-level variations more closely along the 22 miles of Minnehaha Creek.

3. Future District Initiatives.

While the idea for RESNET rose from the need to inform dam operations and assist in emergency planning, there are future benefits from developing a better understanding of hydrology within the District. Currently, the District is developing a better understanding of its role in climate adaptation planning, which will require tools to develop predictions for future extreme weather events. The District currently has a robust hydrology and hydraulics model that is capable of running future scenarios, however, making refinements of the model will reduce the uncertainty assigned to future forecasts. High resolution level and flow data will provide a comprehensive picture of how the upper and lower watershed respond to storm events, which can be used to refine the current model for assessing the Districts role in climate adaptation planning by running future weather scenarios.

Additionally, this stormwater information is critical when we look 10-20 years from now as the District and its partners propose to remove storm outfalls from Minnehaha Creek and add stormwater BMP's. Having continuous real-time water level data will allow us to tell a compelling story of what impact those efforts have made on water quantity and quality.

Next Steps:

At the October 10, 2019 OPC meeting, staff will discuss where the District's Research & Monitoring program has been, where the program currently is, and where the program is going with the addition of RESNET. Below are some short and long-range next steps identified with the RESNET system.

Purchase Equipment:

FEMA grant dollars will cover most of the level and telemetry equipment needed along Minnehaha Creek. The District will still need to purchase equipment for the upper watershed and infrastructure to house the monitoring equipment at each station. Staff will be back in front of the board in January 2020 for approval to purchase the remaining equipment. As mentioned previously, this expense has been included in R&M's 2020 budget.

Install infrastructure:

Staff plan to begin installing the equipment housing this fall and winter so it's ready for the equipment come spring 2020. The install method and cost will vary site to site and staff may be coming to the Board of Managers for approval on future infrastructure purchases. Staff will coordinate with city staff on any local permits and approvals.

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<u>Integration of Sensor Network into Information Technology Overhaul:</u>

The RESNET sensor network has been included in the technology and website redesign discussions. R&M staff have been working with the server provider to ensure that data collected from each site can seamlessly be stored in the District's database. In addition, District staff have been working with KISTERS to ensure that real time level and flow data can be extracted and displayed on our website so that the public can obtain information about water level conditions in their area.

Summary:

Through collaboration with our partners, District staff plan to install a network of real-time water level sensors that will provide staff, cities, and residents with live watershed conditions. This resolution of water level data will provide immediate benefits to the operation of Gray's Bay Dam and efforts in emergency planning. Long term, RESNET will set the stage for future studies and initiatives, such as an updated hydrologic model. To get the sensor network up and running, staff need to purchase equipment, install infrastructure to house equipment, and setup the data transmission to the website. The goal is to have sensors installed and transmitting data by spring of 2020.

If there are questions in advance of the meeting, please contact: Kailey Cermak at (952) 641-4501 or kcermak@minnehahacreek.org.

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