Technical Memorandum

Young Environmental Consulting Group, LLC

To: Linda Loomis, Administrator
Will Lytle, Administrator
Lower Minnesota River Watershed District (LMRWD)

From: Jennifer Mocol-Johnson, Land and Natural Resources Program Manager
Rachel Kapsch, Water Resources Scientist
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Date: July 8, 2025

Re: 2025 Gully Inventory – Post-Field Assessment Summary

INTRODUCTION

In 2023, the Lower Minnesota River Watershed District (LMRWD) reevaluated 315 gullies through a field assessment and gully ranking process that aimed to identify and prioritize gullies in the watershed district most in need of restoration. Due to the erosive nature of gullies, ongoing inventorying was deemed necessary to determine if additional gullies had developed since the previous LMRWD review. Young Environmental Consulting Group, LLC (Young Environmental) previously identified 11 inaccessible gullies. As part of the 2025 work plan, Young Environmental identified additional gullies and sought out ways to access previously inaccessible gullies. This gully assessment aligns with strategy 1.3.1 of the 2018-2027 Lower Minnesota River Watershed District Watershed Management Plan (WMP), which aims to provide strategic resource evaluation and management. Additionally, this assessment aligns with strategy 7.3.1, which seeks to continue addressing gully erosion.

Restoring gullies within the steep slopes overlay district and near high-value resource areas strongly aligns with the watershed management and water quality goals of the LMRWD. The LMRWD's priorities of surface water, groundwater, and unique natural resource management are all addressed by restoring actively eroding gullies within the watershed district. The gullies recommended for restoration are determined not purely from their erosion potential but also due to their impact on important LMRWD resources and alignment with the WMP.

The 2025 Gully Inventory was implemented to gain a comprehensive understanding of all gullies within the LMRWD, including those not inventoried or previously deemed inaccessible. It was also designed to determine their condition and priority for restoration in relation to the previous analysis. The 2025 project is a continuation of previous gully assessments and intended to provide an up-to-date and thorough assessment.

Previous projects and publications concerning gullies within the LMRWD include:

- Minnesota Conservation Corps (2008): Gullies to the north of the Minnesota River were located using ArcGIS.
- Young Environmental (2020): Gullies were continuously monitored by Young Environmental. The 2020 Gully Inventory and Condition Assessment Project, Volume 1, produced a gully and pipe outfall condition assessment and an inventory on the north side of the Minnesota River. This project was intended to provide information to municipalities on the existing conditions of gullies and pipe outfalls that were identified in 2008. It also focused on identifying new gullies that may be contributing sediment to the Minnesota River. Gullies were ranked by risk severity, with some gullies being recommended for mitigation.
- Young Environmental (2021): The 2021 Gully Inventory and Condition Assessment Project, Volume 2, continued the 2020 efforts by surveying gullies on the south side of the Minnesota River, in efforts to identify gullies in areas not previously surveyed. Again, gullies were ranked by risk severity, with some gullies being recommended for mitigation.
- Young Environmental (2023): Using the rankings derived from 2020 and 2021 efforts, the 2023 Project assessed 315 gullies throughout the watershed that had been labeled as "High" and "Very High" priority gullies based on their erosion potential and impact to LMRWD resources.

The following sections of this memorandum present Young Environmental's methodology, findings, and recommendations.

METHODS

Desktop Assessment

Elevation Model Comparison

From 2022–2023, the Minnesota Geospatial Information Office, in coordination with the United States Geological Survey (USGS) and other state partners, acquired Light Detection and Ranging (LiDAR) data for the entire state. LiDAR data is especially useful in producing elevation models that facilitate easy visual verification of changes in topography—such as a gully. The raw point cloud LiDAR data was made available to download in small sections by the USGS. Processing the cloud data first required conversion of the data from LiDAR Aerial Survey Zipped format (LAZ) to LiDAR Aerial Survey (LAS) format and definition of the coordinate system. We then classified the data to process only ground points and converted the data to a raster elevation model. After processing the data into elevation models, Young Environmental staff overlayed previously surveyed locations to use as a guide for assessing new and previous gullies that were not surveyed. Through this process, 17 new gullies were identified for a follow-up field assessment.

Accessibility

For gullies previously identified as inaccessible, a desktop assessment was performed to identify key features like access routes, potential access barriers, and parking before going into the field. Using these methods, Young Environmental staff were able to successfully access and survey nine out of the 11 gullies previously marked as inaccessible. The remaining two locations appear to be within the Minnesota River and are likely the result of global positioning system (GPS) error in the original survey.

Outfall Assessment

Beginning in 2024, Young Environmental staff reached out to the municipalities within the LMRWD requesting storm sewer data for identification of outfalls. The data supplied was plotted in ArcGIS and analyzed to assess proximity to surveyed gullies. Gullies located near outfalls were correlated because, generally, outfalls channelize high concentrations of discharge. Often, this discharge experiences a large vertical drop from pipe to ground surface, potentially exacerbating bank or bottom erosion. In the situation where an outfall was found to contribute to a gully, the gully was surveyed in person and photos were taken. Findings from the outfall assessment and elevation model comparison were combined to determine potential gully locations. If the analysis indicated an outfall was present and the elevation model comparison showed a potential for a gully to be present, Young Environmental staff investigated while in the field to confirm desktop assessment findings.

Field Assessment

Survey

To maintain a consistent approach and methodology, the survey used for the 2023 gully inventory and condition assessment was used to complete the 2025 assessment. For the 2023 inventory, all gullies were given an updated gully ID consisting of a 2-3 letter abbreviation for the City in which the gully is located and a unique identification number (e.g. Carver 63 has an ID of CVR63). To score the gullies in the field, Young Environmental staff answered multiple-choice questions in Survey123 concerning factors that may influence erosion potential such as vegetation cover, gully size, shape, and material. Each question had an associated point value, which were summed to derive the gully's Erosion Score. The greater the point value, the higher the likelihood of the gully experiencing further erosion. Multiple photos of each gully were also collected in Survey123. For additional information on how point values for each survey response were derived, see Attachment 1 (2023 Gully Inventory and Condition Assessment Project).

Overall Ranking Score

A gully's Overall Ranking Score was derived by adding its Erosion Score, Impact Tier Points, and Minnesota Pollution Control Agency (MPCA) Points. The Overall Ranking Score encompasses information from both the desktop review and the field assessment. Point systems are introduced below with a greater level of detail provided in Attachment 3 regarding each of the subcategories of the Overall Ranking Score and how they were derived. This scoring system originated from the 2023 Gully Inventory and Condition Assessment Project Report (Appendix B).

Table 1 and 2 include the following subcategories to the Overall Ranking Score:

- The **Gully ID** field is a unique identifier for each gully.
- The **Erosion Score** is the tally of points based on the field survey.
- The **Impact Tier Points** represent the overall level of impact on watershed resources.
    - The highest value (10) represents a critical impact to a high-value resource such as a calcareous fen or trout stream.
- The **MPCA Points** are assessed by summing active investigations and cleanup sites within a one-mile radius, with each active site weighted as a quarter of a point.
- The **Overall Ranking Score** is determined by summing the Erosion Score Points, Impact Tier Points, and MPCA Points.

FINDINGS

Previously Inaccessible Gullies

Eleven gullies were categorized as inaccessible during previous field efforts. Field staff determined a gully was inaccessible for various reasons including private ownership, restricted access, difficult or dangerous terrain, and/or inundation of the area adjacent to the gully.

Young Environmental staff were able to successfully access and survey nine out of the 11 gullies previously marked as inaccessible as part of the 2025 field assessment. Overall ranking scores for each of the assessed gullies are included below in Table . Respective locations for each inaccessible gully are depicted in Figure 1. The memorandum highlights findings and recommendations for next steps.

Table 1. Overall Ranking Scores for Inaccessible Gullies Surveyed in 2025

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR63	33	0	2.25	35.25
BLM64	15	7	1.5	23.5
BLM61	32	7	1.5	40.5
BLM151	29	7	1.5	37.5
BVL52	32	10	3.25	45.25
BVL8	25	10	3.25	38.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
FSN2	26	0	3.25	29.25
MDH14	19	10	3.75	32.75
MDH11	21	10	3.25	34.25

Carver – CVR63

CVR63 is located south of a constructed pond near a residential neighborhood in the City of Carver. This area is characterized by large gullies with steep banks. Young Environmental staff were successfully able to access the gully and perform the survey. Notably, the gully contained a large amount of debris from disposed vehicles and appliances.

Photo 1. CVR63 Gully Condition

Bloomington – BLM61, BLM64, BLM151

BLM61, 64, and 151 are located to the west of Interstate 35 West (I-35W) near the interstate bridge. To access the gullies, Young Environmental staff accessed residential property. BLM151, shown below, is the largest of these Bloomington gullies and forms a drainage ditch that the other nearby gullies empty into. BLM61 and BLM64, shown on page 6, are both small gullies created by groundwater seepage.

Photo 2. BLM151 Gully Condition

Photo 3. BLM64 Gully Condition

Photo 4. BLM61 Gully Condition

Burnsville – BVL52, BVL8

BVL52 and 8 are located adjacent to railroad tracks. The gullies were accessed by walking along the City right-of-way (Hayes Drive), exiting Hayes Drive to the north, following a constructed drainage channel, and through undeveloped, US Fish and Wildlife Service land. The gullies were close in proximity (within 50 feet of one another). BVL52 is a long drainage ditch that runs along the south side of the elevated rail line. BVL8 is a small gully that has developed where a natural drainage network empties into the larger drainage ditch (BVL52).

Photo 5. BVL52 Gully Condition

Photo 6. BVL8 Gully Condition

Fort Snelling – FSN2

FSN2 is located along a public trail on the south side of Interstate 494 (I-494) near the interstate bridge. Young Environmental accessed the gully from the nearby Minnesota Valley National Wildlife Refuge visitor center and the adjacent walking trail.

Photo 7. FSN2 Gully Condition

Mendota Heights – MDH11, MDH14

MDH11 and 14 are located near Sibley Memorial Highway along the railroad tracks. Both gullies were accessed by parking at the Big Rivers Regional Trail parking lot and walking along the trail. MDH14 is a short distance from the parking lot, and there appears to be rip rap installed previously to prevent erosion. MDH11, shown on page 9, is further north along the trail, has a wide base, and dense vegetation growing in it.

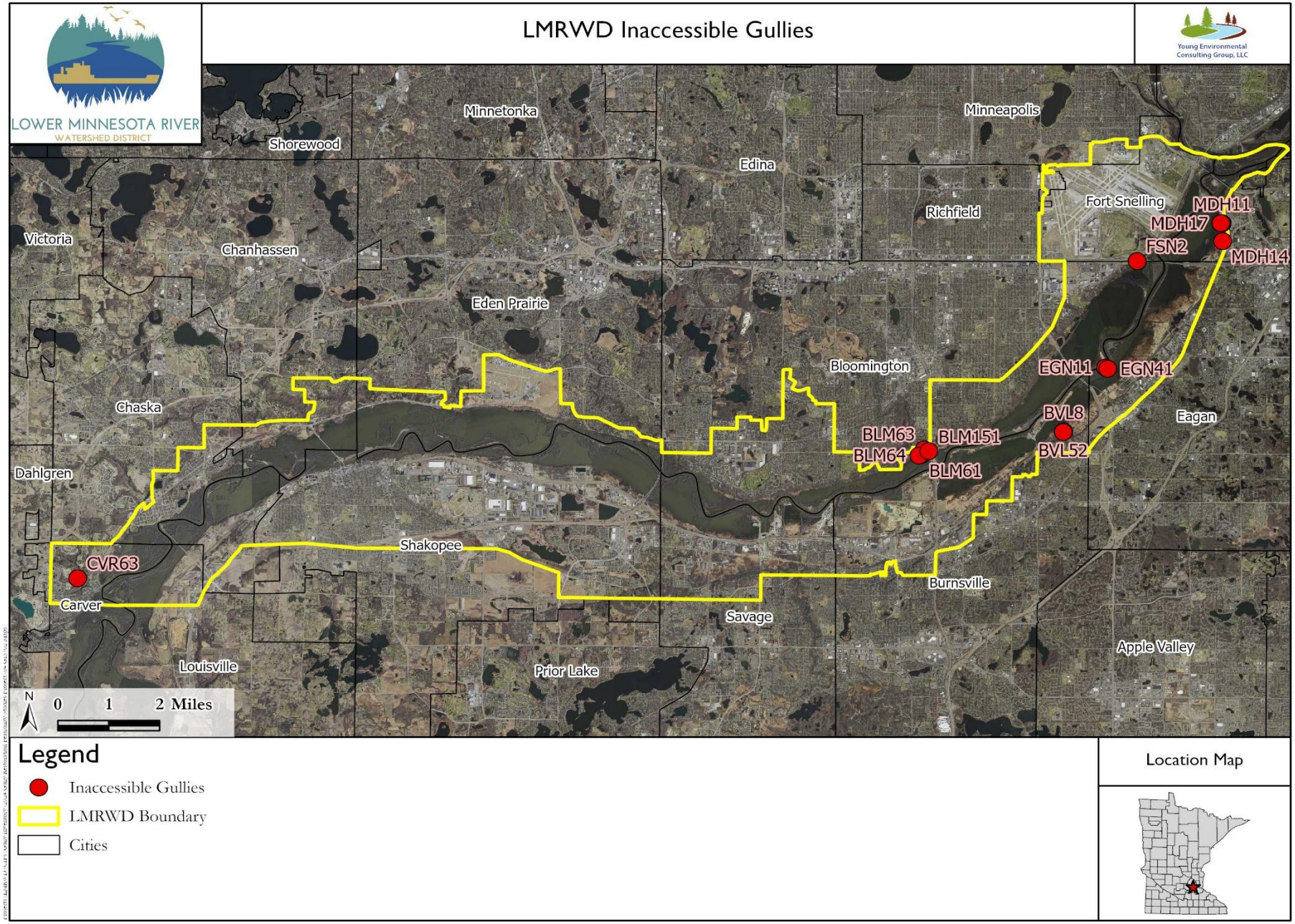
Photo 8. MDH14 Gully Condition

Photo 9. MDH11 Gully Condition

Eagan – EGN11, EGN49

EGN11 and 49 were the only gullies field staff were not able to access. GPS pinpoints the location of these gullies within the Minnesota River, suggesting that the coordinates are inaccurate

Figure 1. Previously Inaccessible Gullies Surveyed in 2025



Newly Assessed Gullies

Seventeen new gullies were identified and surveyed as part of the 2025 field assessment. Overall ranking scores for each of the assessed gullies are included below in Table 2.

