Water Stabilization on the Briggs Chain of Lakes

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This report serves as a written summary of the history of water level investigations on the Briggs Chain of Lakes. As this has been an ongoing topic for many years some events and discussions may not be captured in their entirety. However, an effort has been made to capture the nature of this problem and document efforts to thoroughly understand and address it.

Issue Identification

Water levels have, for some time, been a topic of concern on the Briggs Chain of Lakes. The upper three lakes (Julia, Briggs and Rush) have a relatively small drainage area at 8,600 acres and an Ordinary High Water Level (OHWL) of 964.2 ft. Elk Lake (OHWL 962.2 ft) has a watershed of 151,484 acres contributing water to it primarily through the Elk River (Figure 1).

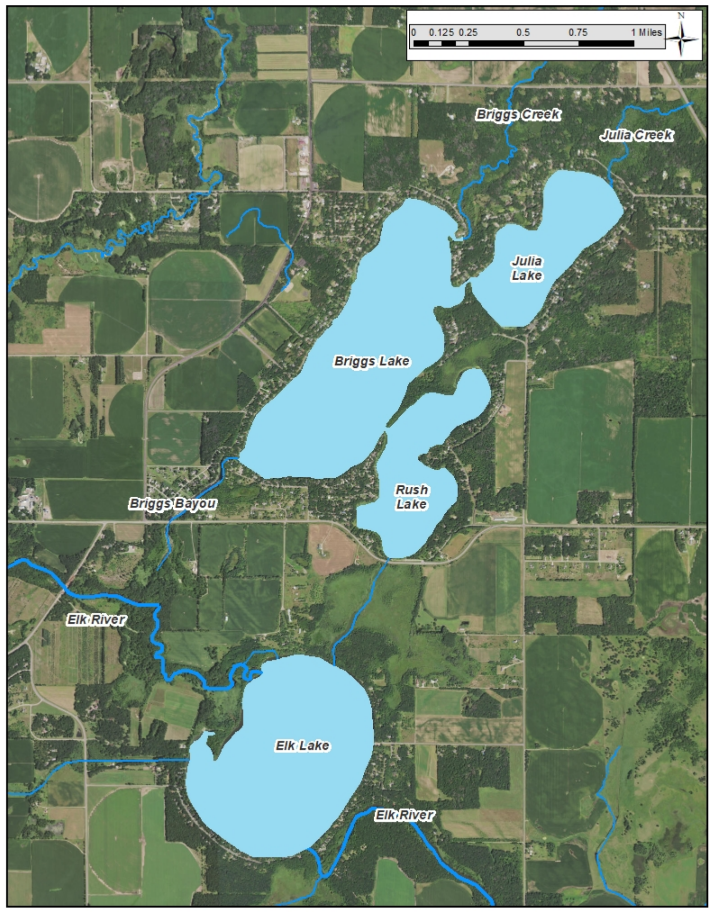

Figure 1: The Briggs Chain of Lakes, Sherburne County.

The hydrology of the Briggs Chain is unique. Under "normal" water conditions water from the Elk River runs its course through Elk Lake and then further downstream towards the City of Becker. In the Upper Briggs Chain Lakes, Julia and Briggs Creeks feed Julia and Briggs Lake, respectively. Water flows from Julia Lake into Briggs Lake, then into Rush Lake, then continues downstream through Lilly Creek into Elk Lake. Following large rain events, water enters the Briggs Chain from these streams and from the shoreland areas. Additionally, the water in the Elk River overtops a bank on the north side and rushes into Briggs Lake through a channel locally known as the "Briggs Bayou". Thus, the upper lakes can flood with water from the Elk River.

At over 160,000 acres, the Briggs Chain watershed is quite large. Larger watersheds capture more precipitation and move a larger volume of water to a downstream lake. The rate of runoff is a critical factor as well; watersheds that are completely "natural" or vegetated tend to hold water on the landscape and release it to streams and lakes at a slower rate. If a watershed is developed, with vegetation removed for houses, roads, fields, parking lots, etc., the discharge rate of water moving downstream increases. Figure 2 displays the relationship between stream discharge and landcover.

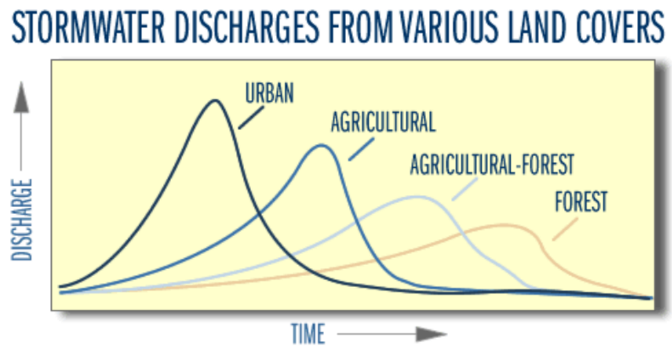

Figure 2: Stormwater discharge under various land covers. Image from www.waterontheweb.org

The topography of the Bayou area includes low-lying wetlands found between two upland shelves on the east and western sides. The north section of the Bayou holds water year-round, but as the channel moves to the south the elevation slightly increases and transitions to a floodplain that resides only slightly above the ordinary high water level. Prior to European settlement of the area it is possible that large rain events may have pushed the elevation of the Elk River above the riverbank and diverted flow into the upper lakes, as it does today. However, this has undoubtedly increased in occurrence and intensity following development of the watershed for dwellings, transportation and agricultural uses. By removing vegetation from the landscape and altering waterways to quickly transport water, the Elk River is able to rise in elevation at a faster pace and to a more dramatic degree.

