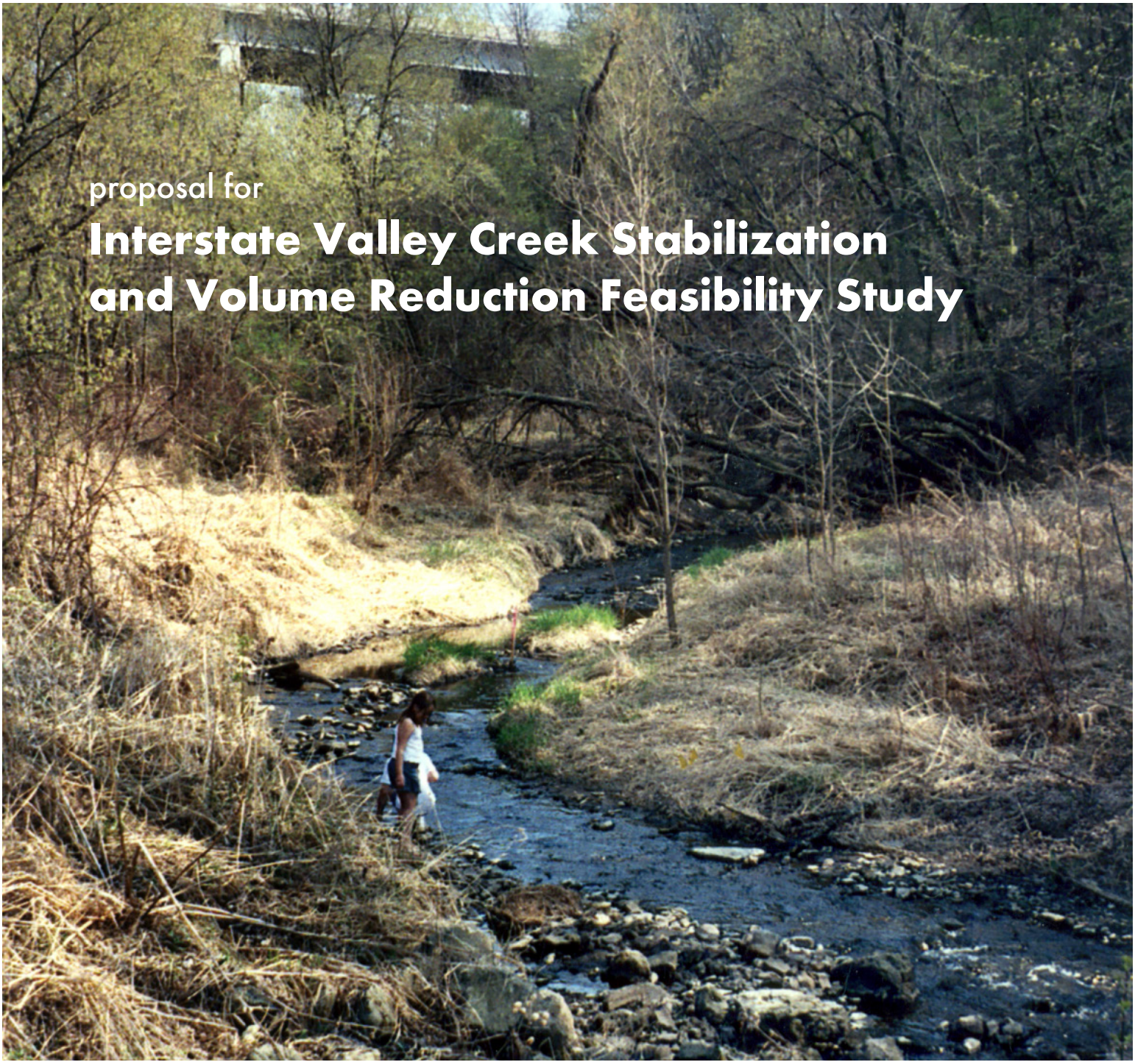


proposal for

Interstate Valley Creek Stabilization and Volume Reduction Feasibility Study

prepared for

The Lower Mississippi River WMO

Submitted by Barr Engineering Co.
May 3, 2022

BARR

resourceful. naturally.
engineering and environmental consultants

BARR

May 3, 2022

Lower Mississippi River WMO
c/o: Joe Barten, Administrator
Dakota County Soil and Water Conservation District
4100 220th St. West Suite 102
Farmington, MN 55024

Re: Request for Proposals for Interstate Valley Creek Stabilization and Volume Reduction Feasibility Study

Dear Mr. Barten:

On behalf of Barr Engineering Co., thank you for the opportunity to offer our services to assist with the Interstate Valley Creek stabilization and volume reduction feasibility study. Our proposal is enclosed in response to your request for proposals dated April 14, 2022.

We believe that retaining Barr for this project will provide the Lower Mississippi River WMO with the following key benefits:

- ***Continuity and familiarity***: Our long-standing relationship gives us a unique understanding of the physical characteristics of the watershed as well as your organizational goals and priorities. Our familiarity with the LMRWMO and its project partners will help us hit the ground running and lead to completion of the project within the desired timeframe.
- ***Stream assessment expertise***: Having completed many stream assessment and watershed volume reduction projects throughout Minnesota and the Midwest, Barr has a well-qualified team ready to serve you. Also, the addition of Chris Lenhart, Barr staff member and part-time research assistant professor with the University of Minnesota, as project manager allows us to offer an expanded level of expertise.
- ***Commitment to your success:*** We understand that this project is important to you as you seek to identify and prioritize projects to improve Interstate Valley Creek and the downstream Mississippi River. We are committed to your success and have developed a tailored work plan to deliver a high-quality study that meets your desired schedule and budget.

Our proposed approach is customized to our understanding of your expectations, our history with the Lower Mississippi River WMO, and our experience working on stabilization and volume reduction feasibility studies. We are enthusiastic about this opportunity and look forward to working with you. If you have any questions or need additional information, please contact me by phone at 612-396-6868 or email at jkieffer@barr.com.

Janna Kieffer
Principal in Charge
Vice President

Contents

Why choose Barr

Barr provides engineering and environmental consulting services to clients across North America and around the world. We have been employee owned since 1966 and trace our origins to the early 1900s. Our engineers, scientists, and technical specialists work together to help clients develop, manage, process, and restore natural resources.

At Barr, we solve clients' problems as if they were our own. We'll bring to your project the insights and expertise we've gained from our work on thousands of projects—and a promise to do our best work on your behalf. We believe Barr is best positioned to assist with the Lower Mississippi River Watershed Management Organization (LMRWMO) Interstate Valley Creek stabilization and volume reduction feasibility study because:

Our history of stream assessment and restoration projects will yield a technical approach tailored to your project.

Barr is a leader in implementing ecological methods for stream restoration, habitat enhancement, and erosion control. Our approach involves understanding the geomorphic, chemical, and biological characteristics of a stream and its riparian corridor. We gather data from a variety of sources—including our own quality diagnostic studies—ranging from Lidar and GIS analyses to field measurements of stream bed materials and vegetation surveys. We then analyze the data to identify problem sources and potential solutions. Solutions are tailored to each unique project location, leading to the longevity and resiliency of our restoration projects. Barr has worked on stream assessment and restoration across the Midwest and Great Plains states. Our stream restoration and ravine stabilization projects within the Twin Cities metropolitan area have included:

Streams		Ravines
• Battle Creek	• Purgatory Creek	• Battle Creek Regional Park (Saint Paul)
• Bluff Creek	• Raleigh Creek	• Carver ravine (Woodbury)
• Fish Creek	• Riley Creek	• DeMontreville ravine (Lake Elmo)
• Minnehaha Creek	• Shingle Creek	• Fish Creek ravine (Maplewood, Saint Paul)
• Nine Mile Creek	• Valley Creek	• Lake Rebecca/County Road 42 (Hastings)
		• Mississippi River bluff (Minneapolis)
		• Riley Creek lower valley (Eden Prairie)
		• West 110th Street ravine (Bloomington)

Our services in this area include evaluating and designing stream and ravine stabilization measures and overseeing construction, conducting classification of stream systems using the Rosgen method and other methods, conducting geomorphic and hydrologic assessments of erosion processes, calculating sediment budgets, and developing erosion control plans for creek systems—focusing on bioengineering solutions when feasible.

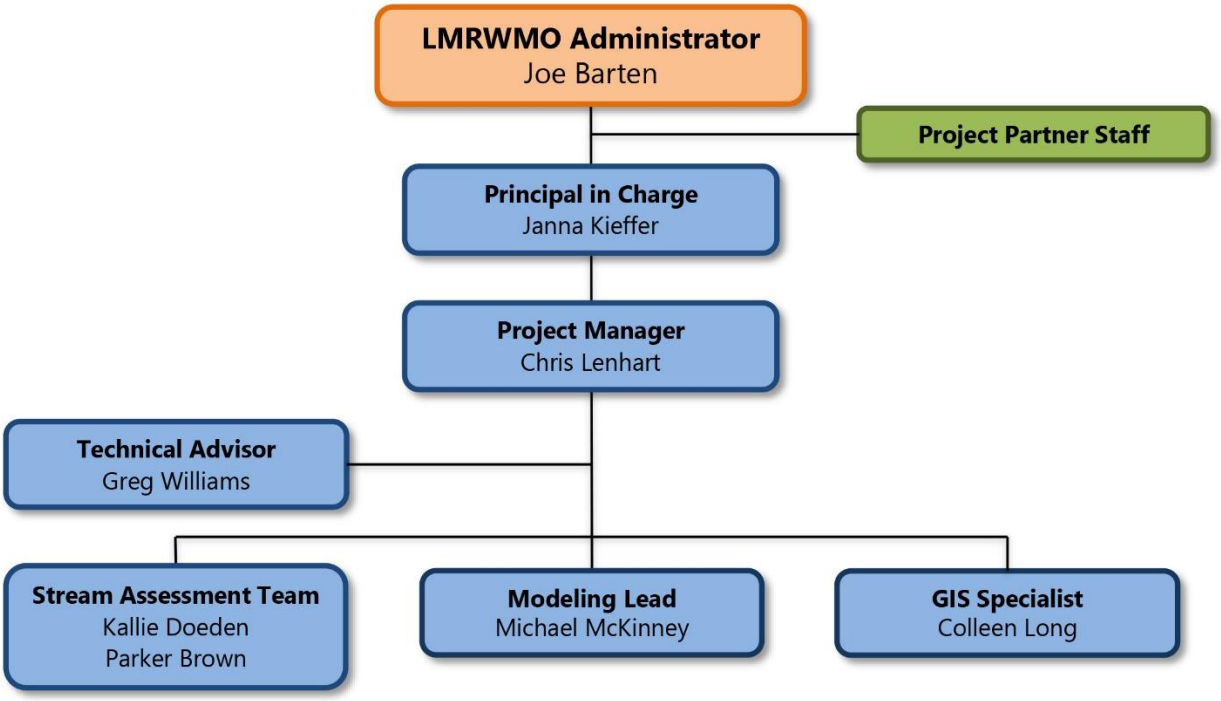
Our familiarity with your organization and your needs
Barr's familiarity with your organization and its goals and objectives will help us deliver a value-conscious project that meets your desired outcomes. Understanding the budget constraints, we have tailored our workplan to focus on providing the highest value for the dollars spent.

Our familiarity with existing modeling will promote efficiency and thorough understanding of the relevant issues.
Barr assisted you in evaluating these watersheds in 2003 and 2006. We are familiar with the topography and land characteristics and associated issues in your watershed and the tools developed to evaluate those issues. We understand the strengths and limitations of those tools. Our knowledge of the watershed and the existing P8 model will allow our team to hit the ground running; we can focus our efforts on efficient, targeted model updates and in-stream assessment. Our project team has experience in leveraging a range of modeling tools (e.g., P8, SWMM) to focus on BMP development, using these tools to understand both the source of the problem and opportunities for solutions.