Table 2. Overall Ranking Scores for Newly Assessed Gullies Surveyed in 2025

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
FSN8	35	7	5.5	47.5
FSN7	34	7	6	47
CHK2	34	10	1	45
CHK3	33	10	1	44
CHK1	33	10	.75	43.75
FSN11	33	7	3	43
EGN44	36	0	6	42
EDP20	37	4	.5	41.5
FSN9	38	7	5.5	40.5
FSN6	25	7	7	39
EDP22	34	4	.75	38.75
BVL70	32	10	3.25	38.25
EDP19	30	4	.5	34.5
EDP21	30	4	.5	34.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EDP23	27	4	.75	31.75
FSN12	22	7	2.75	31.75
FSN10	17	7	3.5	27.5

All Gullies

A comprehensive table including rankings of previously assessed gullies, newly assessed gullies, and inaccessible gullies is included as an attachment (Attachment 2) to this memorandum.

RECOMMENDATIONS

The 2025 gully inventory evaluated 17 new gullies and nine previously inaccessible gullies. Through the ranking process, the project team was able to identify gullies within the watershed district with high erosion potential and create a more comprehensive list of gullies within the LMRWD and their condition (Attachment 2). Based on the 2025 inventory efforts, Young Environmental recommends the following management strategies:

1. Due to the large number of gullies included in the ranking, we recommend that the LMRWD prioritize gullies for restoration on a continuous yearly cycle that alternates between completing a feasibility study for specific gullies one year, followed by completing restoration of the gullies the next year. Depending on the location and complexity of the gullies, three to six gullies should be recommended for feasibility studies each year. Table 3 shows the specific gullies recommended for feasibility studies and restoration in the next five years. Note: this table was previously included as Table 20 (Recommended Timeline for Restoration of Recommended Gullies) in the 2023 Gully Inventory and Condition Assessment Project.

Table 3. Gullies Recommended for Study and Restoration

Year	Gullies Recommended for Feasibility Studies	Gullies Recommended for Restoration Projects
2024	BVL62 SHK1 SHK10 SHK16	N/A
2025	MDH33 BVL16 MDH38	BVL62 SHK1 SHK10 SHK16
2026	BVL15 BLM67 BLM145	MDH33 BVL16 MDH38
2027	MDH21 MDH8 MDH16	BVL15 BLM67 BLM145
2028	CVR92 EDP16 BVL31	MDH21 MDH8 MDH16

2. The LMRWD should notify landowners of the gullies present on their properties, provide educational materials on managing and monitoring gully erosion, and work to offer financial support for remediation.

3. The LMRWD should continue to engage and work with the state agencies to find funding for gully implementation (restoration) projects

4. Increase coordination efforts with municipalities to align LMRWD restoration and investigation efforts with the comprehensive plan and applicable feasibility studies of the respective municipality. Coordination efforts should begin in Quarter 3 of the preceding year for which study or restoration will occur. This preemptive planning should eliminate redundant efforts between the municipalities and the watershed district, aligning Young Environmental's work plan with the goals of both local governmental units (watershed district and municipalities).

5. Work with LMRWD personnel to determine whether newly identified and surveyed gullies should be incorporated into the existing Table 3 (above). This table is used to guide the development of feasibility studies and restoration projects on a five-year rotation.

In past years, the LMRWD has collaborated with municipal partners and potential stakeholders to review the gully inventory and assessment, specifically strategizing ways to prioritize sites, stabilize gullies, and fund stabilization efforts of gullies and pipe outfalls. However, using the prioritization ranking system, the LMRWD can now more strategically identify and recommend restoration project locations to their partners. Additionally, if municipalities or other stakeholders approach the LMRWD for potential partnership on gully restoration projects, the LMRWD can use the developed ranking system to help determine whether a restoration project is a good investment of LMRWD funds.

Attachments

- Attachment 1—2023 Gully Inventory and Condition Assessment Project
- Attachment 2—Comprehensive Gully Inventory – Scored
- Attachment 3—2023 Gully Inventory and Condition Assessment Project Report (Appendix B)

Prepared for

LOWER MINNESOTA RIVER
WATERSHED DISTRICT

August 9, 2023

2023 Gully Inventory and Condition Assessment Project

2023 Gully Inventory and Condition Assessment Project

Prepared for

LOWER MINNESOTA RIVER
WATERSHED DISTRICT

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Final
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LIST OF ABBREVIATIONS

Abbreviation	Name/Term
2008 Project	Minnesota Conservation Corps 2008 Gully Inventory
2020 Project	LMRWD 2020 Gully Inventory and Condition Assessment
2021 Project	LMRWD 2021 Gully Inventory and Condition Assessment
2023 Project	2023 Gully Inventory and Condition Assessment Project
BLM	City of Bloomington
BVL	City of Burnsville
CHH	City of Chanhassen
CVR	City of Carver
EDP	City of Eden Prairie
EGN	City of Eagan
FSN	Fort Snelling
GIS	Geographic Information System
HVRA	High Value Resource Area
JKT	Jackson Township
LMRWD	Lower Minnesota River Watershed District
MDH	City of Mendota Heights
MPCA	Minnesota Pollution Control Agency
SHK	City of Shakopee

Abbreviation	Name/Term
SSOD	Steep Slopes Overlay District
SVG	City of Savage
TSS	Total suspended solids
USDA	United States Department of Agriculture
Young Environmental	Young Environmental Consulting Group, LLC

LIST OF TABLES

1 Executive Summary

This report is the third volume of the Lower Minnesota River Watershed District's (LMRWD) *Gully Inventory and Condition Assessment,* conducted by the district's technical consultant, Young Environmental Consulting Group, LLC (Young Environmental). The first two volumes were published in 2020 and 2021 and identified high- and very high-priority gullies within the watershed district based on their erosion potential and impact to LMRWD resources. The gully assessment this year was implemented to assess the high- and very high-priority gullies identified during past years to determine if the sites continue to pose a risk and identify appropriate candidates for potential restoration projects. The 2023 assessment consisted of four components: field preparation and training, field data collection, gully ranking, and recommendations.

Field Preparation and Training:

This phase of the project allowed the team to prepare for efficient fieldwork and established a foundation for analysis of the gullies. The team first completed an in-depth literature review to understand the cause and effects of gullies and to review previous gully reports from Young Environmental to understand the previous Survey123 erosion scoring system. Additional questions were added to Survey123 to allow for more structured details to assist in future gully ranking. The team reviewed a GIS map of the 315 gully locations, developed a preliminary fieldwork schedule, and began developing gully restoration priority factors.

Field Data Collection:

The fieldwork phase was used to assess the current condition of the gullies and note any factors that may be contributing to continued erosion or changes that occurred since the gully was last assessed. Over the course of four weeks, the project team visited each gully site and reevaluated the erosion score of the gullies using the Survey123 program. Photos and notes were collected at each site for future data analysis.

Gully Ranking:

The gully ranking process consisted of two parts. First, the sites were sorted into four categories: Public Safety Concern, Public No Safety Concern, Private Safety Concern, and Private No Safety Concern. Then the gullies were ranked by need for restoration based on a scoring system within their given categories. To quantitatively rank each gully, multiple factors were considered, including erosion potential score, proximity to LMRWD natural resources, and the number of Minnesota Pollution Control Agency (MPCA) sites marked as "under investigation" or an "active cleanup site" within a one-mile radius of the

site. Each factor was assigned points that correspond to varying rates of degradation and need for remediation to provide a final ranking score for each gully.

Results:

Young Environmental assessed 315 gullies throughout the LMRWD. 274 were included in the ranking process, 16 gullies were found to be duplicate data points, 11 were no longer considered a gully, and 14 were inaccessible, excluding 41 gullies total from the ranking process. The average erosion score for all the gullies was 30.5, and the highest and lowest scores were 50 and 8, respectively. The city of Eden Prairie was found to have the highest average erosion score and the area of Fort Snelling was found to have the lowest average. The average ranking score was 39.8, while the highest and lowest scores were 61.5 and 17, respectively. Burnsville was found to have the highest average ranking score and the area of Fort Snelling had the lowest average ranking score.

Recommendations:

Following the ranking of all gullies assessed in the 2023 Project, Young Environmental recommends the following management strategies for gully restoration:

1. Prioritize gullies for restoration on a continuous yearly cycle that alternates between completing a feasibility study for specific gullies one year, followed by completing restoration of the gullies the next year. To begin this cycle, Young Environmental recommends the top three gullies in the Public Safety Concern category (BVL62, SHK1, and SHK10) as well as one notable gully (SHK16) that is encroaching on a public trail and posing a major safety concern.
2. Notify private landowners of gullies present on their properties and complete a high-level assessment of public outfalls to determine if any private gullies are caused by these public outfalls.
3. Utilize new LiDAR data to conduct a desktop analysis to identify gullies that have not yet been inventoried.
4. Conduct an accessibility assessment of the gullies that were considered inaccessible during field survey.

2 Introduction

Gully restoration of high-priority sites, particularly those in the steep slopes overlay district (SSOD) and near high-value resources, strongly aligns with several of the LMRWD watershed management goals under the issue of water quality. The LMRWD's priorities of surface water management, groundwater management, and unique natural resources management are all addressed by properly restoring actively eroding gullies within the watershed district. Specifically, this gully assessment and ranking follows strategy 1.3.1 from the watershed management plan, which is to provide strategic resource evaluation and management, and strategy 7.3.1 to continue work of addressing gully erosion. The gullies suggested for restoration are determined not purely from their erosion potential, but also by their impact on important LMRWD's resources and alignment with the LMRWD management plan.

To support LMRWD's goals to address gully erosion, the 2023 Gully Inventory and Condition Assessment Project (2023 Project) was implemented to assess and rank gullies throughout the LMRWD. The 2023 Project is a continuation of three previous gully assessments. The first project was conducted by the Minnesota Conservation Corps in 2008 where gullies were located on the north side of the Minnesota River using ArcGIS (2008 Project). Following the 2008 Project, LMRWD tasked Young Environmental to continue monitoring gullies in the LMRWD in 2020 and 2021. The 2020 Gully Inventory and Condition Assessment Project*,* Volume 1 (2020 Project; LMRWD, 2020) was implemented to complete a gully and pipe outfall condition assessment and inventory throughout LMRWD, on the north side of the Minnesota River. This project was intended to provide information to municipalities on the current conditions of gullies and pipe outfalls identified in 2008 as well as identify new locations that may be contributing sediment to the Minnesota River (LMRWD, 2020). Similarly, the 2021 Gully Inventory and Condition Assessment Project, Volume 2 (2021 Project; LMRWD, 2022) continued the gully assessments by surveying gullies on the south side of the Minnesota River to identify new gullies in areas not previously surveyed in 2008 or 2020 (LMRWD, 2022). As part of both the 2020 and 2021 projects, each gully was given a risk category of Very Low, Low, Moderate, High, or Very High based on the erosion potential of the gully combined with its potential to cause degradation to LMRWD resources. The recommended action for gullies identified as High was further study, and the recommended action for gullies identified as Very High was mitigation. Using the prioritization from the 2020 and 2021 projects, the 2023 Project assessed 315 High and Very High priority gullies throughout the entire watershed. Gullies visited are in the cities of Bloomington, Burnsville, Carver, Chanhassen, Eagan, Eden Prairie, Jackson Township, Mendota Heights, Savage, and Shakopee. The objective of the 2023 Project was to continue monitoring and assessing the conditions of High and Very High priority gullies and to recommend specific gullies for restoration projects using a gully ranking system developed by Young Environmental.

Team members involved in this project include the project manager, Hannah LeClaire; the project team, Faith Breeden, Stefanie Gronlund, and Leila Khalid; geographic information systems (GIS) analyst, Chris Ross; and principal-in-charge and quality control reviewer, Della Schall Young. The following sections of this report present Young Environmental's methodology, findings, and recommendations for future gully restoration projects.

3 Field Preparation and Training

To prepare for the 2023 Project, the project team was provided various forms of training to ensure the safety and accuracy of the gully inventory project. The project team was first provided with Gully 101 training to define a gully, identify gully characteristics, and understand the causes and effects of gully formation. The project team then conducted a literature review to examine gully assessments from other organizations, which provided critical information to use when reassessing the High and Very High priority gullies. Literature sources and the purpose for reviewing each document are provided in Table 1. The project team was also provided training on how to correctly score the erosion potential of gullies using the Survey123 application (described in Section 4) through ArcGIS during a trial field inspection. This process ensured consistency with the 2020 and 2021 assessments.

Table 1. Literature Review Sources and Purpose

Literature (Author)	Purpose
The City of Burnsville Slope Stability Analysis; WSB Project No. 011693-000 (WSB: Jen Holmstadt and Nick Bradley)	Provided a local case study for developing a risk analysis method for determining unstable slopes. This process was useful for creating a similar method for gully erosions.
National Engineering Handbook: Chapter 10 – Gully Treatment (USDA) Gully Erosion Assessment and Control Guide (HDR, Engineering Inc.) South East Local Land Services Gully Erosion Assessment and Control Guide (South East LLS) Technical Supplement 14P – Gullies and Their Control (USDA) Gully Control in SAT Watersheds (Pathak et al.)	Identified the main characteristics of gullies and the most common treatment measures used to stabilize gullies.
Seminary Fen/Chaska Ravine Restoration Project (LMRWD)	An informative local case study that documented the reasons for this specific ravine restoration, the project description, funding details, and future maintenance plans. This case study presented the entire process of a ravine stabilization project.

Literature (Author)	Purpose
Strategic Resources Evaluation of the LMRWD (HDR Engineering, Inc.)	Described the method used to differentiate Strategic Resources into either Category 1 or Category 2. This helped inform the impact tiers for the gully ranking system that was developed.

The project team planned to visit a total of 315 gully sites over the course of 5 weeks (Figure 1) and compiled a fieldwork plan spreadsheet that included site information, site access points, and planned visit dates to ensure all sites would be evaluated within the project timeline. The project team decided to include six additional questions in Survey123 to help evaluate the overall condition of the surveyed gullies and better support the 2023 ranking process (Table 2).

Table 2. Additional Questions added to Survey123

Additional Survey123 Questions	Rationale
Is there existing infrastructure near the gully?	If there are homes or buildings near the gully, there may be greater risk of property damage or potential injury.
Is there existing erosion control?	Existing erosion control may cause the gully to stabilize, making another project unnecessary on the site. Erosion control also shows previous action has been taken to attempt to remediate the site.
Does the gully appear stable?	While Survey123 is used to determine the erosion score, an additional question to note the observed stability allowed the team ease in reviewing gullies that were perceived to be unstable.
Is the material in the gully compact?	The level of compaction of the material in the gully relates to how easily the surface will erode. The more compact the material, the more stable the gully. This also differentiates soils of the same general type.
Where is the location of groundwater seepage?	Water seepage from groundwater on the banks of the gullies causes more impact than seepage from the bottom of the gullies; therefore, it is important to note the source of the water.
Is the site accessible?	Gullies must be accessible on foot by fieldwork staff for gullies to be assessed and restored. Construction equipment must be able to reach the gully without causing further damage to the environment. Gullies that are surrounded by dense vegetation or have steep, unstable slopes are evaluated for their accessibility.