Rising water levels on the Briggs Chain are the cause of several concerns. First and foremost is property damage. Property damage includes both structures in the shoreland area and damage to landscaping and erosion of the shoreline. Secondly, ecological damage may result from flooding. Floodwaters may carry nutrient-rich sediment from eroding banks and flushed wetland, bringing these nutrients into the lakes where algae proliferation may occur. Higher water levels also may erode shoreland areas, which results in not only physical property loss but also loss of wildlife habitat and nutrient introduction to the lake. Finally, recreational impacts occur when water clarity decreases due to the turbid flood water and a Slow-No-Wake ordinance goes into effect which is aimed at reducing shoreland erosion from wave energy.

To date, several studies have been completed aiming to understand water stabilization:

1) <u>1987 study completed by the United States Army Corps of Engineers</u>
   Engineers at the St. Paul District of the ACOE completed an appraisal study for flooding issues on the chain lakes. The study was undertaken in response to a formal resolution adopted March 5, 1985 by the Sherburne County Board of Commissioners requesting the ACOE to investigate feasibility of flood damage reduction. The study evaluated potential damage to structures and shorelines, alternatives for flood reduction, and provided an overview of impacts.

2) <u>2006-2007 Mass Balance Study by the Sherburne SWCD</u>
   Sherburne SWCD staff and Briggs Chain residents monitored all inlet and outlet locations for water volume and quality in 2006 and 2007. The results indicate that flow through the Briggs Bayou is highly variable but can contribute substantially to the water quality and quantity of the upper Briggs Chain Lakes.

3) <u>2018 Briggs Chain Flood Study completed by Wenck Associates, Inc.</u>
Engineers at Wenck Associates completed a modeling study to evaluate potential options for flood mitigation. Previous options outlined in the 1987 study were examined as well as new options. One outcome of this study is that a trash rack on the Rush Lake outlet weir was removed, which is estimated to reduce water drawdown times between 32% and 37% (up to two days).

4) <u>2019 Data Collection Study completed by Sherburne SWCD and TLID / BLCA</u>
Staff from Sherburne SWCD and residents of the Briggs Chain Lakes evaluated flow conditions and assessed water quality at the Briggs Bayou in 2019. Additionally, survey grade elevation profiles were collected at the Briggs Bayou County Road 16 bridge, Lilly Creek County Road 16 bridge, and Elk Lake outlet. Data was provided to Wenck Associates for a 2020 Water Stabilization Study.

5) <u>2020 Briggs Chain Phase II Water Stabilization Study completed by Wenck Associates, Inc.</u>
Engineers from Stantec completed a Phase II analysis which utilized survey grade data for better model calibration. Water storage opportunities within the Big Elk Lake watershed were evaluated for potential and relative impact on flooding in the chain lakes.

Alternatives Analysis

The above referenced studies have evaluated several alternatives to mitigate flooding conditions on the Briggs Chain of Lakes. The alternatives explored include:

1. ***Floodplain Evacuation*** – would include the relocation of homeowners, structures, etc. This is likely economically and socially unacceptable. Homeowners have purchased property in the area because of ease of access to the Briggs Chain Lakes. The expense of moving structures and homeowners would be immense. Further, it would not address the water quality and recreational impacts to the lakes.

2. ***Floodproofing*** – would include structural design elements to protect buildings, septic systems, etc. The costs would be immense and likely be born onto the homeowner. This approach still leaves floodwaters to cover roadways, impact shorelines, impair the water quality and cause recreationally impacts.

3. ***Upstream Storage*** – storing rainfall runoff in ponds, wetlands, or other low-lying areas and controlling its release. The 1987 ACOE study determined there was not a single location where an embankment could be constructed that would provide enough storage capacity to mitigate flood issues. Note that this study was examining potential for a single location. Future studies confirmed that a single location meeting storage demand did not exist, but that multiple storage projects across the landscape would be a potential approach to consider. Wetland restorations are now a popular conservation practice due to their multiple benefits (water storage, water filtration, habitat creation, etc.) and as such, funding is often available. Challenges lie with meeting landowner land management goals, ensuring water does not encroach on neighboring properties, and navigating public drainage law if a public ditch is involved.

4. ***Channelization*** – regrading of the Elk River. The Elk River has a very slight grade of roughly 1.7 to 3.0 feet per river mile upstream of the Briggs Chain Lakes. Adjustments to the grade of a river

through channelization would impact discharge rates. However, this approach requires an extraordinary amount of excavation within the riverbed and along the forested river edges. Such an effort would carry a very high financial cost, high environmental impact, and be of questionable technical feasibility because of the existing low grade.