Analyses with an eye towards cooperative feasibility will help the LMRWMO and its partners implement solutions.
Barr and the LMRMWO have a successful history of turning studies into projects. Barr completed the Cherokee Heights culvert analysis and erosion control feasibility study in 2015, which involved stormwater modeling analysis, evaluation and assessment of erosion issues, geotechnical modeling, and conceptual design of options to reduce peak flows. Following that study, Barr assisted the LMRWMO in securing funding and stabilizing the upper portion of Cherokee Heights ravine to improve water quality and protect Saint Paul parkland and visitors. Following the WRAPS study, Barr assisted the LMRMWO in securing grant funding, then performing in-lake alum treatments to improve the water quality of Lake Augusta and Sunfish Lake. As a joint powers organization, we understand that successful projects are only possible through the collaboration of the LMRWMO and its member cities. Throughout this project, we will work with all members of the project team to develop solutions that are supported by all partners.

Proposer's team

Our project team was selected based on their expertise and availability to assist the LMRWMO with the Interstate Valley Creek stabilization and volume reduction feasibility study. An organization chart showing the interrelationship of team members and key personnel can be found below. Following the org chart, we provided a short write-up on each team member describing their relevant experience and areas of responsibility on this project. Resumes are provided in Attachment A.



Principal in charge

Janna Kieffer, PE

Vice President, Senior Water Resources Engineer

MS, Civil Engineering

Janna Kieffer has over 20 years of water resources management experience and serves as a project manager and technical expert for municipal and watershed management organization clients. Her work includes hydrologic and hydraulic modeling, water quality modeling, lake management studies, best management practice (BMP) performance assessments, engineering feasibility studies, stormwater analyses for low-impact development sites, and preparation of water management plans. Prior to Barr, Janna served on the National Pollutant Discharge Elimination System (NPDES) permitting team at the U.S. Environmental Protection Agency, where she developed surface-water discharge permits.

Project manager

Christian Lenhart, PhD

Senior Water Resources Scientist and Restoration Ecologist

PhD, Water Resources Science (hydrology and water quality focus)

Christian has 22 years of experience in stream restoration design, assessment, and research and has taught at the University of Minnesota for 12 years. He led several studies on erosion processes, hydrologic drivers and restoration solutions for ravine, bluff, and stream bank erosion in the Minnesota River basin. At Barr, he's worked on assessing streams, quantifying sediment sources, and developing management and restoration approaches for creeks and ravines in the Twin Cities metro area. Over the past 10 years, Christian has designed procedures to assess sediment contributions from streambank erosion using the Bank Erosion Hazard Index and developed approaches for prioritizing stream and wetland restoration and management projects. Throughout his career, he has worked with a variety of public and private organizations to develop water quality improvement, restoration strategies, and prioritization tools. Since he joined Barr in 2021, Christian's work has focused on stream and wetland restoration and watershed management.

Technical advisor

Greg Williams, PE

Senior Water Resources Engineer

MSCE, Civil and Environmental Engineering

Greg Williams has 15 years of experience providing water resource services to watershed management organizations, industrial clients, and diverse municipal clients. He specializes in creating storm and surface water management plans (SWMPs) for urban and rural watersheds and incorporating hydrologic and hydraulic (H&H) and water quality modeling. His experience allows him to synthesize input from clients and other stakeholders to find solutions to challenging problems related to hydrology, water quality, and resource management, and the interrelated aspects of those fields. Greg serves as the day-to-day engineer for the LMRWMO and is currently managing the LMRWMO's 2023-2032 Watershed Management Plan update.

Modeling lead

Michael Mckinney, PE

Water Resources Engineer

MS, Environmental Engineering

Michael specializes in hydrologic and hydraulic modeling and water quality modeling. He has more than nine years of experience in best management practice (BMP) design and stormwater infrastructure design and has developed numerous large, calibrated water quality and hydraulic models. Michael has been involved in many prioritization and BMP evaluation studies, using water quality modeling results to prioritize maintenance of existing BMPs and optimize sighting and design of proposed BMPs. He is a proficient researcher and technical writer and has successfully managed many large-scale modeling development projects and feasibility studies.

Stream assessment support

Kallie Doeden
Water Resources Engineer
MS, Civil Engineering (Emphasis: Water Quality in Natural Systems)

Kallie joined Barr in 2018 and has more than eight years of combined experience in engineering consulting and the public sector as well as a background in water resources, stream restoration, stream and bank erosion assessments, water quality, stormwater monitoring, and drinking water. Her projects have involved stream restoration, ravine and stream erosion assessments, water quality issues, hydraulic modeling, and municipal drinking water projects in the public sector. She has conducted inspections to assess erosion in Twin Cities streams and ravines to identify and prioritize future feasibility studies and stream restoration and/or bank stabilization design projects to improve habitat and water quality and protect properties.

Stream assessment support

Parker Brown
Water Resources Engineer
BS, Civil Engineering

Parker joined Barr in 2020 after earning a bachelor's degree in civil engineering from the University of Minnesota. His undergraduate projects included conducting a feasibility study and implementing best management practices for Minnehaha Creek in Minneapolis as well as developing a conceptual design for restoration of Waller Creek in Austin, Texas. At Barr, Parker frequently contributes to projects involving civil engineering and hydrologic and hydraulic analysis, including BMP design, stormwater modeling, and water quality modeling.

GIS specialist

Colleen Long
GIS Specialist
MS, Geological Sciences

Colleen Long joined Barr in 2019 with seven years of experience in environmental science, geology, and geographic information systems (GIS). She is well versed in a wide range of geospatial analysis and data management and is adept at creating polished final products in ArcMap. She has provided GIS support and generated maps and figures for a wide range of projects at Barr, included watershed management plans, wetland delineation reports, and other environmental investigations. Prior to joining Barr, Colleen worked as a research assistant for watershed modeling studies at the University of Michigan Water Center.

Qualifications and experience

Below we have identified similar projects undertaken by the Barr team within the last five years and documented the team members' actual responsibility on each project. For each project, we also provided contact information for the client who is familiar with our key personnel and their work.

Bluff Creek restoration feasibility study

Client: Riley Purgatory Bluff Creek Watershed District (RPBCWD)

The RPBCWD identified a reach in the headwaters of Bluff Creek as a high priority for restoration using Barr's Creek Restoration Action Strategy (CRAS). After conducting a geomorphic survey, collected water quality data in the stream reach, and identified problems, including stream entrenchment, bank erosion, gully erosion from the side valley slopes, culvert outlet erosion, sedimentation of the streambed, and poor in-stream water quality (shallow depth and high phosphorus), RPBCWD retained Barr to provide hydrologic and geomorphic assessment of the reach to determine the feasibility of conducting stream restoration or watershed management actions to address the in-stream degradation.

The feasibility study used stream geomorphic assessment in the field as well as an abbreviated form of the Stream Quantification Tool (SQT) used to estimate the benefits of stream mitigation projects in Minnesota. The hydrologic model, SWMMM, was used to predict in-stream flow events, including the bankfull discharge in Bluff Creek used for analysis and design. The P8 model and the Wetland Restoration Effectiveness Tool (WRET) were used to estimate phosphorus loading and the potential hydrologic and nutrient removal benefits of restoring a drained wetland just upstream of the study reach.

Other project components included cost estimation of restoration practices, analysis of existing streamflow and water quality data, review of historic aerial photos and site plans, and assessment of gully erosion off the valley boundary of the creek near a housing development.

Barr staff recommended a combination of gully erosion control, streambank stabilization, rock riffles to control bed erosion and re-connect the channel to its floodplain, and further investigation of wetland restoration in the headwaters to reduce flow and phosphorus loading to Bluff Creek.

Chris Lenhart served as project scientist and provided construction observation and project reporting.

Reference: *Terry Jeffery, Interim District Administrator, 952-807-6885*

Watershed-wide solutions for channel and slope stabilization in Saint Paul

Client: City of Saint Paul, the LMRWMO, and Ramsey County

In 2013 and 2014, large landslides occurred in Lilydale Regional Park in Saint Paul. The park, overlooking the Mississippi River, contains steep bluffs, intermittent streams and seeps, and ravines that convey stormwater from the upstream residential watershed down to Pickerel Lake and the river. As a result of the landslides, the City of Saint Paul and the LMRWMO undertook a series of studies to address slope stability concerns within the park and to evaluate stormwater management improvements in the park and upstream residential watershed. Given that the lake and river are impaired waters, water quality was also an important consideration in evaluating improvements throughout the watershed. Barr conducted the studies and developed recommendations to stabilize the slopes and channels to improve safety, minimize erosion, and reduce pollutant loading from the watershed.

Upon completion of the feasibility studies, Barr worked closely with project partners to secure funding for the project; partners included the LMRWMO; the cities of St. Paul, West St. Paul, and Mendota Heights; Ramsey County, and State and Federal agencies.

The study recommendations ultimately resulted in several construction projects to install hydrodynamic separators in the upstream watershed and stabilize slopes and ravines to improve safety in the park and improve the water quality of the downstream impaired waters. Barr provided design services and construction oversight for these projects. Construction activities concluded in late 2019. Portions of the park have been reopened to visitors and sediment loading has significantly decreased.

For this project, Janna Kieffer served as project manager for one of the initial feasibility studies, assisted with pursuing grant funding, and served as a technical resource throughout the study and design process.

Reference: *Alice Messer, Design and Construction Manager, St. Paul Parks and Recreation, 651-266-6412*

Northern Columbia Heights, Fridley, and Hilltop H&H and water quality modeling and calibration
Client: Mississippi Watershed Management Organization

The MWMO hired Barr to develop H&H and water quality models for a 2,300-acre watershed spanning portions of Columbia Heights, Fridley, and Hilltop. We developed a high-resolution model of surface hydrology and the storm sewer utility network and calibrated the model using pipe monitoring data collected by the MWMO as well as NEXRAD rainfall data adjusted using a network of rainfall monitoring gauges surrounding the watershed, which included several small lakes. After successfully calibrating the model, Barr developed detailed inundation, impacted structure, and pipe capacity mapping for a variety of design events, which will be used to guide and prioritize future capital improvement projects. Using the calibrated H&H model, we developed P8 water quality models to evaluate pollutant loading and the effectiveness of water quality BMPs throughout the watershed. Using results from the P8 models validated to calibrated H&H results, we developed detailed mapping of watershed and effective pollutant loading to help prioritize and target areas within the watershed for future BMP implementation and water quality improvements.

Michael McKinney served as the modeling lead on this project, focusing on calibrated H&H models and P8 water quality models.

Reference: *Stephanie Johnson, former Director of Surface Water and Sewers at City of Minneapolis (now employed at Barr), 952-842-3766*

Richfield citywide water quality modeling

Client: City of Richfield

The City of Richfield (city) requested assistance with development of a citywide water quality model. The key objectives for water quality development were to (a) evaluate the performance of existing water quality BMPs and (b) evaluate pollutant discharge loading related to regulatory requirements (e.g., TMDL, SWPPP, and Minnehaha Creek Watershed Deistic Plan requirements).

Barr worked with the city to review exiting stormwater and BMP information and proposed a plan to develop citywide water quality models using two unique models: P8 and the Barr-developed, GIS-based water quality model (GIS WQM). The P8 model was developed for the purposed of regulatory compliance review, and the GIS WQM model was developed for rapid evaluation of BMP alternatives and as a water quality asset-management program. The water quality models were validated to water quality monitoring data collected at key locations throughout the city and were used for evaluating BMP performance, effective pollutant loading, and TMDL compliance.