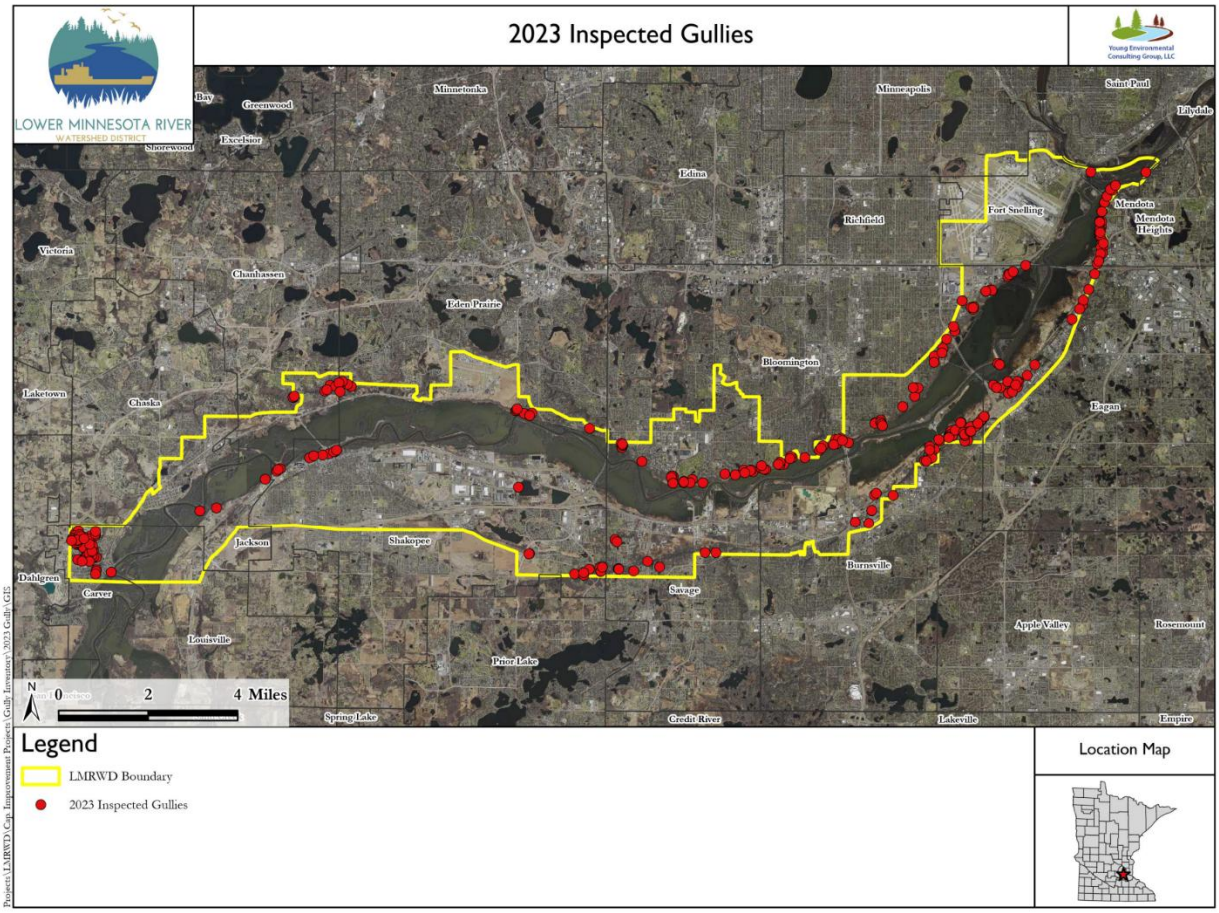

Figure 1. Map of all gully sites assessed during the 2023 Gully Inventory within the LMRWD boundary

4 Gully Ranking Methods

4.1 Field Data Collections

To reevaluate the erosion potential of gullies that were previously ranked as High or Very High priority from the 2020 and 2021 reports, the project team used the Survey123 program, which allows for quantitative measurement of the gullies and is completed in the field using iPads. Because there was no consistent naming convention between the 2020 and 2021 projects, for the 2023 Project, all gullies were given an updated gully ID for consistency. The new gully IDs include an abbreviation for the city in which they are located and a unique identification number. To score the gullies, the project team answered multiple-choice questions in Survey123 about various aspects that influence erosion probability such as vegetation cover, gully size, shape, and material (Appendix A). Each question has an associated point value that adds up to the erosion potential score. The greater the point value, the more potential the gully has for further erosion (Appendix B, Table 2). Multiple photos of each gully were also collected in Survey123.

4.2 Categorization and Point Assignments

To rank a large inventory of gullies effectively and efficiently, the project team established a quantitative method of scoring to assess the need for gully restoration. The gully ranking was separated into two parts. Part 1 categorizes the gullies into four separate categories based on the initial field screening, accessibility, property type, and safety concerns (Figure 2). Each category is given a restoration priority level of High, Moderate, or Low as shown in the legend in Figure 2. Gullies within the public safety concern list are given the highest restoration priority due to the 1) presence of a safety concern and 2) the location on public property. Because cities and other local government units manage public property, there is simplicity in jurisdiction and partnership to manage and restore gullies. Projects on private property often have complexities that could lead to legal or statutory conflicts. In contrast, gullies located on private land with no safety concerns are categorized as lower restoration priority due to the complexity of project planning on private land and the lack of safety concerns near the gully. Part 2 of the gully ranking consists of assigning point values to each gully determined by the erosion potential score from the field survey, the gully's proximity to LMRWD resources, and the number of potentially contaminated MPCA sites within a 1-mile radius of the gully. Refer to Appendix B for a detailed description of the gully ranking categories and the overall process.

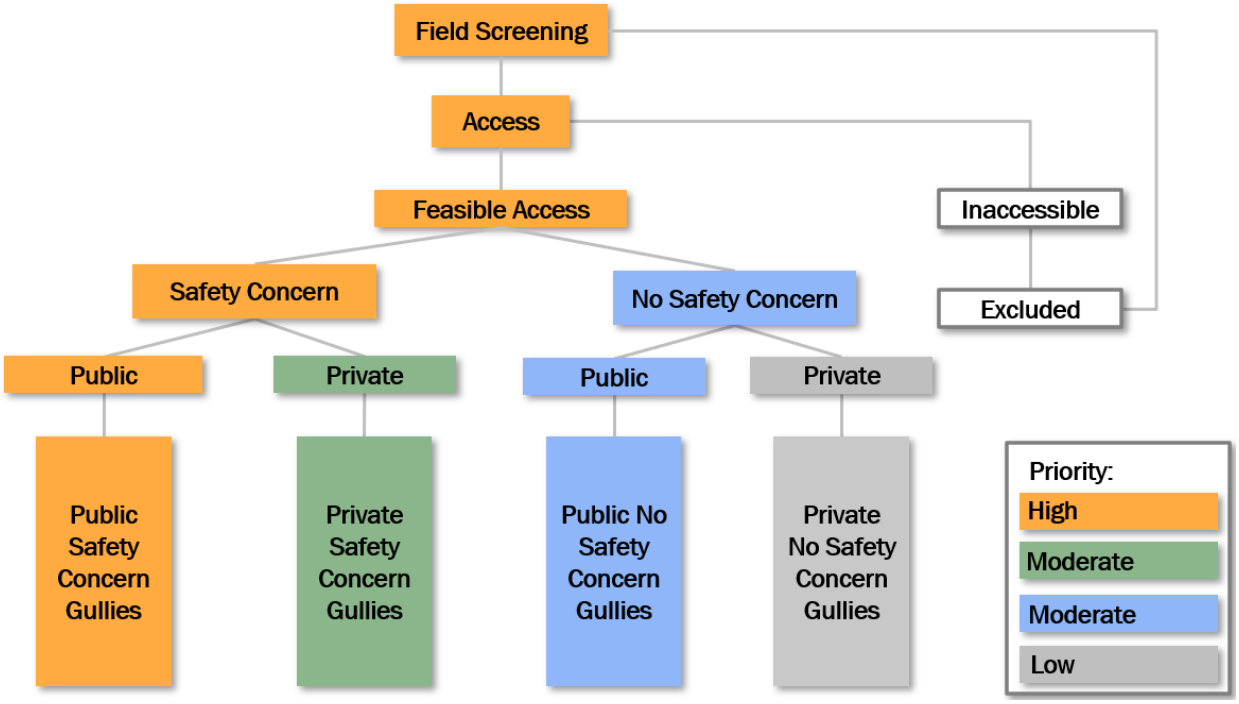

Figure 2. Flow chart to depict the organization of gullies prior to numerical ranking. Gullies are organized into one of the four lists considering accessibility, safety concerns, and property type.

5 Results

5.1 City Overview

As part of the 2020 and 2021 projects, the LMRWD partnered with cities in the LMRWD to identify gully locations and collaborate on next steps for high-priority sites. The 2023 Project aims to continue this partnership by identifying high-priority restoration projects where funding and resources can be pooled to implement a project. The following sections offer a brief summary of each community evaluated, including the conditions encountered in the field, areas of concern, and restoration potential.

5.1.1 Bloomington

The City of Bloomington is located in Hennepin County on the north side of the Minnesota River. Within Bloomington, 73 known gullies and 2 new gullies were surveyed in 2023 and have an average erosion score of 30.7. Many of the gullies in Bloomington are characterized by dense vegetation and are located on private property, which creates a greater safety risk for residents, but can also make restoration harder to fund. In addition, when comparing erosion scores from previous years, nearly all gullies surveyed had decreased in erosion score, indicating some stabilization of the gully without remediation practices.

5.1.2 Burnsville

The City of Burnsville is located in Dakota County along the south side of the Minnesota River. Within Burnsville, 47 gullies were surveyed and have an average erosion score of 28.9. Gullies in Burnsville are typically located on private property, which resulted in numerous interactions with homeowners. Through these interactions with homeowners, the project team was notified of the rapid growth of nearby gullies and of the decline in water quality of a pond near Black Dog Lake.

5.1.3 Carver

The City of Carver is located in Carver County along the north side of the Minnesota River. Within Carver, 66 gullies were surveyed and have an average erosion score of 33.6. The area of Carver that was included within this round of surveys was undergoing rapid development of suburban homes, which has resulted in extensive construction work throughout the area and may be contributing to the development of gullies due to new stormwater outfalls and increased runoff from residential properties. Carver also had the greatest number of erosion control tactics near the gullies such as silt fences, sandbags, and signage to notify residents of the environmental harm of increased erosion. Access to the gullies in Carver was difficult due to dense vegetation and steep slopes. In addition, many of the gullies reported in 2020 and 2021 had converged into single larger gullies.

5.1.4 Chanhassen

The City of Chanhassen is located in Carver County along the north side of the Minnesota River. Within Chanhassen, only 7 gullies were surveyed and have an average erosion score of 32.3. Many of the gullies surveyed in Chanhassen were given high erosion potential scores. The majority of the gullies in Chanhassen were located on or near private residential properties and after speaking with homeowners, the Young Environmental project team was notified of gullies in the area that were not previously surveyed.

5.1.5 Eagan

The City of Eagan is located within Dakota County on the south side of the Minnesota River. Within Eagan, 22 gullies were surveyed and have an average erosion score of 22.2. Many of these gullies were located on private land near the Union Memorial Railroad, which was difficult to access due to steep slopes and dense vegetation. As the average erosion score reflects, many of the gullies were small and at a low risk for erosion. These gullies were likely marked as high priority due to their proximity to valuable resources; however, upon further inspection, they were found to be at low risk for erosion.

5.1.6 Eden Prairie

The City of Eden Prairie is located within Hennepin County and is on the north side of the Minnesota River. Within Eden Prairie, 14 gullies were surveyed and have an average erosion score of 36.1. Gullies within Eden Prairie were on both public and private property. Gullies on public property were primarily located within the Richard T. Anderson Conservation Area and were given high erosion scores. The Richard T. Anderson Conservation Area's gullies were accessible via trails, and all converged into one system with one gully often flowing into the next. Other clusters of gullies in Eden Prairie were located deeper into the woods, accessible through residential homes, but not encroaching upon them.

5.1.7 Jackson Township and Shakopee

The City of Shakopee and Jackson Township are both located within Scott County and are on the south side of the Minnesota River. Within Shakopee and Jackson Township, 25 gullies were surveyed and have an average erosion score of 29.9 and 31.7, respectively. Gullies within Shakopee were typically located on private property; however, there were some located on public land on the banks of the Minnesota River. These gullies clearly deposit sediment directly into the river and pose a greater safety risk due to their proximity to nearby public parks and greenspaces. Gullies within Jackson Township were large and also near the Minnesota River; however, access to these sites is difficult, which can limit the ability for restoration.

5.1.8. Mendota Heights

The City of Mendota Heights is located within Dakota County and is on the south side of the Minnesota River. Within Mendota Heights, 26 gullies were surveyed and have an average erosion

score of 30.5. All the gullies are on public land and are either near public parks or are near the Union Memorial Railroad. Gullies in Mendota Heights ranged in severity where some gullies were more similar to a steep slope with no defining gully features, while others had very high erosion scores. The main concern in this area is the proximity to high value resources such as wetlands.

5.1.9 Savage

The City of Savage is located within Scott County and is on the south side of the Minnesota River. Within Savage, 8 gullies were surveyed with an average erosion score of 25.1. All gullies were located on private property, which resulted in numerous interactions with homeowners. All of the gullies were given erosion scores below 30 due to extensive vegetation cover and few signs of recent erosion. However, much of the vegetation cover was dominated by buckthorn, so if there are efforts to remove buckthorn in this area, the need for remediation may need further evaluation. In addition, many of the gullies previously surveyed were found to be similar to steep hillslopes with no defining gully features like apparent headcuts or banks and showed no signs of degradation.

5.2 Erosion Potential Score Summary

The average erosion potential score, calculated with the Survey123 field assessment, for all gullies surveyed, was 30.5, and the highest and lowest scores were 50 and 8, respectively. The low score of 8 is due to riprap being added and effectively stabilizing the gully. The average erosion potential score per city is shown in Figure 3, where Eden Prairie was shown to have the highest average erosion potential score. This is most likely due to the smaller number of gullies surveyed in Eden Prairie (14) and the location of several within the Richard T. Anderson Conservation Area, where the potential for erosion is very high.