5. ***Clearing of Treefalls*** – physical removal of treefall or other obstacles in the river. The 1987 ACOE study reported that clearing treefall would only slightly affect the frequency of breakout flow to the Briggs Bayou. In this area, the Elk River overbank is quite wide and so flow pushed to the outer banks by treefall can continue downstream with relative ease. The larger problem with this approach is that it would be short-lived; the Elk River is heavily wooded and so fallen trees would present an almost annual maintenance challenge. The Elk River, as a "non-navigable and meandered" waterway as noted by the DNR includes public water that lies on top of riparian private property. So, removal of fallen trees embedded in the river sediment may pose trespassing challenges.

6. ***Control Structures*** – building a levee or water control structure along the Elk River bank or at the County Road 16 bridge. The 1987 ACOE report indicated that this would be a costly project; indeed, estimates place a levee or control structure at $874,000 to $1,300,000. The Wenck study does however communicate the value of having a fixed elevation that would stabilize the channel elevation and shape, allowing for more predictable impacts with rain events. An increase in elevation is not advised as it could significantly change the hydrology to induce damages downstream. This approach could also result in water backing up into the Upper Briggs Chain Lakes through Lilly Creek and thus not achieve flood reduction goals in those lakes. A control structure at the County Road 16 bridge may pond some water within the Briggs Bayou, reducing flow upstream to the Upper Briggs Chain Lakes. This would however inundate private property adjacent to the Briggs Chain Bayou and storage is estimated at ~5 acres. Further, the Briggs Bayou area is the only northern pike spawning area for the lake so impacts to this important gamefish species would need to be evaluated and considered.

   The outlet control structure at the Rush Lake outlet is a horseshoe shaped weir (constructed 1932, elevation 962.5 ft) that is roughly 50 ft in length. The weir included a vertical bar trash rack that served as a fish trap / barrier. A 2018 Wenck study evaluated flood and flow conditions through this structure and calculated drawdown times pertaining to the trash rack being clogged with debris. By assuming a 25% clogging coverage at various elevations, an environmental model predicted that the trash rack added as much as 2 days for water drawdown. As common carp are located both above and below the barrier, and have ample spawning territory in both locations, it was recommended that the trash rack be removed to facilitate greater water drawdown rates at a minimal expense. The trash rack barrier was removed in 2018.

Current Approach to Water Stabilization

Of the alternatives considered, upstream storage is the most feasible and cost-effective approach. It should be noted that there are potential benefits to control structure modification as well, though this approach remains challenging because of the high cost and impacts to downstream waters.

The 1987 ACOE report indicates that the cost to provide permanent flood protection would be greater than the benefit achieved. However, with the passing of time this thought has certainly changed. A higher frequency of large rain events means that flooding will continue, and more extreme floods are likely. Further, land managers are increasingly taking a holistic look at conservation on a watershed scale. This means that an approach that prioritizes water storage across the watershed, as opposed to a single location which was evaluated in the 1987 study, could be not only effective at reducing flood frequency but also achieve other benefits related to water quality, wildlife habitat, and tempered hydrology during rain events. Water storage may be achieved through wetland restorations, improved soil condition on agricultural fields, and stormwater management on a large and individual homeowner scale.

The 2018 and 2020 Wenck reports quantify upland storage projects and the impact on the Briggs Chain Lakes. For example, approximately 915 to 930 acre-feet of water is required to be stored elsewhere to mitigate one foot of flood water across the Briggs Chain Lakes. This is the amount of water generated from a 10-yr flood event (3.50 inches) in the watershed. To mitigate 915 to 930 acre-feet of floodwater, roughly 19-20 water storage projects that are ~25 acres in size with an average of 2-feet of depth would be required. This assumes 1:1 ratio in storage to lake flood reduction. Modeling in the 2020 Wenck study indicates that projects located closer in proximity to the Briggs Chain Lakes will be most impactful, as opposed to in the upper reaches of the watershed.

There are several focus areas being pursued with water stabilization in mind:

1. Wetland restorations – restoring low-lying areas to a natural state to hold and retain water. Areas of marginal cropland, adjacent to streams or ditches, tiled fields, or private ditches hold potential for acres of water storage.

2. Improved soil condition – incorporating cover crops or conservation tillage into an agricultural management program can increase organic matter and soil water retention. With thousands of acres of farmland in the watershed, the impact of large-scale adoption of these practices would collectively add up over time.

3. Stormwater management (large-scale) – the stormwater mitigation requirements for new housing developments and road projects are much stricter than in past decades. Stormwater holding ponds must be included and oversized to be able to accommodate extreme events. Because of this, continued development in the watershed does not necessarily mean that a greater discharge of water will occur in the Elk River. “Smart planning” tools for development and water management should continue to be utilized and enforced.

4. Stormwater management (residential scale) – every homeowner can evaluate the water that is generated from rainfall on their property. Where possible, conservation measures such as rain gardens or French drains allow for roof and driveway runoff to be collected and infiltrated to the ground as opposed to quickly entering a lake or stream. Simple measures such as directing downspouts into dense vegetation may help to slow down the water transport as well.