In a follow up project completed in 2021, Barr used the water quality models for a variety of applications, including:

- Evaluation of pond performance of all ponds and wetland throughout the city. Results were used to develop a pond maintenance prioritization list.
- Development of a street sweeping prioritization strategy. Results from the GIS WQM were used to evaluate and prioritize street sweeping operations throughout the city.
- TMDL compliance modeling. Barr assisted the city in evaluating and tracking TMDL compliance for MS4 Part 2 Permit application reporting. This included evaluating pollutant loading and evaluating BMP implantation alternatives and compliance schedule for non-compliant TMDLs.

Michael Mckinney served as the project manager on this project. He led development of municipality-wide P8 and GIS WQM modeling as well as BMP implementation optimization evaluations.

***References**: Jordan Vennes, Public Works Water Resources Engineer, 612-861-9797*

Shell Rock River restoration
Client: Shell Rock River Watershed District

The Shell Rock River Watershed District (SRRWD) received a grant to restore river habitat and stabilize eroding banks in the headwaters of the Shell Rock River through the Juglans Woods Aquatic Management Area (AMA) and the Panicum Prairie Wildlife Management Area (WMA). Shell Rock River had become too wide and shallow, providing poor fish habitat with minimal pool depth and high summer water temperatures. The Minnesota Department of Natural Resources (MNDNR) conducted a geomorphic review of the reaches and proposed preliminary natural restoration options to restore the channel plan form and improve habitat conditions within the stream. SRRWD retained Barr to provide engineering design, geomorphic assessment, and construction administration. We worked closely with the SRRWD and MNDNR throughout the project to achieve the desired outcomes and address unexpected changes to keep the project on track.

The designs used natural channel design, fluvial geomorphology, hydrology, and ecological engineering principles to restore river functions. As part of their innovative approach, the team worked with natural river processes by placing rows of permeable dikes (wooden posts) placed vertically in the inner river bends to promote sandbar growth and deepen the river in the middle. Other project features included restoring appropriate bankfull width; adding wood for fish and invertebrate habitat; increasing depth for pool habitat; improving water quality through reduced sediment load and water temperature; and maintaining safety for outdoor recreationists. Our services included reviewing site conditions, preparing site plans, permitting, developing engineering drawings and technical specifications for construction bidding, and observing construction.

The project followed the Society for Ecological Restoration's Restoration Principles by engaging stakeholders and involving multiple disciplines, including landscape architecture, engineering, aquatic ecology, and fisheries science. It aimed for the highest extent of restoration achievable and established measurable goals in terms of river width and quantity of large wood placed in the river. At a land-scale level, it helped improve the function of an aquatic ecological corridor from Albert Lea Lake through two public aquatic management areas. Project construction began in winter 2021 and was completed in March 2022. Continued monitoring will begin in 2022 to assess project success.

Christian Lenhart provided construction observation, worked on implementing the restoration, and assisted with project reporting.

Reference: *Jon Lore, Clean Water Specialist, (507) 389-8804*

Work plan and budget for scope of services

Project Understanding

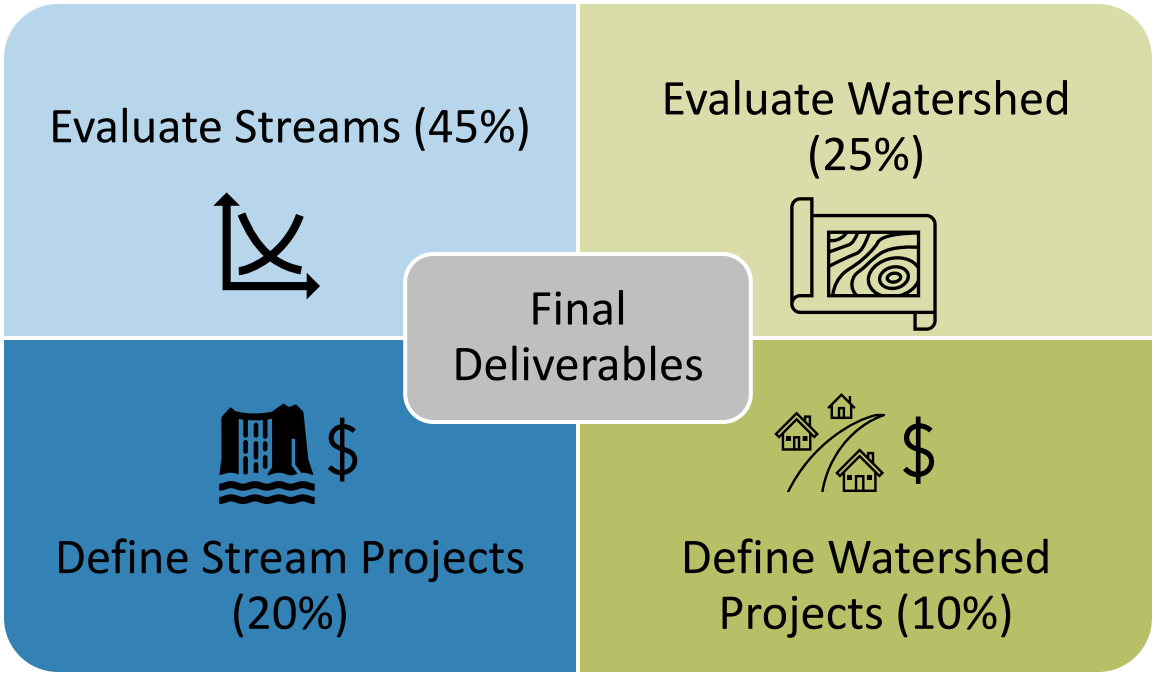
The LMRWMO seeks assistance in identifying and evaluating stabilization and volume reduction opportunities within the Interstate Valley Creek watershed. Interstate Valley Creek was identified as a high priority resource during the LMRWMO's current watershed management plan update. It contributes sediment and nutrient loads to the Mississippi River and is listed as impaired for *Escherichia coli*.

The Interstate Valley Creek watershed was a focus of several studies in the early 2000s. Barr's 2003 *Water Quality Modeling Study – Ivy Falls Creek, Interstate Valley Creek, and Highway 13 Watersheds* focused on phosphorus loading. The 2003 study used a P8 water quality model (version 2.4) to evaluate performance of existing Best Management Practices (BMPs) and evaluated opportunities for BMP additions or modifications to further reduce phosphorus loading. A 2006 Barr study of Marie Creek used an XP-SWMM hydrologic and hydraulic model to evaluate baseflow conditions and potential BMPs designed to augment baseflow conditions.

We understand that there is renewed interest in constructing improvements in the Interstate Valley Creek watershed and that potential funding exists via the Board of Water and Soil Resource's Watershed Based Implementation Funding (WBIF). The LMRWMO and member cities seek prioritized, targeted project opportunities to take advantage of this funding to improve the health of this resource and reduce pollutant loading to the Mississippi River. We understand a goal of this project is to provide a list of such projects, defined as far as the project budget allows, to expedite future implementation.

Much of the knowledge gained from past studies is still applicable as land use conditions are relatively unchanged. Physical conditions of the stream channel, however, have likely been impacted by the wettest decade on record (2011-2020) and high intensity storms. The stream is very steep, dropping over 150 feet in elevation over one mile, so it is likely sensitive to flow changes. Thus, evaluation of current stream conditions is a high priority for this project. We understand that similar assessment of Marie Creek and Wentworth Creek, although desirable, is considered as an alternate task for this project. We recommend including analysis of those tributaries as part of this project to minimize incremental cost and provide a comprehensive assessment that is consistent throughout the study area.

We understand that comprehensive analyses of this watershed incorporating detailed water quality, hydrologic, and hydraulic modeling and feasibility-level definition of proposed projects could exceed the available project budget. To achieve project objectives while maximizing the benefit of available funds, we recommend balancing project resources between the following major project elements (shown conceptually):



We understand that this project is funded largely through WBIF, which must be expended by the end of 2022. Our project schedule is designed to maximize partner participation while meeting the target completion date. Our proposed scope is described in greater detail in the following sections.

Description of the methods

Task 1 – review existing data and plans

Barr's project manager and key project staff will attend a project kickoff meeting with the LMRWMO administrator and project partner staff. We assume the City of Mendota Heights may wish to host the kickoff meeting to facilitate partner attendance; we are happy to provide meeting facilities if requested. In preparation of the kickoff meeting, Barr staff will compile known available information, including:

- 2003 Water Quality Study and associated P8 model
- 2006 Marie Creek Baseflow Study
- City of Mendota Heights Local Water Management Plan
- City of Mendota Heights HydroCAD model
- Publicly available GIS layers (e.g., land use, topography)

At the kickoff meeting, we will work with the project partners to identify and evaluate available data sources and known data gaps and limitations. We will also confirm project goals, project partner roles, and other information to promote project success. Following the kickoff meeting, Barr staff will review additionally provided data and source information necessary to complete tasks 2 through 5. Information

to be requested from the project partners will include storm sewer utility information (GIS), and information on major BMPs and/or developments constructed since the 2003 study.

Task 2 – assessment of Interstate Valley Creek erosion

Interstate Valley Creek, a small tributary to the Mississippi River, delivers a substantial load of sediment and phosphorus to the Mississippi River. The creek drops 150 feet over about one mile as it drops into the Mississippi River valley, which is a very steep gradient, prone to ravine and streambank erosion. Since the main source of sediment in the watershed is likely from channel erosion, we will devthe most time to this task. The assessment will involve desktop analyses, field inspection of ravines, and measurement of factors contributing to streambank erosion using the Bank Erosion Hazard Index (BEHI). First, we will conduct a GIS analysis with Lidar and other tools to identify steep terrain with slopes adjacent to the creek or its valley sides, focusing on the lower part of the creek. The surface area of ravine walls or bluffs will be measured in square meters per 500 meters of stream length. This will be used to assess erosion potential on slopes greater than four meters high, which are likely slumping or at risk of collapsing. Erosion rates will be estimated by taking the bluff surface and multiplying that by values from ravine erosion studies done in the Minnesota River basin (Gran et al. 2011).

Next, we'll conduct field inspections to verify steep sites, to assess the status of erosion, and determine the processes (for example, gravity-driven collapse vs. fluvial erosion). We'll also assess hydrologic derivers of erosion to determine whether it's surface runoff or groundwater driving erosion, looking for flow pathways, gullies, and indicators of groundwater seepage along ravines or bluff walls.

In reaches of the creek with smaller bank heights less than four meters, we will assess erosion potential using the BEHI-BANCS method. First, we will use aerial photos and Lidar to assess typical bank height and width and identify areas that are actively laterally eroding by comparing photos taken at different time periods. We'll use the Minnesota DNR Regional Curves to obtain an estimate of bankfull dimensions for streams of similar size in eastern Minnesota. Then, we'll select a subset of 10–20 bank study sites and go out and collect data on those sites (such as channel width, bed material, bank height, bank angle, vegetative cover, root depth and density). We'll also estimate near bank shear stress (NBS) to predict lateral erosion rates using the BEHI-BANCS equations.