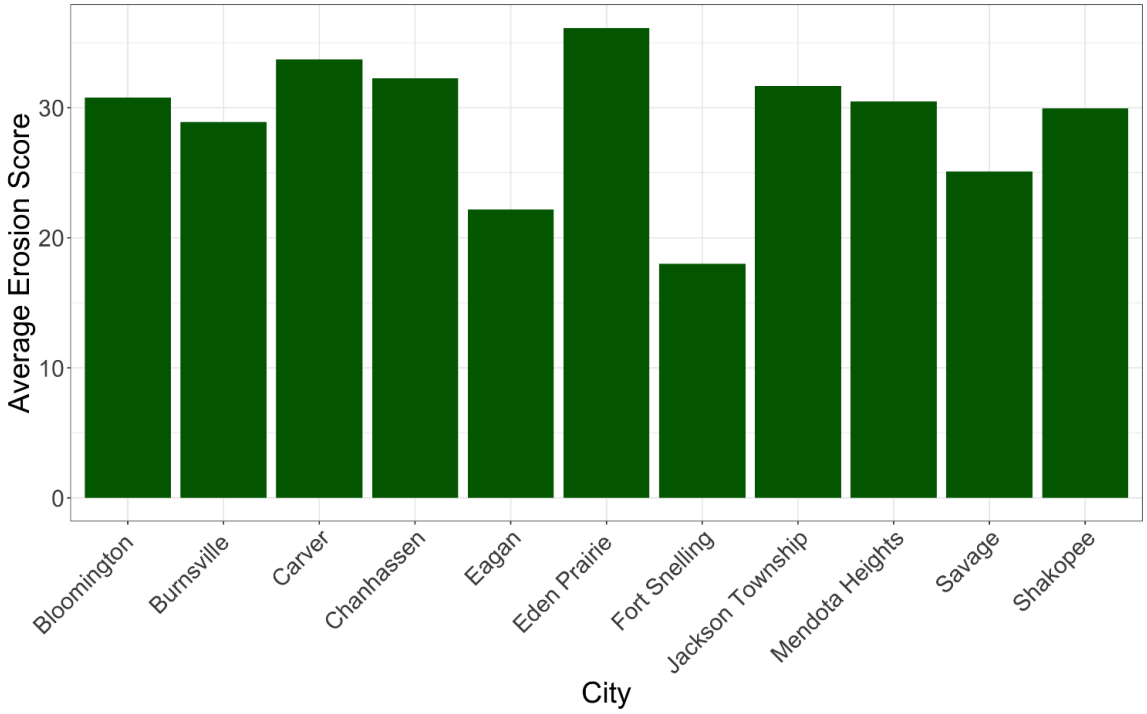

Figure 3. Bar plot of average erosion scores organized by city.

5.3 Gully Ranking Summary

The average gully ranking score (which includes the erosion potential score, proximity to LMRWD resources, and quantity of MPCA sites) across all gullies surveyed was 39.8, where the highest and lowest score was 61.5 and 17, respectively. Average ranking score sorted by city is shown in Figure 4, where Burnsville had the highest average ranking score.

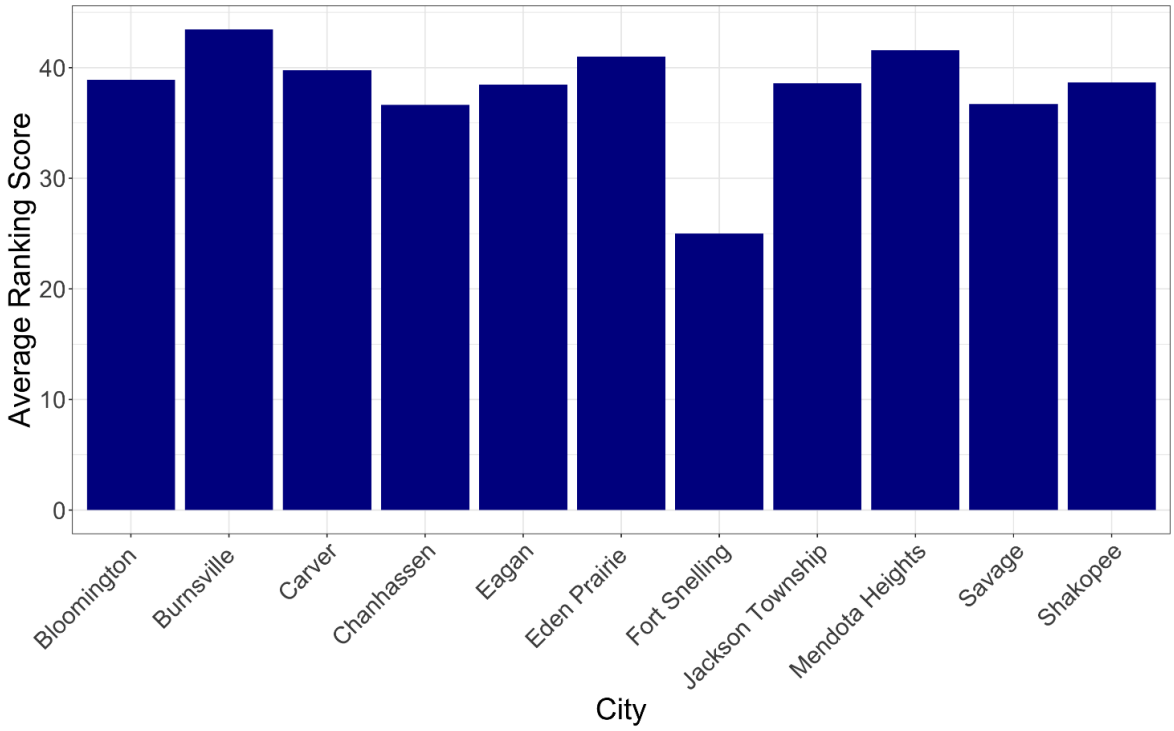

Figure 4. Average Ranking Score by City

The overall ranking scores for each individual gully are plotted in Figure 5 and summarized in the Overall Ranking Score column in Table 3.

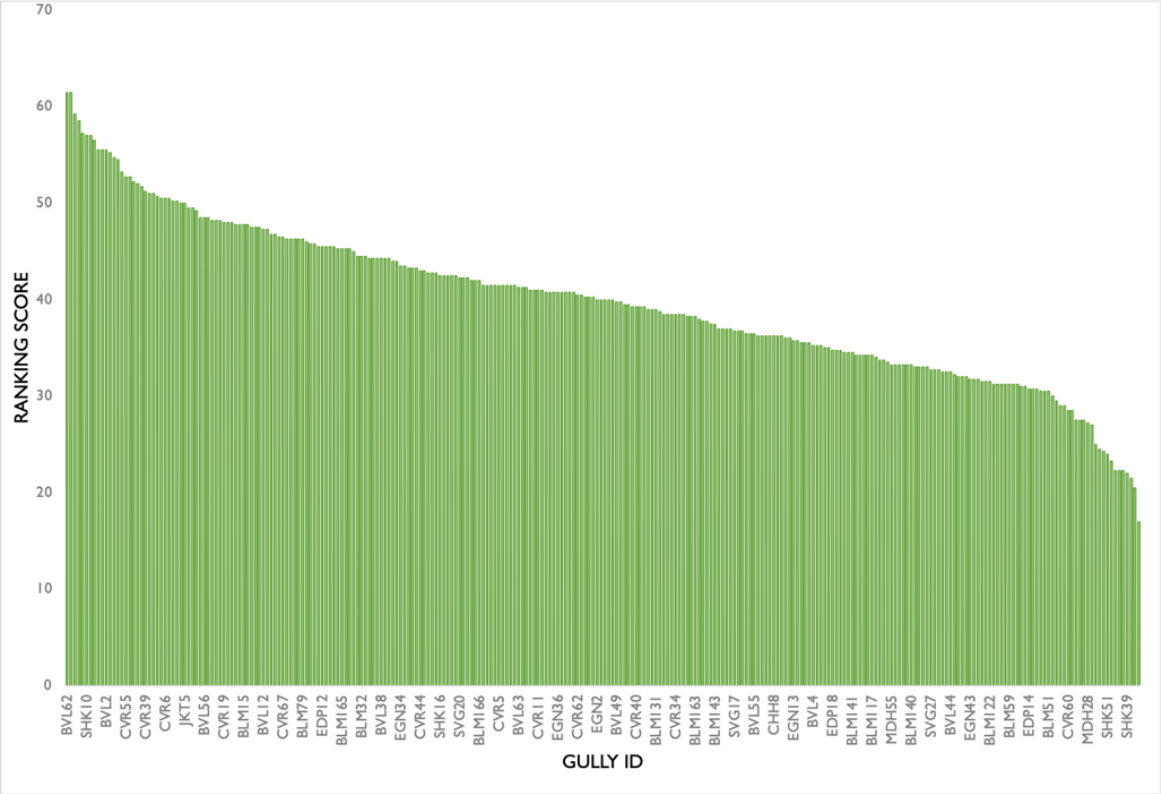

Figure 5. Overall Gully Ranking Scores

Table 3. Gully Ranking Scores

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BVL62	47	10	4.5	61.5
BVL3	44	10	7.5	61.5
BLM68	44	10	5.25	59.25
CVR81	50	7	1.5	58.5
BLM78	50	7	0.25	57.25
SHK10	42	7	8	57
SHK1	42	7	8	57
BVL13	42	10	4.5	56.5
MDH33	42	10	3.5	55.5
CVR38	47	7	1.5	55.5
BVL2	38	10	7.5	55.5
BVL69	38	10	7.25	55.25
BLM154	39	10	5.75	54.75
BVL16	40	10	4.5	54.5
MDH38	40	10	3.25	53.25
CVR55	45	7	0.75	52.75
BVL15	39	10	3.75	52.75
EDP2	45	7	0.25	52.25
SHK3	37	7	8	52
BLM67	36	10	5.75	51.75
CVR39	43	7	1.25	51.25
CVR76	43	7	1	51
CVR56	43	7	1	51
MDH21	38	10	2.75	50.75
CVR7	42	7	1.5	50.5
CVR6	42	7	1.5	50.5
BLM145	44	4	2.5	50.5
MDH8	37	10	3.25	50.25
BVL10	34	10	6.25	50.25
MDH16	37	10	3	50
JKT5	45	4	1	50
EDP16	42	7	0.5	49.5
CVR92	42	7	0.5	49.5
SHK6	38	10	1.25	49.25
MDH7	35	10	3.5	48.5
BVL56	37	10	1.5	48.5
BVL31	32	7	9.5	48.5
MDH34	35	10	3.25	48.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EDP17	39	7	2.25	48.25
CVR18	40	7	1.25	48.25
CVR19	40	7	1	48
CVR15	47	0	1	48
BVL11	31	10	7	48
EGN17	29	10	8.75	47.75
BVL50	32	10	5.75	47.75
BLM15	40	4	3.75	47.75
BLM113	40	4	3.75	47.75
EGN5	29	10	8.5	47.5
CVR3	39	7	1.5	47.5
CHH6	39	7	1.5	47.5
BVL12	35	10	2.25	47.25
BLM18	39	4	4.25	47.25
BVL9	34	10	2.75	46.75
BLM148	40	4	2.75	46.75
CVR8	38	7	1.5	46.5
CVR67	38	7	1.5	46.5
SHK2	35	10	1.25	46.25
EGN3	28	10	8.25	46.25
BVL14	32	10	4.25	46.25
BLM84	39	4	3.25	46.25
BLM79	39	7	0.25	46.25
BLM169	39	4	3	46
EGN24	31	10	4.75	45.75
BVL37	29	10	6.75	45.75
SHK15	38	4	3.5	45.5
EDP12	37	7	1.5	45.5
CHH9	37	7	1.5	45.5
BVL34	29	7	9.5	45.5
BLM13	37	4	4.5	45.5
CVR98	37	7	1.25	45.25
BLM165	37	7	1.25	45.25
BLM102	37	7	1.25	45.25
BLM101	37	7	1.25	45.25
BLM142	41	0	4	45
BVL5	31	10	3.5	44.5
BLM32	38	4	2.5	44.5
BLM116	38	4	2.5	44.5
SHK36	33	10	1.25	44.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
MDH19	31	10	3.25	44.25
CVR71	43	0	1.25	44.25
BVL38	29	10	5.25	44.25
BLM82	37	7	0.25	44.25
BLM133	34	7	3.25	44.25
CVR74	43	0	1	44
CVR25	36	7	1	44
EGN34	26	10	7.5	43.5
BVL1	26	10	7.5	43.5
MDH31	30	10	3.25	43.25
CVR10	42	0	1.25	43.25
BLM156	36	7	0.25	43.25
CVR44	35	7	1	43
CVR37	35	7	1	43
EDP13	34	7	1.75	42.75
CVR24	35	7	0.75	42.75
BLM70	35	4	3.75	42.75
SHK16	32	7	3.5	42.5
JKT9	33	7	2.5	42.5
EDP5	42	0	0.5	42.5
CVR9	34	7	1.5	42.5
BLM107	35	4	3.5	42.5
SVG20	27	10	5.25	42.25
SHK43	31	10	1.25	42.25
CVR49	34	7	1.25	42.25
SHK11	27	7	8	42
EDP7	41	0	1	42
BLM166	33	7	2	42
SHK67	28	7	6.5	41.5
MDH39	29	7	5.5	41.5
EGN31	23	10	8.5	41.5
CVR68	33	7	1.5	41.5
CVR5	33	7	1.5	41.5
CVR43	40	0	1.5	41.5
BLM162	34	4	3.5	41.5
BLM123	35	4	2.5	41.5
BLM100	33	7	1.5	41.5
BVL63	26	10	5.25	41.25
BLM43	35	4	2.25	41.25
BLM33	35	4	2.25	41.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EGN29	23	10	8	41
CVR45	33	7	1	41
CVR11	33	7	1	41
BVL65	23	7	11	41
SVG4	27	10	3.75	40.75
SHK61	30	7	3.75	40.75
MDH37	37	0	3.75	40.75
EGN36	23	10	7.75	40.75
EDP9	40	0	0.75	40.75
CVR23	33	7	0.75	40.75
BVL54	20	10	10.75	40.75
BLM172	32	7	1.75	40.75
CVR62	32	7	1.5	40.5
BVL47	28	10	2.5	40.5
SHK8	29	10	1.25	40.25
EGN39	22	10	8.25	40.25
BVL60	26	10	4.25	40.25
EGN2	21	10	9	40
CVR79	32	7	1	40
CVR75	39	0	1	40
BVL42	27	10	3	40
BLM93	33	4	3	40
BVL49	28	10	1.75	39.75
BLM77	24	10	5.75	39.75
SVG18	26	10	3.5	39.5
CVR47	31	7	1.5	39.5
EDP4	39	0	0.25	39.25
CVR40	31	7	1.25	39.25
CVR27	38	0	1.25	39.25
BLM111	32	4	3.25	39.25
MDH15	26	10	3	39
EDP10	38	0	1	39
BLM131	29	7	3	39
BLM95	31	4	3.75	38.75
MDA57	26	7	5.5	38.5
EGN7	21	10	7.5	38.5
CVR66	30	7	1.5	38.5
CVR34	37	0	1.5	38.5
BVL58	25	10	3.5	38.5
BLM167	31	4	3.5	38.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EGN4	23	7	8.25	38.25
BVL30	25	10	3.25	38.25
BLM163	27	7	4.25	38.25
EGN26	20	10	8	38
EGN25	19	10	8.75	37.75
BLM57	30	7	0.75	37.75
BVL39	25	10	2.5	37.5
BLM143	29	4	4.5	37.5
EDP15	30	7	0	37
CVR57	29	7	1	37
BLM88	29	4	4	37
BLM120	32	4	1	37
SVG17	23	10	3.75	36.75
EGN42	24	10	2.75	36.75
BVL45	22	10	4.75	36.75
SVG26	29	7	0.5	36.5
CVR58	29	7	0.5	36.5
BVL55	24	10	2.5	36.5
EGN8	18	10	8.25	36.25
EGN6	21	10	5.25	36.25
CVR94	35	0	1.25	36.25
CVR65	35	0	1.25	36.25
CHH8	35	0	1.25	36.25
BVL68	21	10	5.25	36.25
BLM98	28	7	1.25	36.25
SHK58	23	10	3	36
CVR36	28	7	1	36
EGN13	22	10	3.75	35.75
BVL67	23	10	2.75	35.75
CVR90	27	7	1.5	35.5
BVL40	23	10	2.5	35.5
BLM158	28	7	0.5	35.5
BVL4	23	10	2.25	35.25
BLM168	28	4	3.25	35.25
BLM112	28	4	3.25	35.25
CVR46	27	7	1	35
BLM135	25	7	3	35
EDP18	27	7	0.75	34.75
BLM170	26	7	1.75	34.75
BLM152	27	4	3.75	34.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR22	27	7	0.5	34.5
CVR13	33	0	1.5	34.5
BLM141	26	7	1.5	34.5
CVR70	33	0	1.25	34.25
CHH4	33	0	1.25	34.25
CHH2	33	0	1.25	34.25
BVL48	21	10	3.25	34.25
BLM117	27	4	3.25	34.25
BLM54	28	4	2	34
SVG29	26	7	0.75	33.75
BLM105	26	4	3.75	33.75
CVR100	32	0	1.5	33.5
MDH55	20	10	3.25	33.25
MDH35	29	0	4.25	33.25
MDH20	20	10	3.25	33.25
BLM83	26	4	3.25	33.25
BLM80	26	7	0.25	33.25
BLM140	28	4	1.25	33.25
SHK49	32	0	1	33
CVR54	25	7	1	33
CVR53	25	7	1	33
BLM69	17	10	6	33
SVG27	25	7	0.75	32.75
BVL51	20	10	2.75	32.75
BLM90	25	7	0.75	32.75
CVR87	31	0	1.5	32.5
CVR50	31	0	1.5	32.5
BVL44	19	10	3.5	32.5
BVL20	19	10	3.25	32.25
CVR96	31	0	1	32
CVR91	24	7	1	32
BLM121	26	4	2	32
EGN43	19	10	2.75	31.75
BLM28	27	4	0.75	31.75
BLM153	24	4	3.75	31.75
SVG28	18	10	3.5	31.5
BVL57	18	7	6.5	31.5
BLM122	25	4	2.5	31.5
MDA1	21	7	3.25	31.25
EGN12	26	0	5.25	31.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR48	23	7	1.25	31.25
CHH7	30	0	1.25	31.25
BLM59	23	7	1.25	31.25
BLM138	25	4	2.25	31.25
BLM134	21	7	3.25	31.25
SHK62	18	7	6	31
SHK50	30	0	1	31
EDP14	23	7	0.75	30.75
CVR88	29	0	1.75	30.75
BLM94	23	4	3.75	30.75
CVR41	29	0	1.5	30.5
CVR16	29	0	1.5	30.5
BLM51	22	7	1.5	30.5
EDP11	29	0	1	30
BLM132	19	7	3.5	29.5
SHK48	28	0	1	29
EGN32	12	10	7	29
CVR60	21	7	0.5	28.5
BLM157	21	7	0.5	28.5
MDH54	23	0	4.5	27.5
CVR61	19	7	1.5	27.5
CHH5	19	7	1.5	27.5
MDH28	23	0	4.25	27.25
SHK55	26	0	1	27
FSN4	18	0	7	25
CVR101	23	0	1.5	24.5
BLM118	17	4	3.25	24.25
SHK51	23	0	1	24
JKT10	17	4	2.25	23.25
EGN10	8	10	4.25	22.25
CVR80	14	7	1.25	22.25
BLM58	14	7	1.25	22.25
SHK39	21	0	1	22
CVR28	14	7	0.5	21.5
BLM161	15	4	1.5	20.5
SHK44	16	0	1	17