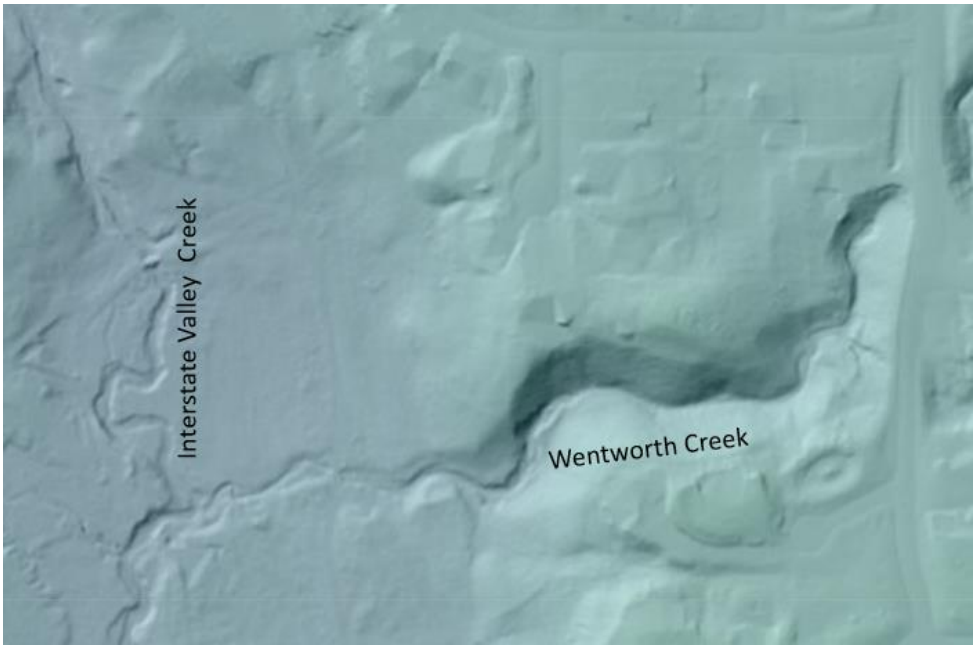
The collected data will be used to categorize erosion rates by stream characteristics and predict erosion rates from non-surveyed sites of similar stream dimensions and slope. We will then use BEHI-BANCS erosion equations from the region or use a similar streambank erosion tool created by Barr called the Creek Restoration Assessment Strategy (CRAS). The CRAS uses erosion rates from the western Twin Cities metro area and is likely similar to those rates seen in Interstate Valley Creek.

The Lidar and BEHI-BANCS estimates will be used to determine which reaches of streams are contributing the most sediment to Interstate Valley Creek. This information is then used to target more focused hydrologic investigation or modeling in certain sub-reaches where the most channel erosion is occurring. Management practices to reduce flow or stabilize the ravines or streambanks will be identified at a high level or concept level. In-stream stabilization; natural channel design; and practices such as installation of cross vanes or toewood, and channel relocation away from ravine walls would be considered. We'll also examine the feasibility of upland storage ponds or hydrologic practices to reduce flow into highly erosive

channel reaches, particularly where the watersheds are small enough for a newly installed BMP to substantially reduce flow.

Task 3 – [optional] assessment of Interstate Valley Creek tributaries

If this optional task is selected, the tributaries to Interstate Valley Creek will be assessed using aerial photos and Lidar. If the tributaries are assessed, we suggest focusing the assessment on the lower portion of Wentworth Creek since it flows through a ravine that is over 50 feet deep near its mouth. Although it is forested, it has very high potential for erosion because of its steep side slopes. The same procedure proposed for the mainstem of Interstate Valley Creek, will be used for the tributaries only it will focus on a much smaller reach of about 300–400 meters, as shown below. We will conduct a field investigation of this site to assess the erosion activity, vegetation cover on ravine walls, and indicators of gullies or active groundwater input causing slumpage.



Task 4 – watershed analysis study to identify volume reduction BMPs

As part of this project, the LMRWMO seeks to assess the watershed hydrology through updated watershed modeling. While a detailed H&H model such as XP-SWMM would provide valuable information on peak flows and velocities to and throughout Interstate Valley Creek, inclusion of development of this type of model is beyond the available budget for this project. Instead, we are recommending that we use the watershed modeling developed by Barr in 2003 for the LMRWMO. In 2003, Barr developed a detailed P8 watershed and water quality model of the Interstate Valley Creek and nearby watersheds. In addition to model development, a focus of this study was to evaluate and recommend structural and non-structural BMPs to reduce sediment and nutrient (e.g., total phosphorus) loading to the Mississippi River. Since completion of the study, nearly 20 years of development has occurred within the watershed, including major land use change, storm sewer reconstruction, and BMP implementation.

To achieve model development and BMP implementation goals outlined in the project approach, Barr will update the 2003 P8 models within the Interstate Valley Creek watershed to reflect best available land use datasets, changes in storm sewer routing, and significant BMPs implemented within the watershed since 2003. Based on Barr's familiarity with the 2003 P8 models, it is unlikely that major changes to the P8 model (e.g., revaluation of all subwatershed divides, re-evaluation of all existing BMPs inputs) will be necessary. Instead, Barr will review best available datasets and make necessary major updates to the model to best-reflect modern conditions within the watershed, including a model-wide update of watershed input parameters and incorporation of new and significantly reconstructed BMPs within the watershed. Barr has extensive experience updating legacy P8 models, including tools used to automate the conversion from DOS-based versions of P8 to modern version (i.e., P8 version 3.5). This update will greatly enhance model usability for LMRMWO and project partners for this and future water quality modeling efforts within the watershed.

Using the updated Barr P8 models, we will sight and evaluate four to six significant (i.e., large scale) BMPs within the watershed for existing and future land use conditions. The goals of BMP implementation will be to (a) reduce runoff volume and rate discharged to Interstate Valley Creek and its tributaries and (b) reduce sediment, total phosphorus, and E. coli loading discharged to the stream and receiving waterbodies. Proposed BMP concepts may overlap and/or interact with stabilization concepts explored in task 2. Barr will develop planning-level cost estimates for each BMP, consider secondary benefits (e.g., habitat benefit, increasing aquifer recharge, and stream baseflow) and implementation challenges (e.g., permitting, tree loss, and park and private property impacts), and use results to develop a priority ranking for each BMP concept. We anticipate the updated P8 models will be sufficient for evaluating all concept BMPs. If more detailed hydraulic evaluation is needed, it is assumed that the City of Mendota Heights 2018 Interstate Valley Creek HydroCAD model will be available for use.

Task 5 – final deliverables

Following the completion of tasks 1 through 4, Barr will prepare a report in electronic format documenting project results. The report will describe the specific analyses performed and provide results in narrative, tables, figures, and maps, as appropriate. The report will be provided to the LMRWMO administrator for one review and edit cycle (note that preliminary results of other tasks will be shared with the project partners as those tasks are completed).

Electronic files will be provided to the LMRWMO and project partners, as requested. GIS data developed as part of the project will be provided to project partners as a geodatabase. Watershed model(s) developed or updated as part of the project will also be made available to the project partners.

Following completion of final deliverables, Barr staff will present the results of the project at a regularly scheduled LMRWMO board meeting, if desired.

Project schedule

We understand that the project needs to be completed by November 30, 2022, to allow sufficient time for administration of the grant that is funding most of this project. The following schedule has been developed with this in mind. Our project scope includes coordinating with project partners to review interim results; timely cooperation from project partners will be necessary to maintain this schedule.

task		est. completion date
1.	Review Existing Data and Plans	May – June 2022
2.	Assessment of Interstate Valley Creek Erosion	June – September 2022
3.	(alternate) Assessment of Interstate Valley Creek Tributaries	July – August 2022
4.	Watershed Analysis Study to Identify BMPs	July – September
5.	Final Deliverables	October – November 2022
6.	Presentation to LMRWMO Board of Managers (if requested)	December 2022

Detailed budget

We understand that the total project budget is based in part on available WBIF grant funds. Our proposed scope, omitting alternate task 3, is developed to fit within that budget and carries an estimated cost of **$75,000**. If additional funding is available from the LMRWMO plan implementation fund, additional partner funds, or other sources, we recommend that the project scope and budget be expanded to include alternate task 3; the incremental cost to perform this task in coordination with task 2 is smaller than the standalone cost to perform this work later. A detailed breakdown of staff hours by task is provided as Attachment B.

task		estimated hours	labor subtotal	expenses	total cost
1.	Review Existing Data and Plans	48	$ 6,680	$0	$ 6,680
2.	Assessment of Interstate Valley Creek Erosion	253	$32,550	$0	$32,550
2a.	Subtask – Desktop Analysis	63	$8,138	-	- Included in task 2
2b.	Subtask – Field Assessment of Stream	127	$16,275	-	- Included in task 2
2c.	Subtask – BMP Evaluation	63	$8,137	-	- Included in task 2
3.	(Optional) Assessment of Interstate Valley Creek Tributaries	127	$16,275	$0	$16,275
4.	Watershed Analysis Study to Identify BMPs	193	$24,145	$0	$24,145
5.	Final Deliverables	81	$11,625	$0	$11,625
	total without optional task 3 **total with optional task 3**	**603** **744**	**$75,000** **$91,275**	**$0** **$0**	**$75,000** **$91,275**

Conflict of interest

Barr Engineering Co. has no known potential conflict of interests providing the services contemplated by the RFP.

Attachment A:
Resumes

JANNA KIEFFER, PE
Vice President, Senior Water Resources Engineer

Experience

Janna Kieffer has over 20 years of water resources management experience and serves as a client lead, project manager, and technical expert for municipal and watershed management organization clients. Her work includes hydrologic and hydraulic modeling, flood risk reduction studies, water quality modeling, lake management studies, best management practice (BMP) performance assessments, engineering feasibility studies, stormwater analyses for development sites, and water resource permitting, as well as preparing watershed management plans. Prior to coming to Barr, she served on the National Pollutant Discharge Elimination System (NPDES) permitting team at the U.S. Environmental Protection Agency, Region 8, where she developed surface water discharge permits. Janna's project experience includes:

- Overseeing a flood risk and resiliency study for the Nine Mile Creek Watershed District, including updating the detailed hydrologic and hydraulic model for a 50-square mile watershed, calibrating the model to observed creek flows, determining flood elevations using Atlas 14 precipitation frequency estimates, evaluating potential flood impacts, and preparing flood damage cost estimates.
- Conducting city-wide hydrologic and hydraulic modeling for the cities of Edina and Bloomington based on NOAA Atlas 14 precipitation frequency estimates. Analyses included XP-SWMM modeling, flood inundation mapping for multiple rainfall depth scenarios, identification of storm sewer system capacity restrictions, and assistance with developing flood reduction and management strategies.
- Overseeing a hydrologic and hydraulic modeling analysis of the Nine Mile Creek, Purgatory Creek, and Bassett Creek watersheds within the city of Minnetonka, including updating the XP-SWMM models, simulating flood conditions based on updated NOAA Atlas 14 precipitation frequency estimates, determining 100-year flood elevations, identifying flood risk, and evaluating future infrastructure improvements to reduce flood impacts.
- Developing a Climate Change Vulnerability Assessment for Hennepin County, including mapping and data analysis to identify key vulnerabilities to residents, county operations, buildings, energy systems, transportation infrastructure, and natural resources. The assessment included focus on social vulnerability factors.
- Developing a detailed XP-SWMM hydrologic and hydraulic model of the Minnehaha Creek watershed within the city of Minnetonka, including conducting model calibration, simulating flood conditions based on updated NOAA Atlas 14 precipitation frequency estimates, determining 100-year flood elevations, identifying flood risk, and evaluating future infrastructure improvements to reduce flood impacts.
- Serving as lead engineer for the Nine Mile Creek Watershed District, which includes overseeing technical assistance related to implementation of the regulatory program, lake and stream monitoring and data analysis, water quality studies, flood management, engineering feasibility studies, design and construction administration of capital improvement projects, watershed management planning, and other day-to-day watershed management activities.

- Overseeing a flood modeling and flood risk analysis in the Gleason Lake watershed in the City of Plymouth, including development of a hydrologic and hydraulic model, identification and mapping of flood elevations and potentially impacted structures, and evaluation of planning-level flood mitigation options.
- Conducting feasibility studies for several flood-prone areas in the City of Edina, including conducting detailed XP-SWMM modeling, evaluating improvement alternatives, and mapping flood risk.
- Overseeing development of the City of Minnetonka's 2021 Water Resource Management Plan. Work included updating the city's policies, stormwater treatment design standards, and other plan components to meet the requirements of the Nine Mile Creek and Minnehaha Creek Watershed Districts.
- Providing stormwater management services to the City of Edina, including developing a comprehensive water resources management plan and subsequent update, developing and utilizing XP-SWMM stormwater hydrology and hydraulics models to identify and improve flooding issues, conducting P8 water-quality modeling, and providing Federal Emergency Management Agency review and appeal support.
- Developing a comprehensive XP-SWMM model of the Nine Mile Creek watershed for the Nine Mile Creek Watershed District. Work included collecting detailed hydrologic and storm sewer data from the cities of Hopkins, Bloomington, Edina, and Eden Prairie; compiling data into GIS; and conducting hydrologic and hydraulic modeling using XP-SWMM.
- Developing the Nine Mile Creek Watershed District's fourth-generation watershed management plan.
- Preparing a regional stormwater volume reduction plan for the Centennial Lakes area in Edina, including development of concept-level infiltration system designs, stormwater modeling to quantify benefits, and completion of a cost/benefit analysis.
- Conducting a storm sewer failure risk analysis for the City of Minnetonka to identify pipes with the greatest failure risk, including likelihood and consequences, and prioritize future inspections and replacement.
- Overseeing development of a subwatershed assessment for the City of Minnetonka to identify opportunities to install stormwater practices to improve water quality in downstream lakes and wetlands.
- Securing funding for, planning, and facilitating a series of climate change adaptation and community resilience workshops with several communities within the Nine Mile Creek Watershed District in Minnesota.
- Serving as a key team member of the Minimal Impact Design Standards (MIDS) project team for the Minnesota Pollution Control Agency, including conducting a continuous hydrologic modeling analysis to support development of stormwater volume control standards, developing volume and pollutant crediting approaches for the MIDS calculator, preparing a memoranda and report, and presenting information at MIDS stakeholder work group meetings.

- Overseeing the Investigation of Stormwater Low Impact Development (LID) Installations project for the City of Calgary, including inspection, sampling, and analysis of 30 LID practices (bioretention areas, bioswales, and soil cells). The investigation also included development of an inspection scoring system, data analysis, and development of recommendations for improved performance of LID practices in Calgary.
- Managing a culvert analysis and erosion control feasibility study of a steep ravine area in Saint Paul for the Lower Mississippi River Watershed Management Organization, which included stormwater modeling, slope stability analysis, alternatives analysis, and facilitation of stakeholder participation.
- Serving as the lead engineer for the Lower Mississippi River Watershed Management Organization, including attending monthly meetings, overseeing engineering feasibility studies, conducting water quality studies, assisting with watershed management planning, and advising on watershed management activities.
- Preparing grant applications and successfully securing funding for several clients, including the Shell Rock River Watershed District, City of Minnetonka, and Lower Mississippi River Watershed Management Organization.
- Managing development of annual water quality monitoring reports for the Shell Rock River Watershed District.
- Overseeing the annual water quality monitoring program for the City of Minnetonka, including preparing annual water quality monitoring reports.
- Preparing contract documents for the Nine Mile Creek stream restoration project in Edina, Minnesota.
- Conducting stakeholder involvement for a Watershed Restoration and Protection Strategy (WRAPS) and total maximum daily load (TMDL) for the Lower Mississippi River Watershed Management Organization, including development of a resident survey and facilitation of meetings with citizens and technical stakeholders.
- Conducting water quality studies for several lakes in the Nine Mile Creek Watershed District, including Mirror Lake and Lake Cornelia in Edina, Normandale Lake in Bloomington, and the Holiday-Wing-Rose Chain of Lakes in Minnetonka. Work included performing water quality modeling and analyses, evaluating Best Management Practices (BMPs), developing cost estimates, developing lake management recommendations, and stakeholder involvement with affected municipalities and residents.
- Managing the development of a pond inventory and maintenance program for the City of Minnetonka. Project work included identifying stormwater ponds to be maintained by the city in GIS, assessing sedimentation in selected stormwater ponds, and identifying and prioritizing future maintenance activities for these stormwater ponds.
- Managing pond sediment assessments for the City of Brooklyn Center to determine if sediment contamination was present and to document sediment re-use options.

- Completing model development, calibration, and stormwater management feasibility studies for the Airport South area in the City of Bloomington, including evaluating the system-wide impacts of significantly lowering Lindau Lane near the Mall of America.
- Developing portions of the City of Minnetonka's 2008 local water management plan. Work included updating the city's stormwater treatment design standards to comply with those of the four involved watershed management organizations. Work also included developing a phosphorus loading reduction strategy to meet the requirements of the Minnehaha Creek Watershed District.
- Developing an impervious analysis for the City of Minnetonka, assessing the state of imperviousness for land uses within the city to help with ordinance development.
- Completing nondegradation loading assessments and reports for the cities of Edina and Minnetonka to satisfy the MPCA's NPDES permit requirements. Work included quantifying the loading reductions from past and future BMPs using P8.
- Performing diagnostic-feasibility studies for Earley and Twin Lakes and Wood Pond in Burnsville, MN. The studies are based on historical water quality data, the results of an intensive lake water quality monitoring program, and P8 computer simulations of existing and future land use conditions using lake and watershed models calibrated to the data set. The studies include various water quality components as well as macrophyte and fisheries evaluations. Using all of these data, remedial measures (BMPs) are prescribed to achieve the water quality goals established for the water bodies (either in-lake total phosphorus concentration or Secchi disc transparency).
- Completing a water quality modeling analysis of the Burnsville Center and surrounding watershed using P8 to evaluate and compare the pollutant removal effectiveness of several proposed BMP retrofit scenarios.
- Conducting stormwater management development reviews for the cities of Edina and Minnetonka, Minnesota and Nine Mile Creek Watershed District.
- Performing a hydrologic and hydraulic study for the north industrial stormwater system for the City of Mankato. Work included revisions to the city's stormwater management plan to account for future land-use conditions and XP-SWMM modeling to optimize the storm-sewer system and alleviate area flooding.
- Writing Ramsey-Washington Metro Watershed District's third-generation watershed management plan. Work included developing a strategic plan that highlights the district's goals, accomplishments, and future priorities and a resource inventory that summarizes the district's resources and future plans on a subwatershed basis.
- Performing a stormwater analysis for a low-impact development on a trout stream in the City of Winona. Work included hydrologic and hydraulic modeling to ensure that the stormwater treatment design was in compliance with NPDES requirements.

Education MS, Civil Engineering, Mississippi State University, 2002

BS, Engineering, Civil Specialty, Colorado School of Mines, 1998

Registration Professional Engineer: Minnesota, Michigan

CHRISTIAN F. LENHART, PhD
Senior Water Resources Scientist and Restoration Ecologist

Experience

Christian has 22 years of experience in stream restoration design, research, and regulatory review and has taught in the areas of ecological restoration, erosion control, and ecological engineering design. He has helped obtain more than $1.7 million in grants and contracts involving the assessment, design, monitoring, and implementation of restoration projects and agricultural best management practices (BMPs), including buffers, bioreactors, treatment wetlands, and bioreactors.

In the past 10 years, Christian has designed procedures to assess sediment contributions from streambank erosion in the upper Midwest and developed approaches for prioritizing stream and wetland restoration and management projects. Throughout his career, he has worked with many public and private organizations to develop water quality improvement and restoration strategies.

At Barr, Christian contributes to projects involving water quality management and stream and wetland restoration. Specifically, his work includes:

- Assessing causes of stream instability and sediment loading rates from stream erosion.
- Conducting water quality analyses in urban and rural settings, primarily for sediment, phosphorus, and nitrogen treatment.
- Assessing stream and wetland sites for restoration design and prioritization of projects.
- Estimating ecological services of alternative land uses and management practices.
- Completing hydrologic analysis for stormwater and watershed management planning.
- Supervising project teams involved in hydrologic and geomorphic assessment, stream restoration planning, and the assessment of BMP performance.
- Preparing plans, specifications, and technical reports for wetland and stream projects.
- Working with permitting agencies and public officials.

Prior to Barr, Christian was a research assistant professor in the University of Minnesota's Bioproducts and Biosystems Engineering Department and still has a 20% appointment. In this role, his research and design experience has included:

- Designing, building, and monitoring treatment wetlands in Minnesota.
- Designing and assessing two-stage ditches for local government units.
- Teaching classes on ecological engineering, including treatment wetland design.
- Developing guidance on culvert design for fish and aquatic life passage at road crossings for the Minnesota Department of Transportation (MnDOT).
- Working with the University of Cuenca, Ecuador, to assess potential impacts of a metal mine on high Paramo wetlands, a sensitive high-mountain environment. Provided training on the use and design of treatment wetlands for water quality improvement.
- Guiding students on the design of rain gardens, agricultural and water quality BMPs, and stream restoration.

- Developing a tool for MnDOT to assess the benefits of riparian buffers for wetlands.
- Providing a cost assessment to MnDOT of alternative culvert designs for fish passage.
- Leading numerous workshops on erosion control, stormwater pollution prevention plans (SWPPPs), and sedimentation control BMPs for contractors and agencies.
- Conducting hydrologic analysis and providing concept design for an alternative ditch project in southern Minnesota to enhance nutrient removal and address flooding.
- Assessing a bioreactor for agricultural drainage water treatment for the Martin County Soil and Water Conservation District (SWCD). Results were submitted to the Minnesota Department of Agriculture.
- Assessing bluff erosion along the Poplar River in northeastern Minnesota for the Minnesota Pollution Control Agency (MPCA).

As a restoration scientist with Minnesota, South Dakota, and North Dakota chapters of The Nature Conservancy, Christian's work involved:

- Developing watershed-scale freshwater restoration strategies for the purposes of nutrient load reduction and biodiversity protection and enhancement, including:
  - Leading the creation of a wetland restoration effectiveness tool (WRET) to predict the removal of nitrogen and phosphorus, plus carbon storage benefits provided by restored wetlands.
  - Overseeing the development of a strategy to restore peatlands in Minnesota.
- Planning and designing wetland stream restoration projects, including floodplain reconnection and fen restoration in Minnesota. Specific projects consisted of:
  - Contributing to the design and leading the assessment of fen and floodplain restoration in Cold Spring.
  - Designing and managing the construction of small oxbow restoration projects.
  - Contributing to the assessment, design, and planning of a large river re-meandering project on the Rum River, led by the Minnesota Department of Natural Resources (DNR) and Isanti SWCD.
  - Helping assess the restoration of a beaver dam analog on a small creek in northeastern Minnesota.
- Generating strategies for floodplain and wetland restoration throughout Minnesota and the Dakotas, with the goal of protecting water quality in targeted areas.
- Developing a strategy for reducing nonpoint source pollution to the upper Mississippi River basin, focusing on watersheds at risk for development or conversion to agriculture.
- Creating a management guide for small prairie streams in South Dakota that have been impacted by grazing. The guide was developed for the U.S. Department of Agriculture's Natural Resources Conservation Service through a Collaborative Conservation Grant.