Figure 6 shows how many sites were categorized into each list as explained in the Gully Ranking Process section of this report.

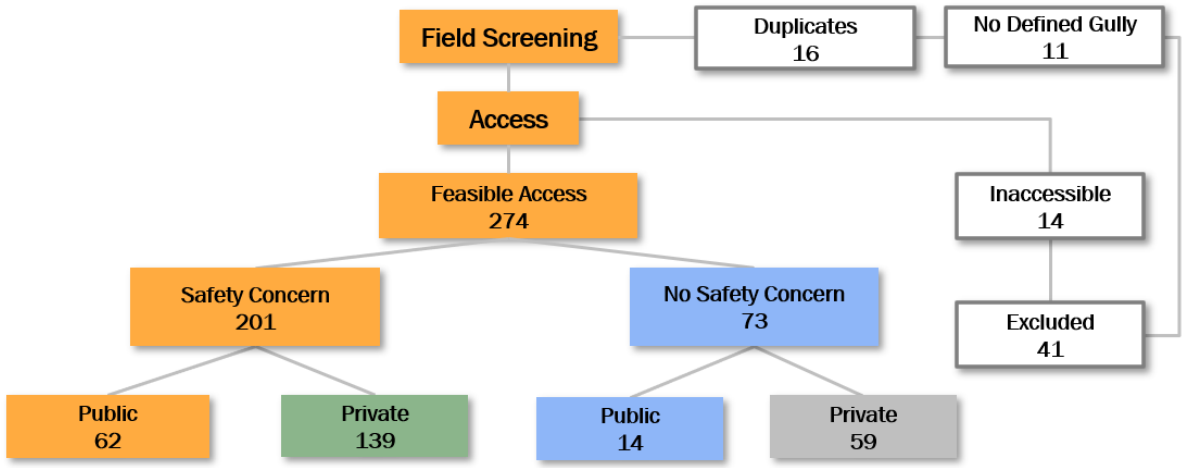

Figure 6. Total Number of Gullies in Each Step of the Categorization Process

5.4 Highest Overall Ranked Gullies

This section outlines the top ranked gullies prior to being organized into categories based on property type or safety concern. The three gullies with the overall highest gully ranking score are summarized in Table 4. These gullies earned the highest gully ranking scores due to their high erosion potential score and close proximity to LMRWD high value resources and MPCA sites.

Table 4. Overall Highest Ranking Gullies

Gully Name	Overall Ranking Score	Erosion Score	Impact Tier/ points	MPCA Sites Points	City
BVL3	61.5	44	A/10	7.5	Burnsville
BVL62	61.5	47	A/10	4.5	Burnsville
BLM68	59.25	44	A/10	5.25	Bloomington

The three gullies with the highest erosion potential score are summarized in Table 5. These gullies were identified to have the greatest risk of erosion; however, due to other factors such as proximity to LMRWD resources and number of MPCA sites, these gullies may not have been ranked within the top three of each category.

Table 5. Gullies with Highest Erosion Potential Score

Gully Name	Overall Ranking Score	Erosion Score	Impact Tier/ points	MPCA Sites Points	City
CVR81	58.5	50	B/7	1.5	Carver
BLM78	57.25	50	B/7	0.25	Bloomington
BVL62	61.5	47	A/10	4.5	Burnsville

5.5 Highest Ranked Gullies by Category

All gullies that were deemed accessible (details on determining accessibility are included in Appendix B) were categorized into one of four groups including, 1) private property with no safety concerns, 2) private property with safety concerns, 3) public property with no safety concerns, and 4) public property with safety concerns. The gullies were then ranked within their given category (Appendix C). The top three gullies in each category are described in Sections 5.5.1 through 5.5.4. Locations of each gully within the watershed district are shown in Figure 7.

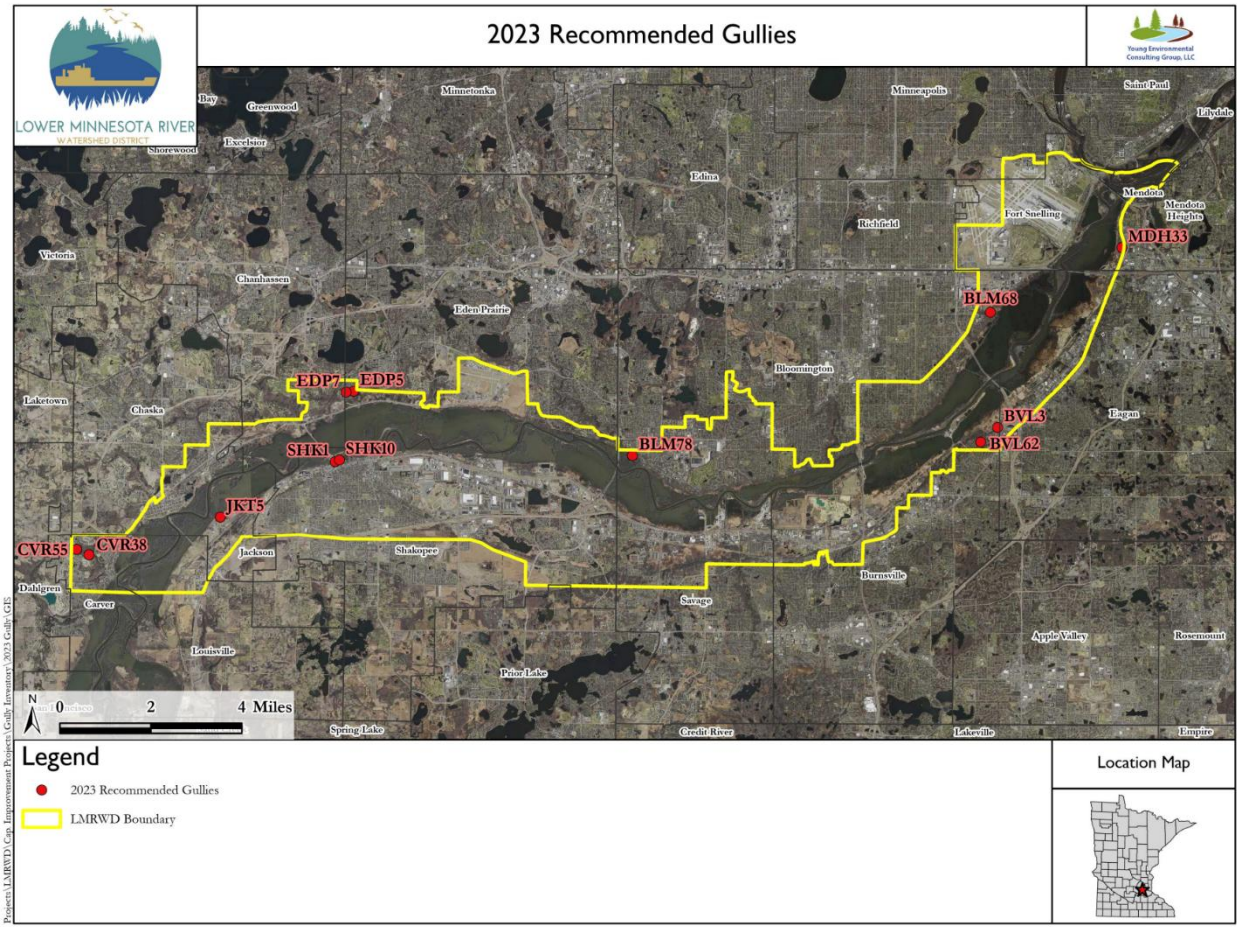

Figure 7. Map of recommended gully sites within the LMRWD boundaries

5.5.1 Gullies on Public Land with a Safety Concern

BVL62:

- **Location:** BVL62, located in Burnsville and was easily accessible behind homes on Chatham Ct N (Figure 7).
- **Size:** The gully is over 100 feet long, 15 feet high, and 1-5 feet wide at the bottom.
- **Safety:** This gully is within 50 feet of a home and a yard, making it a potential safety concern.
- **Vegetation:** The gully has no vegetation on the bottom and some newer vegetation on the banks.
- **Soils:** BVL62 consists of very sandy, non-compact material, which contributes to the overhanging banks and slumping observed.
- **Field Observations:** There is a large pipe outfall located near the headcut of the gully, which is surrounded by existing riprap (Figure 8). This pipe conveys water from BVL14 into BVL62. BVL14 was a much smaller gully on the other side of the pipe and did not receive a high-ranking score. There was also severe accumulation of sediment below the flowing water within BVL62.
- **Ranking Score Breakdown:** This gully has a total erosion score of **47**, which is greater than the 2021 assessment's score of **32**. This is due to the gully being longer, deeper, and less vegetated than in the last visit. BVL62 is in impact Tier A, meaning it is near high value resource areas in the LMRWD, adding **10** points to the final ranking score. BVL62 specifically impacts Black Dog Fen. It also has 18 sites of active investigation or cleanup within a 1-mile radius, adding **4.5** points to the final ranking score. Gully BVL62 received a total of **61.5** points (Table 6), which is the highest-ranking score given out of all the gullies surveyed.