Christian also served as hydrologist and geomorphology expert for total maximum daily load (TMDL) studies at an engineering and environmental consulting company. His projects included:

- Providing sediment transport assessment and design specifications for the Rice Creek re-meander project for the Rice Creek Watershed District.
- Assessing the geomorphology of Long Lake Creek and providing restoration alternatives to the Minnehaha Creek Watershed District.
- Analyzing grazing impacts on streams in the Dakota National Grasslands for the U.S. Forest Service using the Proper Functioning Condition (PFC) index.
- Completing geomorphic assessments as part of TMDL studies for the MPCA, including for Bois de Sioux, the Nemadji River, Grand Marais, and Pope County lakes.

As a water resources scientist with a landscape architectural firm, Christian gained experience:

- Developing restoration plans for prairie, wetland, and stream restoration and management in Minnesota, including for the Minneapolis Chain of Lakes.
- Leading the assessment and design of a gully erosion reduction project with streambank bioengineering on a small stream near Choteau, Montana, to protect a trout lake.
- Assessing the restoration of Bridal Veil Creek and the surrounding woods for the Mississippi Watershed Management Organization. Developed a concept plan for stream and forest restoration.
- Planning streambank bioengineering and stabilization of a semi-natural outlet channel on Prior Lake.

Christian's role as a water resources specialist with a Minnesota watershed district involved:

- Managing a hydrologic monitoring program encompassing the collection, management, and analysis of rainfall, groundwater, and stream flow data focusing on several wetlands.
- Inventorying, assessing, and researching wetland mitigation monitoring sites.
- Contributing to streambank stabilization projects and applying for ditch management permits.
- Reviewing development plans to determine compliance with district rules and the Clean Water Act and conducting field inspections of district projects and permit sites.

Education

PhD, Water Resources Science (hydrology and water quality focus), University of Minnesota, 2008

MS, Landscape Architecture (restoration and ecology focus), University of Wisconsin—Madison, 2000

MS, Water Resources Management, University of Wisconsin—Madison, 1999

BS, Biological Sciences, University of Notre Dame, 1993

Training

Highly effective teams, The Nature Conservancy, December 2018

Rosgen Level III: river monitoring and assessment, Wyoming, August 2015

HEC-RAS/BSTEM modeling, U.S. Army Corps of Engineers, 2015

ArcGIS and ArcMap online training courses, 2012

Rosgen Level II: applied fluvial geomorphology; South St. Paul, MN; 2010

Rosgen Level I: river morphology and applications; Rochester, MN; 2010

HEC-RAS hydrologic and sediment transport modeling; American Society of Civil Engineers 2010 Watershed Management Conference; Madison, WI; 2010

Steam restoration; Minnesota DNR; Fergus Falls, MN; 2007

Geomorphic and numerical analysis of unstable channels and streambank processes; American Society of Association Executives conference; St. Paul, MN; Andrew Simon, U.S. Department of Agriculture; 2004

A geomorphic approach to natural channel design in river restoration; American Society of Association Executives conference; St. Paul, MN; Dave Rosgen and Richard Hey; 2004

Certification

Certified Ecological Restoration Practitioner (pending)

Affiliations

Research associate professor for University of Minnesota's Department of Bioproducts and Biosystems Engineering, 2010-present

Affiliated faculty member of University of Minnesota's Natural Resources Science and Management program and Water Resources Science graduate program

Minnesota DNR technical advisory committee for development of a new wetland functional assessment, 2021-present

Society for Ecological Restoration Midwest-Great Lakes Chapter: president, 2020-present; vice president, 2015-2019; Minnesota representative, 2011-2014

Minnesota Pollution Control Agency technical advisory committee for Minnesota River basin sediment management study, 2018-2019

Collaborative for Sediment Source Reduction interagency group, university team member, 2013-2017

Diversity, Equity and Inclusion committee for University of Minnesota's Department of Bioproducts and Biosystems Engineering, 2021-present

Publications

Jiang, B., Mitsch, W.J., and **C. Lenhart**. 2021. Estimating the importance of hydrologic conditions on nutrient retention and plant richness in a wetlaculture mesocosm experiment in a former Lake Erie basin swamp. *Water*.

Gordon, B.A., **Lenhart, C.**, and J. Nieber. 2021. Modeling the applicability of edge-of-field treatment wetlands to reduce nitrate loads in the Elm Creek watershed in southern Minnesota, USA. *Journal of Soil and Water Conservation*, 02155.

Gordon, B.A., **Lenhart, C.**, Peterson, H., Gamble, J., Nieber, J., Current, D. and Brenke, A., 2021. Reduction of nutrient loads from agricultural subsurface drainage water in a small, edge-of-field constructed treatment wetland. *Ecological Engineering*, 160, p.106-128.

Gordon, B.A., Dorothy, O. and **Lenhart, C.F.**, 2020. Nutrient retention in ecologically functional floodplains: a review. *Water*, 12(10), p.2762.

Gordon, B.A., **Lenhart, C.** and LaPara, T.M., 2020. A comparison of nitrate removal and denitrifying bacteria populations among three wetland plant communities. *Journal of Environmental Quality*, 49(1), pp.210-219.

Lenhart, C.F., Smith, D.J., Lewandowski, A., Belmont, P., Gunderson, L., and Nieber, J.L., 2018. Assessment of stream restoration for reduction of sediment in a large agricultural watershed. *Journal of Water Resources Planning and Management*, 144(7), p.04018032.

Lauer, J.W. Echterling, C., **Lenhart, C.F.** and P. Belmont. 2017. Air-photo based changes in channel width in the Minnesota River Basin, Minnesota: Implications for sediment budgeting and historic channel capacity.

Lenhart, C. F., M. L. Titov, J. S. Ulrich, J. L. Nieber, and B. J. Suppes. 2013. The role of hydrologic alteration and riparian vegetation dynamics in channel evolution along the lower Minnesota River. *Transactions of the ASABE* 56(2): 549-561.

Lenhart, C. F., J. Naber, and J. Nieber. 2013 impacts of hydrologic change on riverine turtle nesting potential in eastern Minnesota, USA. *Water* 5(3), 1243-1261.

Lenhart, C., Verry, E., Brooks, K., and Magner, J. 2012. Adjustment of prairie pothole streams to land-use, drainage and climate change and consequences for turbidity impairment. *River Research and Applications* 28 (10): 1609-1619.

Lenhart C., 2012. Restoration of the Mississippi River Gorge in the Twin Cities: assessing the options. *Ecological Restoration* 30 (3): 218-227.

Lenhart, C.F. and Petersen, H. 2011. Watershed response to climate change in the upper Midwest: The importance of low and mean flow increases for agricultural watershed management. *Watershed Science Bulletin*, spring 2011: 25-31.

Lenhart, C., Brooks, K., Magner, J., and Suppes, B. 2010. Attenuating excessive sediment and loss of biotic habitat in an intensively managed midwestern agricultural watershed. Proceedings, *2010 Watershed Management Conference Proceedings*. American Society of Civil Engineers: Madison, Wisconsin.

Lenhart, C., Brooks, K., Magner, J., and Suppes, B. 2010. Riparian corridor-channel restoration and management in Elm Creek, Minnesota. *Ecological Restoration* 28.

Lenhart, C.F. and Magner, J.A., 2011. Human causes of stream degradation in agriculturally dominated landscapes. *In Assessing the Health of Streams in Agricultural Landscapes: How Land Management Changes Impact Water Quality*. R. Cruse, editor. A technical report by the Council on Agricultural Science and Technology (CAST): Ames, Iowa.

Lenhart, C.F. and P. Smiley. 2018. Ecological restoration in the Midwest: past, present, and future. University of Iowa Press: Iowa City, IA.

Aquatic organism passage guide, MnDOT, 2019

Agriculture BMP manual for Minnesota, Minnesota Department of Agriculture, 2017

Field to streams: rural water storage for landowners handbook, University of Minnesota Extension funded in part by the McKnight Foundation, 2015

Guidance for buffers along depressional wetlands, MnDOT, 2010

Streambank bioengineering handbook, MnDOT, 2006

Mississippi River Gorge Restoration Feasibility: Background Report. For the McKnight Foundation, Mississippi River Program, Minneapolis, Minnesota. 2010

Assessment of Techniques for Biota TMDLs in the Red River Basin. By EOR, Inc for Minnesota Pollution Control Agency 2009.

Water Resources Management Plan by The Kestrel Design Group Letterman ranch in western Montana. 2007

Minnesota Soil Bioengineering Handbook. St. Paul: MnDOT, with the Kestrel Design Group. 2006.

Water Resources Investigation for the Letterman Ranch, northwestern Montana. 2006

Impacts on Wetlands and Stream Geomorphology of Proposed Mining Actions. Environmental Impact Statement for a proposed iron mine in northern Minnesota (for the Minnesota DNR). 2006

Bridal Veil Watershed Assessment, for Mississippi Watershed Management Organization, Minneapolis, MN. 2006

Bridal Veil Creek Natural Area Restoration Plan, for Mississippi Watershed Management Organization, Minneapolis, MN. 2005

GREG WILLIAMS, PE
Senior Water Resources Engineer

Experience

Greg Williams has 15 years of experience providing water resource services to watershed management organizations, industrial clients, and diverse municipal clients. He specializes in creating storm and surface water management plans (SWMPs) for urban and rural watersheds, incorporating hydrologic and hydraulic (H&H) and water quality modeling. His experience allows him to synthesize input from clients and other stakeholders to find solutions to challenging problems related to hydrology, water quality, and resource management, and the interrelated aspects of those fields. Greg also serves as the day-to-day engineer for the Lower Mississippi River Watershed Management Organization. Examples of his project work at Barr include:

- Managing the 2023-2032 update to the Lower Mississippi River Watershed Management Organization watershed management plan. Tasks include developing a stakeholder engagement plan, including survey, citizen advisory committee, and public engagement events; developing a gaps analysis; prioritizing issues and resources; updating policies and performance standards; establishing measurable resource and program goals; and developing a targeted implementation schedule.
- Updating hydrologic modeling of the Seidls Lake watershed using XP-SWMM software at Atlas 14 hydrology to develop a cost allocation for proposed improvements following the allowable flow methods described in the Lower Mississippi River Watershed Management Organization's joint powers agreement
- Developing a cost allocation for improvements to a stormwater pond in Inver Grove Heights based on the allowable flow methods described in the Lower Mississippi River Watershed Management Organization's joint powers agreement.
- Performing a feasibility study for a levee extension project in the city of South St. Paul. Tasks include facilitating stakeholder engagement, managing the collection of field data, designing optimal levee alignments, and assessing estimated cost and benefits.
- Developing and running P8 models to correlate phosphorus and total suspended solids removal to best management practice size, percent impervious area coverage, and soil type as part of the Minnesota Pollution Control Agency's minimal impact design standards (MIDS) project.
- Developing and running HEC-RAS model for a FEMA flood-map project in Olmsted and Carver counties in Minnesota, including several small streams and a 20-mile reach of the Crow River.
- Conducting a cross-section stream survey for a channel restoration and re-meander project along Nine Mile Creek in Hopkins, Minnesota.
- Conducting a use attainability analysis for a chain of lakes in Minnetonka. Work included developing a P8 urban runoff model, water balance, and in-lake water quality models to evaluate management strategies.
- Calibrating and performing quality control on HEC-HMS models developed to evaluate flood mitigation options for the Mouse River in North Dakota.

- Modeling potential hydrologic impacts from mining in a 20-square-mile watershed using HEC-HMS. Work included model construction, calibration, and analysis of future conditions.
- Managing development of a comprehensive watershed management plan for the Lower Minnesota River West watershed consistent with One Watershed, One Plan (1W1P) requirements in cooperation with a partnership including the counties and soil and water conservation districts (SWCDs) of McLeod, Nicollet, and Sibley, and the High Island Creek Watershed District. Tasks include working with the partnership's steering team, technical advisory committee, and policy committee to develop and implement a stakeholder engagement program, prioritize issues and resources, establish measurable goals, and develop a targeted implementation schedule covering a 10-year period.
- Managing development of a comprehensive watershed management plan for the Zumbro River and Mississippi River-Lake Pepin watersheds consistent with 1W1P requirements in cooperation with the Watershed Alliance for the Greater Zumbro (WAGZ), a partnership including the counties and SWCDs of Dodge, Goodhue, Olmsted, Rice, and Wabasha, the Bear Valley Watershed District, and the City of Rochester. Tasks Include working with the WAGZ's planning work group, technical advisory group, and policy committee to develop and implement a stakeholder engagement program, prioritize issues and resources, establish measurable goals, and develop a targeted implementation schedule covering a 10-year period.
- Managing the 2022-2031 update to the Black Dog Watershed Management Organization watershed management plan. Tasks include developing and executing a stakeholder engagement plan including partner staff interviews, technical advisory committee meetings, a survey, and virtual public kickoff meeting, prioritizing issues and resources, identifying measurable goals, updating policies and performance standards, and developing a targeted implementation schedule that coordinated the Cities of Apple Valley, Burnsville, Eagan, and Lakeville.
- Writing portions of municipal stormwater management plans for several Minnesota cities. Tasks include inventorying water resources, assessing stormwater management issues, developing stormwater management policies, and developing implementation programs. Clients include the cities of Hastings, Lakeville, North St. Paul, Red Wing, St. Louis Park, and Willmar.

Education

MSCE, Civil and Environmental Engineering, University of Washington, 2005

BCE, Civil Engineering, University of Minnesota, 2003

BA, English (writing), University of Minnesota, 2003

Registration

Professional Engineer: Minnesota

MICHAEL B. McKINNEY, PE
Water Resources Engineer

BARR

Experience

Michael specializes in hydrologic and hydraulic modeling and water quality modeling. He has more than nine years of experience in best management practice (BMP) design and stormwater infrastructure design and has developed numerous large, calibrated water quality and hydraulic models. Michael has also been involved in many prioritization and BMP evaluation studies, using water quality modeling results to prioritize maintenance of existing BMPs and optimize sighting and design of proposed BMPs. He is a proficient researcher and technical writer and has managed many large-scale modeling development projects and feasibility studies. Michael's projects include:

- Managing development of water quality modeling for the City of Richfield. P8 models and a GIS WQM model were developed spanning the entire municipal boundary and tributary drainage areas. Model results were validated to observed water quality sampling datasets and used for applications, including pond maintenance prioritization, street sweeping prioritization, and evaluation of BMPs to achieve compliance with TMDL waste load allocation goals.
- Managing the development of intersection-scale XP-SWMM and P8 models for the 8,000-acre watershed to the Capitol Region Watershed District's Trout Brook interceptor. Model development included creating processes to track and merge datasets from numerous project partners and incorporating technical advisory committee feedback. This project is in progress and will incorporate XP-SWMM model calibration and may include P8 water quality model calibration.
- Developing calibrated inlet-scale water quantity and water quality models (XP-SWMM and P8, respectively) for a 2,000-acre urban drainage area in Fridley and Columbia Heights, Minnesota, for the Mississippi Watershed Management Organization. This project included identification, evaluation, and prioritization of flood and water quality improvement CIP opportunities throughout the watershed.
- Developing a GIS-based water quality model (GIS WQM) for the City of Minneapolis. The empirical, annualized model can predict pollutant loading from land use based on land use density characteristics, estimate removal from BMPs, and track pollutant loading and impacts of treatment trains through all elements of the link-node routing network. The city is currently using the model for water quality evaluation and asset management.
- Managing the Nine Mile Creek Watershed District's Flood Risk Assessment: Atlas 14 and Beyond project. The project includes projecting and modeling mid-century climate change rainfall events, updating model calibration, evaluating risk of crossing clogging and failure, and quantifying flood damage costs across the 44-square-mile watershed.
- Managing the development of a detailed XP-SWMM and P8 model for the City of Saint Paul's Saint Anthony Park storm sewer tunnel watershed. Developed a streamlined methodology for incorporating Saint Paul rate control areas throughout the more than 4,000-acre watershed and developed processes to convert model input parameters to be consistent with Saint Paul model development guidance.

- Designing and developing a pond performance and assessment prioritization study for the Ramsey-Washington Metro Watershed District.
- Performing water quality modeling (using P8 and Barr in-lake models) and assisting with the development of several TMDL reports for the Ramsey-Washington Metro Watershed District watershed restoration and protection strategy (WRAPS) reports.
- Developing a detailed, inlet-scale hydrologic and hydraulic model of nearly 8,000 acres of northern Minneapolis for the City of Minneapolis.
- Modeling, evaluating, and optimizing stream restoration options for rapidly eroding ravines in Scott County, Minnesota, using XP-SWMM.

Education

MS, Environmental Engineering, University of Nebraska–Lincoln, 2012

BS, Biological Systems Engineering, University of Nebraska–Lincoln, 2010

Registration

Professional Engineer: Minnesota

Software

XPSWMM, HydroCAD, P8, Barr's In-Lake Model, ArcGIS, HEC-RAS, HEC-HMS, AutoCAD, SWAT, Visual Basic, MatLab, LabView

Affiliations

American Society of Agricultural and Biological Engineers

American Society of Civil Engineers

National Society of Professional Engineers

KALLIE DOEDEN
Water Resources Engineer

Experience

Kallie joined Barr in 2018 with more than eight years of combined experience in engineering consulting and the public sector, as well as a background in water resources, water quality, stormwater monitoring, drinking water, habitat restoration, and environmental chemistry. Her projects have involved water quality issues, hydraulic modeling, and water-system planning and management in the public sector. She has used hydraulic water-system modeling software to determine and design capital improvement projects for municipal water systems.

At Barr, Kallie contributes to projects involving civil engineering and hydraulic and hydrologic analysis. Specifically, her work includes:

- Working with the Minnesota cities of Bloomington, Fridley, New Brighton, and Richfield and Owatonna Public Utilities to meet U.S. Environmental Protection Agency (EPA) AWIA (America's Water Infrastructure Act) regulatory requirements for risk and resiliency assessments and emergency response plans.
- Evaluating various hydraulic modeling software for the City of Richfield, Minnesota.
- Serving as the lead hydraulic modeler and lead designer for the water distribution system at the Crab Orchard Wildlife Refuge in Marion, Illinois, for the U.S. Fish and Wildlife Service. The overall project entailed designing a new booster station and replacing approximately half of the system's water mains and services. Work involved updating and calibrating the existing model, modeling the proposed distribution system and booster station, preparing plans, and performing CAD work.
- Serving as lead designer for drinking water and sanitary sewer design for a development expansion at Laborer's Training Center in Lino Lakes, Minnesota. Work included preparing plans, specifications, and cost estimates.
- Assisting in a project involving the evaluation of potential locations for aquifer storage recharge for the City of Provo, Utah. Work entailed conducting an overall water rights assessment, evaluating various conceptual-design locations (including cost estimates), and developing pilot studies for two of the selected locations, and conducting water system distribution hydraulic modeling support.
- Assisting with stormwater planning and watershed management.
- Performing hydrologic and hydraulic modeling and analysis for water quality, floodplain management, open-channel and pipe-flow design, design of infrastructure (water control structures, swales, pipes, and pumps), and hydrologic runoff.
- Developing best management practices, treatment, sampling, analyses, and habitat restoration to improve lake, stream, and stormwater water quality.
- Assisting with design, plans, and specifications for water supply projects, including potable water treatment and delivery, wells, wellhead protection, and stream and reservoir reliability studies.
- Designing water infrastructure (supply and treatment), including cost estimating and preparation of plans and specifications.

- Designing green infrastructure, including low-impact site development, infiltration and filtration systems, and rain gardens.
- Developing reports, plans and specifications, grading plans, earthwork balance calculations, erosion protection plans, and cost estimates.
- Completing fieldwork, including construction observation, surveying, monitoring, collection of hydrologic and water quality measurements, and materials testing.
- Communicating with permitting agencies and public officials.

Prior to Barr, Kallie was a civil engineer at an engineering firm in Seattle, Washington, where her work involved:

- Managing and conducting water system analysis with hydraulic modeling software for five public water systems. Results were used to assess needs for capital improvement projects and fire-flow water availability.
- Preparing comprehensive water system plans for public water systems to determine the state of the water systems and possible operation and system improvements to better serve customers. Reports included historic and future projected water demands and populations, geographic information system (GIS) maps, hydraulic modeling for system analysis, coliform monitoring plans, wellhead protection plans, capital improvement projects, and financial planning and analysis.
- Designing and conducting chlorine contact-time tracer studies for public water systems.
- Designing and determining solutions for water quality problems, including corrosion control for lead and copper, pilot projects for manganese and iron contamination, and reservoir disinfection improvements.
- Designing water-main installation projects and assisting with booster station design. Developed project cost estimates as well as construction plans and specifications.

Kallie also served as an intern with Seattle Public Utilities, where she gained experience:

- Managing, maintaining, and installing 20 creek- and pipe-flow monitoring sites to collect data on physical characteristics. Results were used to monitor stormwater management projects.
- Collecting flow measurements for a hydrological rating curve for water management.
- Surveying creek sites for comparison to previous years to identify structural changes at the site area.
- Troubleshooting and repairing data logging, surveying, and flow monitoring equipment at the field sites.

As an assistant supervisor for the Washington Conservation Corps, Kallie's responsibilities included:

- Supervising the implementation of restoration and trail maintenance projects on salmon habitat, wetlands, and recreational areas on public and private land in King County, Washington.
- Managing and supervising herbicide treatment and global positioning system (GPS) location recording for knotweed and other invasive plant species on dozens of properties along the Raging River near Preston, Washington.
- Managing supply cache and conducting public outreach during emergency response for the March 2014 mudslide in Oso, Washington.

In addition, Kallie has a variety of research experience. In the chemistry and environmental studies departments at St. Olaf College, her research included:

- Conducting a stream habitat assessment for water quality on Rice Creek through fieldwork and data collection to evaluate water resource usage and stream health.
- Helping develop a restoration plan for conservation of the county area by measuring water quantity characteristics and performing GIS programming and analysis in order to evaluate historical and current land use.
- Leading a team in developing a greenhouse-gas chemistry lab aimed at increasing awareness of climate change. The lab taught students about thermodynamic measurements, spectroscopic analysis, and molecular modeling of greenhouse gases.
- Participating in evaluating the college's Green Chemistry in Education curriculum. Developed and conducted student interviews, and designed a plan that broadened the green chemistry focus to benefit St. Olaf's future scientists and the community.

As a National Science Foundation undergraduate researcher at Washington State University, Kallie evaluated the effects of chemical coatings containing titanium dioxide on vehicle emissions. Research included designing a gaseous manifold system, investigating air quality relating to the reaction of vehicle emissions with titanium dioxide coated concrete, and calibrating and maintaining laboratory instruments. Results were used to assist academics, city planners, and construction companies in their future development plans.