Figure 8. Photos of gully BVL62. A) Headcut with large pipe outfall and surrounding rip rap. B) Facing North at bank from the side of the headcut. C) Gully bottom condition. D) Image of water pooling at bottom of rip rap

Table 6. BVL62 Ranking Score Summary

BVL62	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	47	10	4.5	61.5

SHK1:

- **Location:** SHK1 is on land owned by the City of Shakopee and is located off a trail accessible from Huber Park and flows directly into the Minnesota River (Figure 7).
- **Size:** The gully is less than 50 feet long, less than 3 feet deep and is V-shaped.
- **Safety:** The gully is considered a safety concern due to its proximity to a public trail.
- **Vegetation:** The gully has no vegetation on the bottom or the banks.
- **Soils:** The gully was observed to be very unstable because it is on the banks of the Minnesota River and consists of easily erodible sand (Figure 9).
- **Field Observations:** The gully included areas that were undercut causing hanging banks, and there was evidence of seepage leading to high erosion potential.
- **Ranking Score Breakdown:** The calculated erosion score was **42,** which is greater than the previous year's score of **35**. SHK1 is in impact Tier B because it directly discharges sediment to the Minnesota River, which is defined as an impaired water body, adding **7** points to the final ranking score. This gully has 32 active investigation or cleanup sites within a mile radius, adding **8** points and giving it a final score of **57** (Table 7).

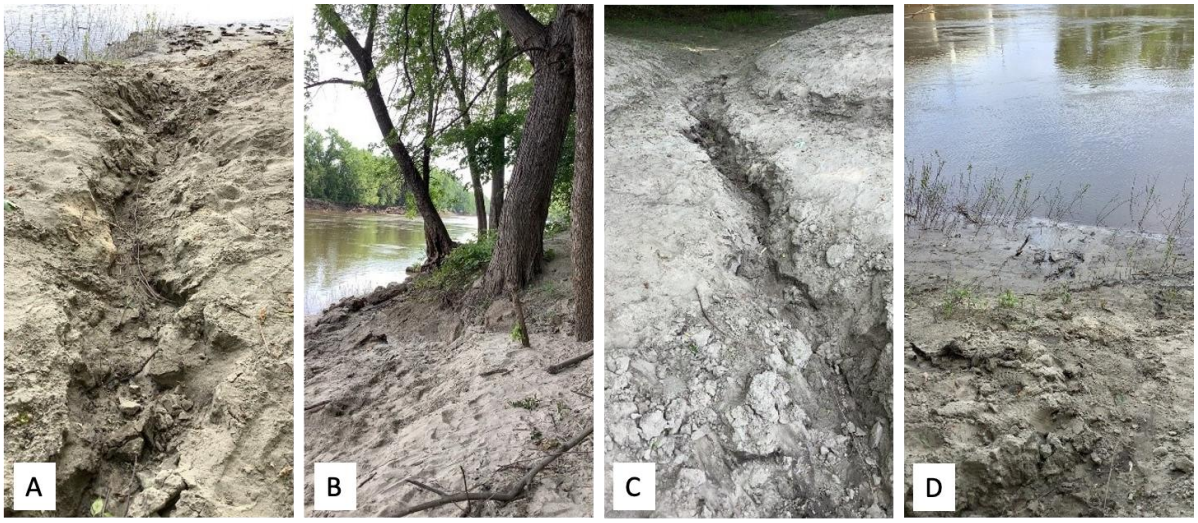

Figure 9. Photos of gully SHK1. A) Facing north looking down at gully. B) Facing south looking up at gully. C) Leaning tree along bank adjacent to the gully. D) Water at gully edge in the Minnesota River.

Table 7. SHK1 Ranking Score Summary

SHK1	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	42	7	8	57

SHK10:

- **Location:** SHK10 is also located off a trail accessible from Huber Park (Figure 7) and flows directly into the Minnesota River.
- **Size:** The gully is less than 50 feet long, less than 3 feet deep and less than 1 foot wide, with undercut areas and noticeable slumping.
- **Safety:** The gully is considered a safety concern due to its proximity to a public trail.
- **Vegetation:** The gully has no vegetation on the bottom or the banks.
- **Soils:** The gully consists of sand with observed seepage.
- **Field Observations:** While the gully is small, the area has undergone severe erosion as seen in Figure 10 where the top of a manhole and the concreate is fully exposed and apparent sedimentation can be seen at the outlet of the gully.
- **Ranking Score Breakdown:** The erosion potential score is **42,** which is higher than the previous erosion score of **34**. SHK10 falls into impact Tier B because of its proximity to the Minnesota River, which is an impaired waterbody, contributing **7** points to the final score. This gully was found to have 32 active investigation or cleanup sites found within a mile radius adding another **8** points, giving it a final score of **57** (Table 8).

Figure 10. Photos of gully SHK10. A) Facing northwest looking down at gully. B) Image of structure that is surrounded by evident erosion.

Table 8. SHK10 Ranking Score Summary

SHK10	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	42	7	8	57

5.5.2 Gullies on Private Land with a Safety Concern

BVL3:

- **Location**: BVL3 is located in Burnsville and easily accessed behind houses on McCool Court (Figure 7). This gully was connected to BVL1, which had a relatively low erosion potential score of 26.
- **Size**: The gully is over 100 feet long, 15 feet high, and V-shaped at the downstream end of the gully.
- **Safety**: This gully is within 50 feet of a home and a yard, making it a potential safety concern for those living in the area.
- **Vegetation**: There was limited vegetation on the bottom and banks of the gully (Figure 11).
- **Soils**: The gully consisted of a fine-grained cohesive material.
- **Field Observations**: There were areas with overhanging banks and subsequent slumping and flattened banks. There was observed evidence of groundwater upwelling or seepage from the gully bottom, but the water was not flowing, indicating that the gully was actively eroding and unstable.
- **Ranking Score Breakdown:** The gully ultimately has an erosion score of **44**, which is higher than the previous erosion potential score of **39**, due to the gully being longer and less vegetated. BVL3 is in impact Tier A contributing **10** points, as this site is near the location of the high value resource, Black Dog Fen. There are also 30 active investigation or cleanup sites within a 1-mile radius of this gully, which contributed **7.5** points. Gully BVL3 received a total of **61.5** points (Table 9), which is the highest score given from these assessments.

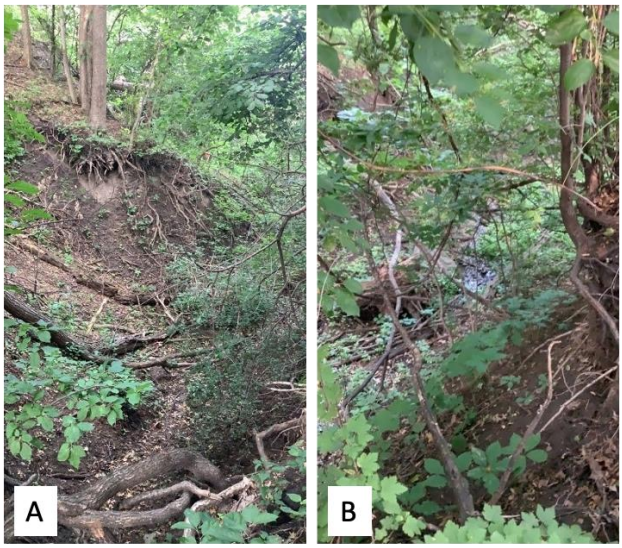

Figure 11. Photos of gully BVL3. A) Facing west by the headcut, viewing overhanging bank B) Seepage at gully bottom

Table 9. BVL3 Ranking Score Summary

BVL3	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	44	10	7.5	61.5

BLM68:

- **Location**: BLM68 is located off Old Shakopee East Road, extremely close to Long Meadow Lake (Figure 7). The access to this gully was simple as it was behind homes, but difficult to photograph within the gully due to the steepness of the slopes.
- **Size**: This gully is greater than 100 feet in length, greater than 15 feet in depth, and less than a foot in width.
- **Safety**: The gully is within 10 feet of a shed, making it a safety concern.
- **Vegetation**: There was limited vegetation on the bottom and banks of the gully (Figure 12).
- **Soils**: The gully material was sandy, making it more at risk for erosion.
- **Field Observations**: There were undercut areas causing slumping. Many fallen trees were observed in the channel and the gully was very unstable due to its extremely steep slopes (Figure 12).
- **Ranking Score Breakdown:** The final erosion potential score was calculated to be **44**. This gully fell into impact Tier A, due to its proximity to the high value resource Black Dog Fen, contributing **10** points to the final ranking score. Lastly, there were 21 active investigation or cleanup sites within a mile of the gully contributing another **5.25** points. The final score for this gully is **59.25** (Table 10).

Figure 12. Photos of gully BLM68. A) Facing southeast on bank, looking down at the gully. B) Image of large shed near the gully

Table 10. BLM68 Ranking Score Summary

BLM68	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	44	10	5.25	59.25

CVR81:

- **Location**: CVR81 is easily accessible off a community trail labeled the Purple Trail between Broadway North and Ironwood Drive and is located on private property (Figure 7).
- **Size**: The gully was over 100 feet long, over 15 feet deep, and V- shaped with hanging banks near the headcut.
- **Safety**: The proximity to a public trail categorizes this gully as a safety concern.
- **Vegetation**: The bottom and banks of the gully had no vegetation.
- **Soils**: The gully banks were made up of a sandy material, increasing the potential for erosion (Figure 13).
- **Field Observations**: Two drainage pipes were identified near the headcut of the gully which are likely the cause of the gully's continued development.
- **Ranking Score Breakdown:** CVR81 received a final erosion score of **50**, which is tied for the highest erosion potential score of all the gullies surveyed. Previously, CVR81 received an erosion potential score of **43**; however, the gully has become more V-shaped, developed overhanging banks, and had more sediment aggradation, increasing its erosion potential score during the 2023 Project assessment. CVR81 is within impact Tier B, as it affects the impaired waterbody of Spring Creek, accounting for **7** points toward its final score. CVR81 has 6 active investigation and cleanup sites within a mile radius, giving it an additional **1.5** points toward the final score. The final ranked score for this gully is **58.5** (Table 11).

Figure 13. Photos of Gully CVR81. A) Northeast looking down from headcut with view of outlet. B) East looking at new headcut development

Table 11. CVR81 Ranking Score Summary

CVR81	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	50	7	1.5	58.5

5.5.3 Gullies on Public Land with No Safety Concerns

CVR55:

- **Location:** CVR55 is located within the City of Carver and is accessible behind homes on Red Oak Ridge (Figure 7).
- **Size:** This gully is more than 100 feet long, over 15 feet in depth, and V-shaped.
- **Safety:** There is no existing infrastructure or erosion control near the gully, categorizing it as having no safety concerns.
- **Vegetation:** The gully banks and bottoms had some vegetation, but it was sparse. Most notably, the banks were vegetated in the previous survey, and sparse in the 2023 survey, indicating that the gully continues to grow more unstable.
- **Soils:** The gully material was comprised of sand along the banks, making it a greater erosion risk.
- **Field Observations:** There were numerous points where undercuts, overhanging roots, and leaning or fallen trees were observed (Figure 14). There are additional gullies of a lower risk connected to this gully; however, CVR55 seems to be the main contributor to the downstream erosion of nearby gullies.
- **Ranking Score Breakdown:** CVR55 received a previous erosion score of **32** and had a large increase in erosion since the last assessment. Due to its easily erodible material and large size, CVR55 received an initial erosion score of **45**. Seven points were added because the gully is in impact Tier B contributing **7** points, affecting the impaired waterbody Spring Creek, which is of some concern to LMRWD. There were also 3 active investigation or cleanup sites near the gully, adding **0.75 points** to the score. The total score for this gully was **52.75** (Table 12)

Figure 14. Photo of CVR55. Facing west looking downstream of the gully.

Table 12. CVR55 Ranking Score Summary

CVR55	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	45	7	0.75	52.75

SHK3:

- **Location:** SHK3 is located in Shakopee and on City-owned land located off a trail near Huber Park (Figure 7). It flows directly into the Minnesota River.
- **Size:** The gully is less than 50 feet long, less than 3 feet deep, and the gully bottom is V-shaped.
- **Safety:** This gully was defined as having no safety concerns.
- **Vegetation:** There were no signs of vegetation within or near the gully, which results in decreased bank stabilization
- **Soils:** The gully material is made up of easily erodible sand and could be visibly seen eroding directly into the Minnesota River upon inspection (Figure 15).
- **Field Observation:** At the time of the field inspection, water was actively flowing through the gully although there had been no recent rainfall, suggesting groundwater upwelling occurring in the gully. Silt fences and sandbags were present upstream of the gully; however, these erosion measures appeared ineffective at the time of the assessment.
- **Ranking Score Breakdown:** Due to these conditions, this gully received an erosion potential score of **37**. This gully was found to be within impact Tier B and **7** points were awarded to the gully ranking score. Lastly, 14 MPCA active investigation or cleanup sites were found within a 1-mile radius resulting in **8** points added. In total, SHK3 received a ranking score of **52** (Table 13) and was the second highest ranked gully on public property without a safety concern.

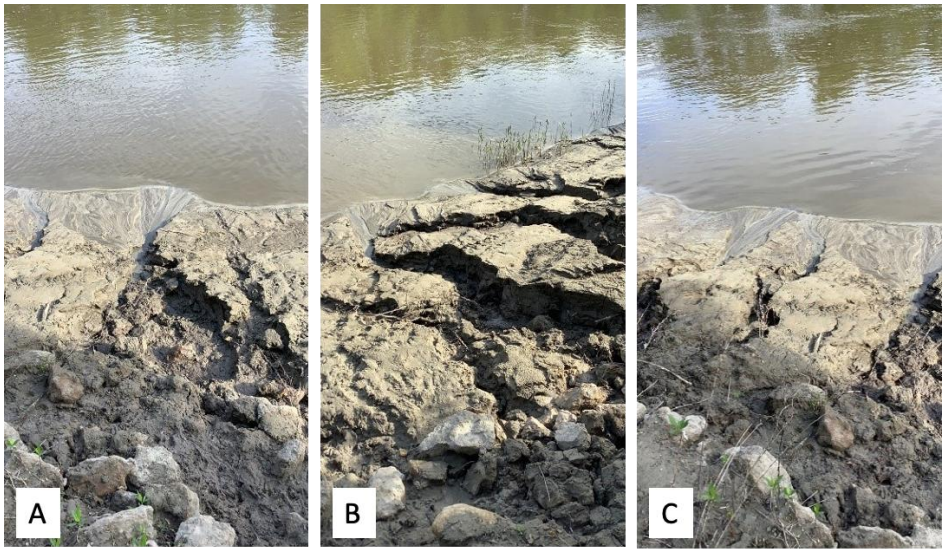

Figure 15. Photos of gully SHK3. A) Facing north looking downstream from the headcut. B) Facing northeast looking at the side of the gullies. C) Another view of the gully from the headcut.