Education

MS, Civil Engineering (Emphasis: Water Quality in Natural Systems), University of Washington, 2016

BA, St. Olaf College, Chemistry and Mathematics (Concentration: Latin American/Latino Studies), 2013

Training

Watershed Assessment and Regulation Course, Lisa Lewis, Washington State Department of Ecology, June 2014

Wetland Delineation and Regulation Course, Rick Mraz, Washington State Department of Ecology, June 2014

Registration

Engineer in Training

Software CE-QUAL-W2 Water Quality Model, Innovyze InfoWater, Innovyze H2ONet, ArcGIS, AutoCAD, GPS, Hydstra, LoggerNet, MATLAB, Visual Minteq

Publications/ Presentations

Brett, M. T; Doeden, K.B.; et. al. "The Modeled and Observed Response of Lake Spokane Hypolimnetic Dissolved Oxygen Concentrations to Phosphorus Inputs". Lake and Reservoir Management. 2016, Vol. 32, No. 3, pgs 243-255.

Kallie B. Doeden, Claudia A. Toro, Tom B. Jobson. Laboratory Generation of HO Radical and Their Effects on Vehicle Emissions in a TiO2 Coated Setting.12th Annual AMS Student Conference, 93rd AMS National Meeting, Austin, TX. January 2013. (Poster)

Kallie B. Doeden, Erik M. Epp & Robert M. Hanson. Green Chemistry in Education: Sources of Student Conceptions of Green Chemistry. Peer-Reviewed Chemical Education Research Symposium, 241st ACS National Meeting, Anaheim, CA. March 2011. (Oral)

Kallie B. Doeden, Erik M. Epp & Robert M. Hanson. Green Chemistry in Education. Midstates Consortium: Undergraduate Symposium in the Physical Sciences, Mathematics, and Computer Science, Washington University, St. Louis, MO. November 2010. (Poster)

Experience

Parker joined Barr after earning a bachelor's degree in civil engineering from the University of Minnesota. His undergraduate projects included conducting a feasibility study for and implementing best management practices along Minnehaha Creek in Minneapolis as well as developing a conceptual design for restoration of Waller Creek in Austin, Texas. At Barr, Parker frequently contributes to projects involving civil engineering and hydrologic and hydraulic analysis. Specifically, his work includes:

- Working as a modeler for a 30% design of BMPs near Powers Lake for the South Washington Watershed District. Tasks included quantifying volume and volume reduction with XPSWMM, determining water quality benefits with P8 and MIDS calculators, and sizing BMPs.
- Performing XPSWMM modeling of the Brook Drive crossing over Nine-Mile Creek in Edina, Minnesota. The model was used to evaluate the feasibility of no-rise conditions for a culvert replacement.
- Assisting with development of the Trout Brook Interceptor detailed model for Capitol Region Watershed District. Tasks thus far have included gathering storm sewer data, generating subwatershed divides, determining longest flow paths, generating P8 inputs, and performing volume capture in XPSWMM.
- Modeling the Phalen Chain of Lakes system in Ramsey-Washington Metro Watershed District to determine flood-reduction options, specifically for areas near Ames Lake Park.
- Performing field inspections of conveyance systems in Valley Branch Watershed District. Conveyance systems include underground storm sewer, dams, underground and above ground control structures, ditches, creeks, and ravines.
- Assisting in writing reports for Valley Branch Watershed District, including the district's annual reports, the 2022 Valley Creek erosion inventory report, and the 2021 Valley and Kelle's Creek erosion control feasibility study.
- Assisting with XPSWMM modeling of the more than 4,000-acre Saint Anthony Park watershed for the City of Saint Paul, Minnesota.
- Assisting with modeling of the Farr Lake subwatershed for the City of Fridley, Minnesota.
- Modeling study areas in two-dimensional XPSWMM as part of the City of Edina, Minnesota's comprehensive water recourses management plan.
- Serving as a modeler for the design of a stormwater filter in Seasons Park for the South Washington Watershed District.
- Assisting in administrative tasks and performing construction observation for a 3-building Habitat for Humanity townhome development in Prior Lake, Minnesota.
- Performing infiltration testing and constriction observation for various developments on behalf of the city of Inver Grove Heights, Minnesota.
- Helping review stormwater design for the former Ford site (Highland Bridge) in Saint Paul, Minnesota.
- Contributing to stormwater planning efforts.

- Conducting hydrologic runoff modeling and analysis.
- Providing open-channel and pipe flow design as well as design of water control structures.
- Collecting water quality and hydrologic measurements.
- Performing construction observation, surveying, and materials testing.
- Developing plans and specifications, reports, and spreadsheets.
- Providing geographic information system (GIS) and computer-aided design and drafting (CADD) work.
- Working with permitting agencies and public officials.

Prior to Barr, Parker interned with the City of Minneapolis Public Works Department, where his responsibilities included:

- Conducting field tests of fresh concrete used in resurfacing throughout the city.
- Sampling asphalt and soil and testing grain size distribution and density.
- Assisting engineers, technicians, and contractors with road construction projects.

Parker also served as an engineering technician aide with Hennepin County Public Works, where his work involved:

- Analyzing traffic data with the goal of improving safety on county roads.
- Assisting engineers with transportation planning, including road surveys, traffic studies, and project drafting.

Education BS, Civil Engineering, University of Minnesota Twin Cities, 2020

Software AutoCAD, Civil 3D, MATLAB, R, HEC-RAS/HMS, XPSWMM, P8, GIS

COLLEEN M. LONG
GIS Specialist

Experience

Colleen joined Barr with seven years of experience in environmental science, geology, and geographic information systems (GIS). She is well versed in a wide range of geospatial analysis and data management and is adept at creating polished final products in ArcMap. She also creates other types of graphics, including geologic cross sections in Adobe Illustrator. Colleen has coauthored 12 peer-reviewed journal articles, including developing figures and writing and editing text, and has given presentations at national and international conferences. At Barr, her work includes:

- Creating maps for reporting in ArcGIS.
- Formatting, editing, and managing spatial data and performing QC.
- Analyzing raster and vector data with GIS extensions in ArcMap and ArcPro.
- Supporting fieldwork with maps and spatial data and managing field data gathered with Collector and Survey123 in ArcGIS Online.
- Managing and processing GPS data.
- Compiling geologic, topographic, and soils data for, and tracking the progress of, desktop and geotechnical studies for renewable energy projects throughout the U.S.
- Compiling soils and wetlands data for wetland restoration and delineation projects.
- Creating graphics for reports and presentations in Adobe Illustrator.

Prior to Barr, Colleen was a research associate at the University of Michigan's Graham Sustainability Institute, where her responsibilities included:

- Creating, managing, and analyzing large water-quality and environmental datasets.
- Providing data support for watershed modeling (SWAT) and urban water-quality modeling (SWMM) projects.
- Using ArcGIS, ERDAS, and R for geospatial analyses of raster and vector data.
- Producing all maps and figures (more than 30 total) for the research team's final publication from a three-year research project on nutrient loads in the Detroit River.

As a wetlands geology specialist with the Illinois State Geological Survey, she worked on:

- Conducting biweekly fieldwork to collect water quality data throughout Illinois.
- Maintaining field equipment, including water-quality data loggers and autosamplers.
- Managing and analyzing large water-chemistry databases and documenting methods.
- Using ArcGIS to perform analyses on spatial data and create maps for publications.

Education

MS, Geological Sciences, University of North Carolina at Chapel Hill, 2012 (Thesis: Remote Sensing of Suspended Sediment in a Complex Wetland Environment)

BS, Geo. Sciences and the Program in the Environment, University of Michigan, 2010

Publications

Martin, J., and 20 authors including Long., C., 2021. Evaluating Management Options to Reduce Lake Erie Algal Blooms Using an Ensemble of Watershed Models. Journal of Environmental Management, 280, 111710.

Kast, J., Apostel, A., Kalcic, M., Muenich, R., Dagnew, A., Long, C., Evenson, G., and Martin, J., 2021. Source Contribution of Phosphorus Loads from the Maumee River Watershed to Lake Erie. Journal of Environmental Management, 279, 111803.

Scavia., D., Anderson, E., Dove., A., Hill, B., Long, C., and Wang, Y., 2020., Lake Huron's Phosphorus Contributions to the St. Clair-Detroit River Great Lakes Connecting Channel, Environmental Science & Technology, 54(9), 5550-5559.

Scavia, D., Bocaniov, S., Dagnew, A., Hu, Y., Kerkez, B., Long, C., Muenich, R., Read., J., Vaccaro, L., and Wang, Y. 2019. Detroit River phosphorus loads: Anatomy of a binational watershed. Journal of Great Lakes Research, 45 (6): 1150-1161.

Hu, Y., Long, C., Wang, Y., Kerkez, B., and D. Scavia. 2019. Urban total phosphorus loads to the St. Clair-Detroit River System. Journal of Great Lakes Research 45 (6): 1142-1149.

Dagnew, A. D. Scavia, Y. Wang, R. Muenich, C. Long, M. Kalcic. Modeling Nutrient and Sediment Delivery from a Large International Watershed Using a Field-Scale SWAT Model. 2019. Journal of the American Water Resources Association, 55 (5): 1288-1305.

Kast, J., Long., C., Muenich, R., Martin, J., Kalcic, M., 2019. Manure Management at Ohio Confined Animal Feeding Facilities in the Maumee River Watershed. Journal of Great Lakes Research. 45(6): 1162-1170.

Manning, N.F., Y. Wang, C. M. Long, I. Bertani, M. J. Sayers, K. R. Bosse, R. A. Shuchman, D. Scavia. 2019. Extending the Forecast Model: Predicting Harmful Algal Blooms at Multiple Spatial Scales. Journal of Great Lakes Research. 45 (3): 587-595.

Scavia, D., S.A. Bocaniov, A. Dagnew, C. Long, Y. Wang. 2018. St. Clair-Detroit River system: Phosphorus mass balance and implications for Lake Erie load reduction, monitoring, and climate change. J. Great Lakes Research. 45 (1): 40-49.

Long, C.M., Muenich, R.L., Kalcic, M.M., and Scavia, D., 2018, Use of manure nutrients from Concentrated Animal Feeding Operations, Journal of Great Lakes Research, 44: 245-252.

Matthews, J.W., Spyreas, G., and Long, C.M., 2015, A null model test of Floristic Quality Assessment: Are plant species' Coefficients of Conservatism Valid?, Ecological Indicators, 52, 1-7.

Long, C.M. and Pavelsky, T.M., 2013, Remote sensing of suspended sediment concentration and hydrologic connectivity in a complex wetland environment, Remote Sensing of Environment, 129, 197-209.

Attachment B:
Staff hours by task

staff	Kieffer, Janna	Lenhart, Christian	McKinney, Michael	Williams, Sterling	Doeden, Kallie	Brown, Aaron	Long, Colleen				
2022 Rate ($/hr)	$185	$145	$140	$155	$120	$105	$105				
task	estimated staff hours per task (hr)							total hours	labor subtotal	expenses	total cost
Review Data and Plans	8	12	12	2	0	4	10	48	$6,680	$ -	$6,680
Interstate Valley Creek Erosion Assessment	14	72	2	14.095	80	55	16	253.095	$32,550	$ -	$32,550
OPTIONAL - Wentworth Creek/Marie Creek Erosion Assessments	7	36	1	7	40	28	8	127	$16,275	$ -	$16,275
Watershed Analysis for volume reduction BMPs	9	4	80	4	0	92	4	193	$24,145	$ -	$24,145
Final Reporting	9	24	24	12	0	0	12	81	$11,625	$ -	$11,625
total (without optional)	**40**	**112**	**118**	**32.095**	**80**	**151**	**42**	**575.095**	**$75,000**	**0**	**$75,000**
total (with optioinal)	**47**	**148**	**119**	**39.095**	**120**	**179**	**50**	**702**	**$91,275**	**$ -**	**$91,275**