Table 13. SHK3 Ranking Score Summary

SHK3	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	37	7	8	52

CVR56:

- **Location**: CVR56 is located in Carver between the streets of Broadway North, Red Oak Ridge, and Hackberry Court (Figure 7).
- **Size**: The gully is greater than 100 feet long, greater than 15 feet deep, and V-shaped.
- **Safety**: There is no existing infrastructure within 50 feet of this gully and it was not considered a safety concern.
- **Vegetation**: The bottom of the gully has no vegetation while the banks of the gully have some vegetation and leaning trees.
- **Soils**: The gully consisted of fine-grained cohesive material (Figure 16).
- **Field Observations**: CVR56 is connected to many other gullies throughout the area and forms a large system of gullies that run from behind the houses on Red Oak Ridge and Hackberry Court. These gullies would have to be considered for a joint restoration project to reduce the chances of gullies reforming after restoration. Throughout this gully there is clear evidence of seepage leading to running water along the bottom. The gully includes overhang and exhibits signs of severe degradation and active erosion.
- **Ranking Score Breakdown:** The erosion score of the gully was **43**. The previous erosion score for CVR56 was **41,** suggesting that the gully has not changed drastically but has continued to actively erode. The gully is in impact Tier B affecting the impaired waterbody Spring Creek and contributing **7** points towards the ranking score. Lastly, 4 active investigation and cleanup sites were found within a 1-mile radius, contributing 1 point towards the final score of **51** (Table 14).

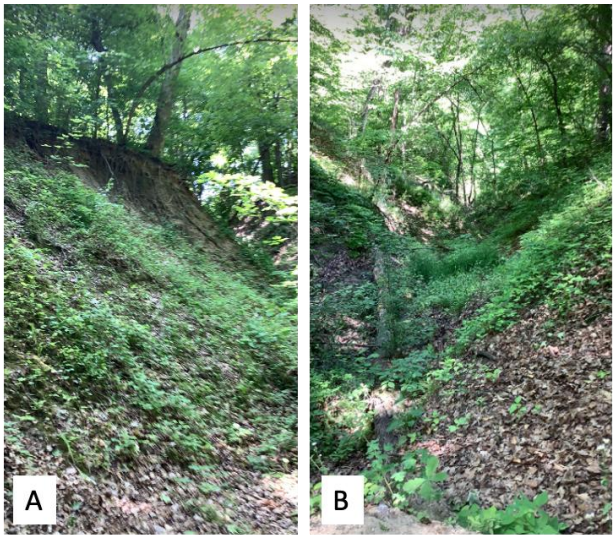

Figure 16. Photos of gully CVR56. A) Facing west looking towards left bank from inside. B) Facing north looking up gully.

Table 14. CVR56 Ranking Score Summary

CVR56	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	43	7	1	51

5.5.4 Gullies on Private Land with No Safety Concerns

BLM78:

- **Location:** BLM78 was somewhat difficult to access through the woods off West 110th Street in Bloomington (Figure 7).
- **Size:** The gully is more than 100 feet long, 15 feet high, and V-shaped.
- **Safety:** There is no existing infrastructure near the gully, therefore it is not considered to be an immediate safety concern.
- **Vegetation:** The gully has no vegetation on the bottom or banks.
- **Soils:** There is bare soil on the banks and the gully bottom, consisting of mostly sandy material.
- **Field Observations:** There is evidence of overhanging banks and slumping, due to the non-compact soil (Figure 17). There was a drainage feature observed as well as running water at the bottom of the gully, but due to extremely steep slopes, photos of these conditions are not available.
- **Ranking Score Breakdown:** This gully received a potential erosion score of **50,** which is higher than its previous erosion score of **45**. This change in erosion score is due to the change in gully depth and lack of vegetation during the 2023 Project assessment. This gully is located in impact Tier B contributing **7** points, due to its proximity to an impaired waterbody or tributary to a high value resource. BLM78 contained only 1 active investigation or cleanup site within a 1-mile radius, contributing **0.25** points to the ranking score. BLM78 resulted in a final score of **57.25** (Table 15).

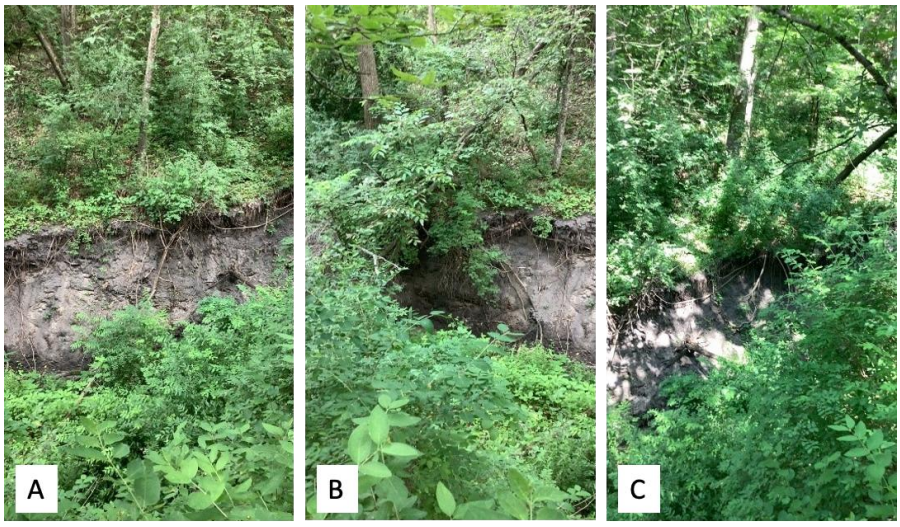

Figure 17. Photos of gully BLM78. A) Facing south looking across the gully at bare bank. B) Facing southeast at bare bank. C) Facing southwest at bare bank with leaning trees.

Table 15. BLM78 Ranking Score Summary

BLM78	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	50	7	0.25	57.25

CVR38:

- **Location:** CVR38 is located off Ironwood Drive in Carver (Figure 7), through somewhat dense vegetation to access the gully.
- **Size:** CVR38 is more than 100 feet long, 15 feet high, and V-shaped at the bottom.
- **Safety:** There is no existing infrastructure near the gully, therefore it is not considered to be an immediate safety concern.
- **Vegetation:** The banks have some vegetation, but the gully bottom is completely bare soil (Figure 18).
- **Soils:** It consists of sandy, non-compact material, which has led to overhanging banks and slumping.
- **Field Observations:** This gully contains no seepage or outfalls, but is very large.
- **Ranking Score Breakdown:** The current erosion score of this gully is **47**. CVR38 had a previous erosion score of **40** and previously had more vegetation on its banks. This increased erosion score indicates that CVR38 is unstable and should be considered for a restoration project. This gully fell within impact Tier B contributing **7** points, which is of some concern to the LMRWD as it is near an impaired waterbody, Spring Creek. There are 6 active investigation or cleanup sites within a 1-mile radius, bringing the total score for CVR38 to **55.5** (Table 16).

Figure 18. Photos of gully CVR38. A) Facing south looking up at headcut. B) Gully bottom material and aggradation.

Table 16. CVR38 Ranking Score Summary

CVR38	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	47	7	1.5	55.5

CVR76:

- **Location:** CVR76 was accessed by walking through several neighboring gullies off Green Ash Drive in the City of Carver (Figure 7).
- **Size:** This gully is over 100 feet long, 15 feet high, and V-shaped farther from the headcut.
- **Safety:** There is no existing infrastructure near the gully and not a safety concern.
- **Vegetation:** There is no vegetation on the banks or the bottom of the gully.
- **Soils:** The gully consists of sandy non-compact material.
- **Field Observations:** The slopes were extremely steep and there were significant overhanging banks, causing many leaning or falling trees within the channel (Figure 19). There was also severe sediment aggradation and degradation observed.
- **Ranking Score Breakdown:** The overall erosion potential score was **43**. In previous assessments, this gully received a score of **39**, but as the gully became deeper, narrower, and less vegetated, the erosion potential score increased. Additionally, the gully material is no longer sand and has eroded away to a fine-grained cohesive material. It was also noted from 2020 that the nearby homeowner had expressed concerns about the gully worsening. CVR76 is in impact Tier B contributing **7** points, due to its proximity to Spring Creek. There are 4 active investigation or cleanup sites within a 1-mile radius of CVR76, which contributed **1** point. This resulted in gully CVR76 receiving a final ranking score of **51** (Table 17).

Figure 19. Photos of gully CVR76. A) Facing east looking up at the gully. B) Facing east looking at headcut.

Table 17. CVR38 Ranking Score Summary

CVR76	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	43	7	1	51

5.6 Additional Gullies of Concern

Gullies were ranked to determine which are of greatest concern and are likely in need of immediate restoration; however, some gullies that were not ranked in the top of their categories are still of major concern. This could be due to heightened safety concerns or noticeable active erosion.

BVL15:

- **Location:** BVL15 is easily accessible from behind a home off Chatham Court South in Burnsville, but it is located on private land.
- **Size:** BVL15 is over 100 feet tall, 15 feet high, and V-shaped at the bottom.
- **Safety:** The home is within 50 feet of the gully, indicating a possible safety concern.
- **Vegetation:** No vegetation was found on the banks or bottom (Figure 20).
- **Soils:** The gully consisted of non-cohesive material that was not compact (Figure 20).
- **Field Observations:** There was a drainage feature observed, causing water to flow within the channel. Additionally, there was evidence of severe aggradation in the bottom of the gully.
- **Ranking Score Breakdown:** BVL15 received an erosion score of **39**. Previously, this gully had an erosion score of **37**, but has become more V-shaped and less vegetated. This gully is in impact Tier A, contributing **10** points for Black Dog Fen and has 15 active investigation or cleanup sites within a 1-mile radius for a total score of **52.75** (Table 18). Since the outfall is likely the cause of this erosion and it is near a residential home, BVL15 is a gully of concern.

Figure 20. Photos of gully BVL15. A) Facing south viewing the drainage feature in the headcut. B) Facing north looking down at the gully from bank. C) Bare bank of gully with water flowing in channel.

Table 18. BVL15 Ranking Score Summary

BVL15	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	39	10	3.75	52.75

SHK16:

- **Location:** SHK16 is easily accessible from a paved trail behind a trailer park.
- **Size:** SHK16 is less than 50 feet long, between 3-15 feet tall, and has a V-shaped bottom.
- **Safety:** The headcut of the gully is destroying the paved trail as it continues to erode, creating a serious safety concern (Figure 21).
- **Vegetation:** The gully contains some vegetation on the bottom and none on the banks.
- **Soils:** The material is made up of fine-grained cohesive material with parts of the trail present within the gully.
- **Field Observations:** There are also overhanging and flattened banks observed.
- **Ranking Score Breakdown:** SHK16 was given an erosion potential score of **32**. Previously, this gully had a similar erosion score of **31**. It is within impact Tier B, contributing **7** points, due to its proximity to the Minnesota River and has 14 active investigation or cleanup sites within a 1-mile radius, contributing **3.5** points to the final ranking score. Although the overall score for SHK16 is only **42.5** (Table 19) and it is located on private land, the gully is causing significant damage to infrastructure and poses a safety threat. Thus, SHK16 should be considered for a restoration project.

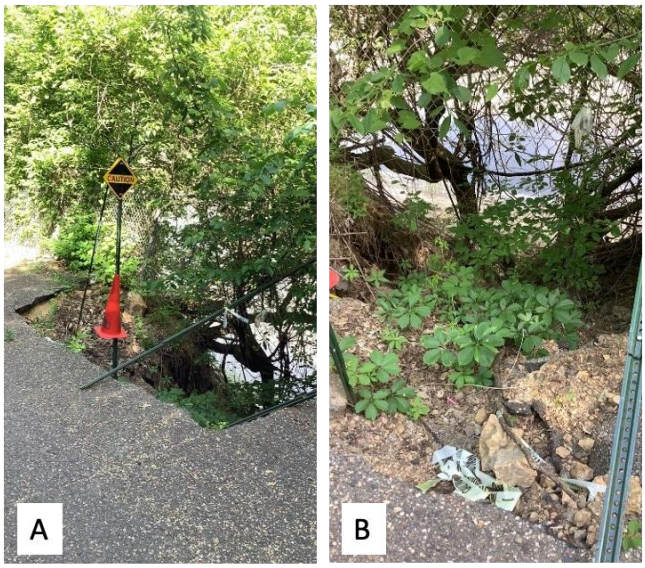

Figure 21. Photos of SHK16. A) Gully marked with sign as it encroaches on paved trail. B) Looking down at the gully from the headcut.

Table 19. SHK16 Ranking Score Summary

SHK16	Erosion Score	Impact Tier	MPCA Sites	Total Score
Points Assigned	32	7	3.5	42.5

Richard T Anderson Conservation Area (EDP 5, 7, 9, 10, 11 and CHH7):

- **Location:** These sites are found in a cluster off Flying Cloud Drive and can be accessed via community trails.
- **Size:** Almost all gullies in this system were longer than 100 feet and deeper than 15 feet.
- **Safety:** The gullies were split between safety and non-safety concerns due to their varying proximity to trails and homes**.**
- **Vegetation:** All gullies in this area contained little to no vegetation on the bottoms and banks.
- **Soils:** The gullies consisted mostly of fine grain cohesive soil, but were prone to erosion as well as in active erosion.
- **Field Observations:** Groundwater seepage was a common occurrence in these gullies often leading to flowing water. These gullies did not rank at the very top of their lists but are still notable due to their potential impact as a group and their location within a conservation area. Many of the gullies connect or flow into one another, so to effectively restore these gullies, all must be restored rather than selecting one from the cluster. If only one gully is restored, other gullies would continue to erode and potentially cause the restored gully to reform.
- **Ranking Score Breakdown:** The gullies in this area range from ranking scores of **30** to **42.5** (Table 3). Most of the points for these gullies came from the erosion score as they are found within impact Tier D and average only 1 point from investigation and cleanup sites.

5.7 New Gullies

During the 2023 gully inventory, the Young Environmental project team added four additional gullies to the inventory. The new gullies were in Bloomington or Chanhassen. New gullies were generally discovered by the team while traveling to other high priority sites; however, one gully was discovered after speaking with homeowners who notified the project team of increased erosion near a golf course. Two gullies, one in Bloomington and one in Chanhassen, are not currently high priority but should be added to the gully inventory and continued to be monitored. The other two gullies discovered were determined to have active erosion, are of high priority, and are described in the following section.

BLM173:

- **Location:** This gully was found while accessing another gully in the area and is located behind an assisted living center off 100th Street East in Bloomington.
- **Size:** The gully was measured to between 50 and 100 feet long, 15 feet deep, and is a V-shape.
- **Safety:** The gully is considered a safety concern due to its proximity to the assisted living center building.
- **Vegetation:** This gully has no vegetation present on the bottom or the banks (Figure 22).
- **Soils:** The gully consists of a sandy material.
- **Field Observations:** The gully is caused by several drainage pipes that run from the building directly into the gully. The gully is actively eroding, has steep slopes and overhanging banks (Figure 22).
- **Erosion Score Breakdown:** The erosion potential score for this gully is **48**. While the gully is not currently extremely long, it will continue to rapidly grow if no intervention takes place. Many other drainage pipes were observed around the area that could lead to similar issues.

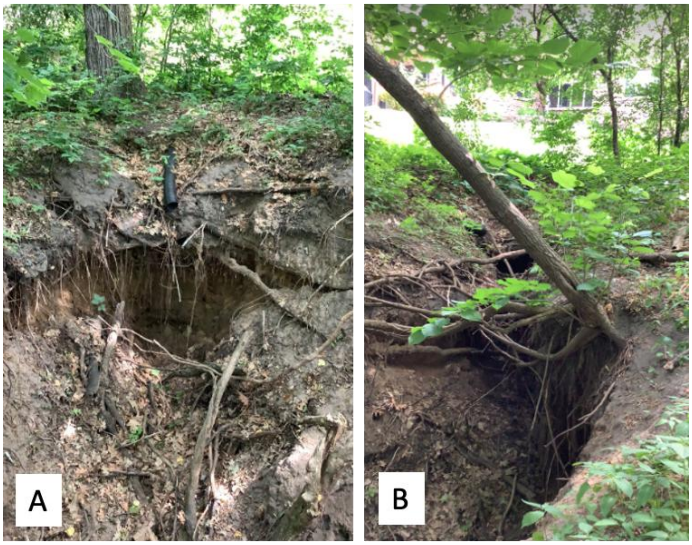

Figure 22. Photos of BLM173. A) Facing north looking at one headcut of the gully. B) Facing northeast looking at another headcut

CHH11:

- **Location:** This gully was located after speaking with a homeowner about erosion in the area. They informed the project team of a developing gully near Bluff Creek Golf Course off Creekwood Drive and stated it had been growing rapidly.
- **Size:** The gully is greater than 100 feet, deeper than 15 feet, and is V-shaped.
- **Safety:** This area is connected to a series of trails that run throughout the woods that many people frequent, making this gully a safety concern for the community.
- **Vegetation:** The gully banks and bottoms have no vegetation
- **Soils:** The gully consisted of a sandy, very erodible material.
- **Field Observations:** There are many overhanging roots and fallen trees leading to higher erosion potential (Figure 23). It was thought upon visual inspection that the gully was likely formed due to stormwater runoff from the nearby golf course parking lot.
- **Erosion Score Breakdown:** The total erosion score for this gully is **49**.

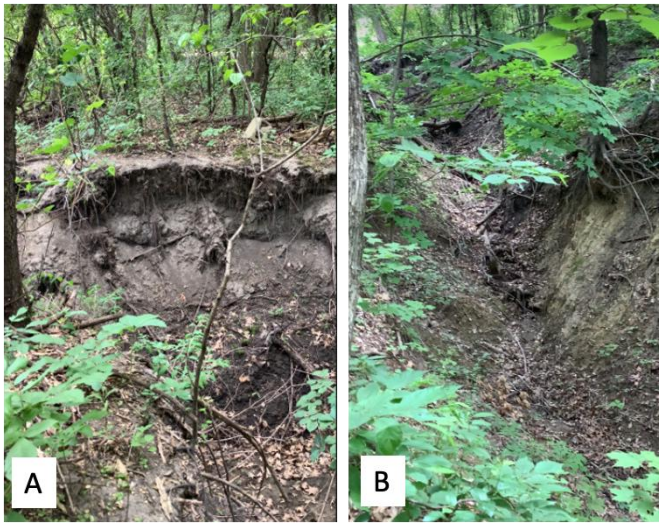

Figure 23. Photos of CHH11. A) Headcut viewed from gully bottom. B) V-shaped banks viewed from gully bottom.

6 Recommendations

The 2023 Project reevaluated 315 gullies through a field assessment and gully ranking process. Of these 315, 16 were determined to be duplicates, 11 were determined to not be a gully, 14 were inaccessible by foot, and 274 were located and analyzed. Two additional gullies were also found for a total of 276 presented throughout the report. Through the ranking process, the project team was able to identify gullies within the watershed district that should be prioritized for restoration. Based on the 2023 ranking process, we recommend the following management strategies for gully restoration:

1. Due to the large number of gullies included the ranking, we recommend that the LMRWD prioritize gullies for restoration on a continuous yearly cycle that alternates between completing a feasibility study for specific gullies one year, followed by completing restoration of the gullies the next year. Depending on the location and complexity of the gullies, three to six gullies should be recommended for feasibility studies each year. Table 20 shows the specific gullies recommended for feasibility studies and restoration in the first five years.

Table 20. Recommended Timeline for Restoration of Recommended Gullies

Year	Gullies Recommended for Feasibility Studies	Gullies Recommended for Restoration Projects
2024	BVL62 SHK1 SHK10 SHK16	N/A
2025	MDH33 BVL16 MDH38	BVL62 SHK1 SHK10 SHK16
2026	BVL15 BLM67 BLM145	MDH33 BVL16 MDH38
2027	MDH21 MDH8 MDH16	BVL15 BLM67 BLM145
2028	CVR92 EDP16 BVL31	MDH21 MDH8 MDH16

2. Although gullies located on private property were categorized as lower priority, the LMRWD should notify landowners of the gullies present on their properties and provide educational materials on managing and monitoring gully erosion. Additionally, the LMRWD should complete a high-level assessment of public pipe outfalls to determine if any of the gullies located on private property are directly caused by a public pipe outfall, in which case public funding and partnership may be more readily available for restoration.
3. The United States Geological Survey (USGS) department is in the process of updating light detection and ranging (LiDAR) data for Minnesota, which is the basis for digital elevation model (DEM). The new data is expected to be available to the public at the end of 2023 or early 2024. The LMRWD should utilize this new DEM data to conduct a desktop analysis to identify gullies in the watershed district that have not yet been inventoried. The desktop analysis may help locate gullies that are otherwise difficult to find on foot.
4. The 2023 Project identified 14 projects as inaccessible. Although these gullies are difficult to access, they may still be contributing to the degradation of LMRWD resources, and it is essential to continue to monitor these gullies. The LMRWD should conduct an accessibility assessment of the gullies that were considered inaccessible by foot and coordinate with the municipalities and county public works departments to determine the best method of study. Alternative ways to monitor gully erosion include drone survey, access by boat, or a desktop analysis to compare old DEM data to the new DEM data. In some cases, drone study may not be feasible due to rules regarding airports in the area.

In past years, the LMRWD has collaborated with municipal partners and potential stakeholders to review the gully inventory and assessment, specifically strategizing ways to prioritize sites, stabilize gullies, and fund stabilization efforts of gullies and pipe outfalls. However, using the prioritization ranking system, the LMRWD can now more strategically identify and recommend restoration project locations to their partners. Additionally, if municipalities or other stakeholders approach the LMRWD for potential partnership on gully restoration projects, the LMRWD can use the developed ranking system to help determine whether a restoration project is a good investment of LMRWD funds.

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Young Environmental Consulting Group, LLC

Comprehensive Gully Inventory – Scored

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BVL3	44	10	7.5	61.5
BVL62	47	10	4.5	61.5
BLM68	44	10	5.25	59.25
CVR81	50	7	1.5	58.5
BLM78	50	7	0.25	57.25
SHK1	42	7	8	57
SHK10	42	7	8	57
BVL13	42	10	4.5	56.5
BVL2	38	10	7.5	55.5
CVR38	47	7	1.5	55.5
MDH33	42	10	3.5	55.5
BLM173	48	4	3.25	55.25
BVL69	38	10	7.25	55.25
BLM154	39	10	5.75	54.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BVL16	40	10	4.5	54.5
MDH38	40	10	3.25	53.25
BVL15	39	10	3.75	52.75
CVR55	45	7	0.75	52.75
EDP2	45	7	0.25	52.25
SHK3	37	7	8	52
BLM67	36	10	5.75	51.75
BLM145	44	4	3.25	51.25
BVL7	33	10	8.25	51.25
CVR39	43	7	1.25	51.25
CVR56	43	7	1	51
CVR76	43	7	1	51
MDH21	38	10	2.75	50.75
CHH11	49	0	1.5	50.5
CVR6	42	7	1.5	50.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR7	42	7	1.5	50.5
BVL10	34	10	6.25	50.25
MDH8	37	10	3.25	50.25
JKT5	45	4	1	50
MDH16	37	10	3	50
CVR92	42	7	0.5	49.5
EDP16	42	7	0.5	49.5
SHK6	38	10	1.25	49.25
BLM174	38	7	3.75	48.75
BVL56	37	10	1.5	48.5
MDH7	35	10	3.5	48.5
CVR18	40	7	1.25	48.25
EDP17	39	7	2.25	48.25
MDH34	35	10	3.25	48.25
BVL11	31	10	7	48

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR15	47	0	1	48
CVR19	40	7	1	48
BLM113	40	4	3.75	47.75
BLM15	40	4	3.75	47.75
BVL50	32	10	5.75	47.75
EGN17	29	10	8.75	47.75
CVR3	39	7	1.5	47.5
EGN5	29	10	8.5	47.5
FSN8	35	7	5.5	47.5
BLM18	39	4	4.25	47.25
BVL12	35	10	2.25	47.25
FSN7	34	7	6	47
BLM148	40	4	2.75	46.75
BVL9	34	10	2.75	46.75
CVR67	38	7	1.5	46.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR8	38	7	1.5	46.5
BLM79	39	7	0.25	46.25
BLM84	39	4	3.25	46.25
BVL14	32	10	4.25	46.25
EGN3	28	10	8.25	46.25
SHK2	35	10	1.25	46.25
BLM169	39	4	3	46
BVL70	32	10	4	46
BVL37	29	10	6.75	45.75
EGN24	31	10	4.75	45.75
BLM13	37	4	4.5	45.5
EDP12	37	7	1.5	45.5
SHK15	38	4	3.5	45.5
BLM101	37	7	1.25	45.25
BLM102	37	7	1.25	45.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BLM165	37	7	1.25	45.25
BVL52	32	10	3.25	45.25
CVR98	37	7	1.25	45.25
BLM142	41	0	4	45
CHK2	34	10	1	45
BLM116	38	4	2.5	44.5
BLM32	38	4	2.5	44.5
BVL5	31	10	3.5	44.5
BLM133	34	7	3.25	44.25
BLM82	37	7	0.25	44.25
BVL38	29	10	5.25	44.25
CVR71	43	0	1.25	44.25
MDH19	31	10	3.25	44.25
SHK36	33	10	1.25	44.25
CHK3	33	10	1	44

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR25	36	7	1	44
CVR74	43	0	1	44
CHK1	33	10	0.75	43.75
BVL1	26	10	7.5	43.5
EGN34	26	10	7.5	43.5
BLM156	36	7	0.25	43.25
CVR10	42	0	1.25	43.25
MDH31	30	10	3.25	43.25
CVR37	35	7	1	43
CVR44	35	7	1	43
FSN11	33	7	3	43
BLM70	35	4	3.75	42.75
CVR24	35	7	0.75	42.75
EDP13	34	7	1.75	42.75
BLM107	35	4	3.5	42.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR9	34	7	1.5	42.5
EDP5	42	0	0.5	42.5
JKT9	33	7	2.5	42.5
SHK16	32	7	3.5	42.5
CVR49	34	7	1.25	42.25
SHK43	31	10	1.25	42.25
SVG20	27	10	5.25	42.25
BLM166	33	7	2	42
EDP7	41	0	1	42
EGN44	36	0	6	42
SHK11	27	7	8	42
BLM123	35	4	2.5	41.5
BLM162	34	4	3.5	41.5
BVL31	32	0	9.5	41.5
CVR43	40	0	1.5	41.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR5	33	7	1.5	41.5
CVR68	33	7	1.5	41.5
EDP20	37	4	0.5	41.5
EGN31	23	10	8.5	41.5
MDH39	29	7	5.5	41.5
SHK67	28	7	6.5	41.5
BLM33	35	4	2.25	41.25
BLM43	35	4	2.25	41.25
BVL63	26	10	5.25	41.25
CVR11	33	7	1	41
CVR45	33	7	1	41
EGN29	23	10	8	41
BLM172	32	7	1.75	40.75
CVR23	33	7	0.75	40.75
EDP9	40	0	0.75	40.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EGN36	23	10	7.75	40.75
MDH37	37	0	3.75	40.75
SHK61	30	7	3.75	40.75
SVG4	27	10	3.75	40.75
BLM61	32	7	1.5	40.5
BVL47	28	10	2.5	40.5
CVR62	32	7	1.5	40.5
FSN9	28	7	5.5	40.5
BVL60	26	10	4.25	40.25
EGN39	22	10	8.25	40.25
SHK8	29	10	1.25	40.25
BLM93	33	4	3	40
BVL42	27	10	3	40
CVR75	39	0	1	40
CVR79	32	7	1	40

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EGN2	21	10	9	40
BLM77	24	10	5.75	39.75
BVL49	28	10	1.75	39.75
CVR47	31	7	1.5	39.5
SVG18	26	10	3.5	39.5
BLM111	32	4	3.25	39.25
CVR27	38	0	1.25	39.25
CVR40	31	7	1.25	39.25
EDP4	39	0	0.25	39.25
BLM131	29	7	3	39
EDP10	38	0	1	39
FSN6	25	7	7	39
MDH15	26	10	3	39
BLM95	31	4	3.75	38.75
EDP22	34	4	0.75	38.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BLM167	31	4	3.5	38.5
BVL34	29	0	9.5	38.5
BVL58	25	10	3.5	38.5
CVR66	30	7	1.5	38.5
EGN7	21	10	7.5	38.5
MDA57	26	7	5.5	38.5
BLM163	27	7	4.25	38.25
BVL30	25	10	3.25	38.25
BVL8	25	10	3.25	38.25
EGN26	20	10	8	38
BLM57	30	7	0.75	37.75
EGN25	19	10	8.75	37.75
BLM143	29	4	4.5	37.5
BLM151	29	7	1.5	37.5
BVL39	25	10	2.5	37.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BLM120	32	4	1	37
BLM88	29	4	4	37
CVR57	29	7	1	37
EDP15	30	7	0	37
BVL45	22	10	4.75	36.75
SVG17	23	10	3.75	36.75
BVL55	24	10	2.5	36.5
CVR58	29	7	0.5	36.5
BLM98	28	7	1.25	36.25
BVL68	21	10	5.25	36.25
CHH8	35	0	1.25	36.25
CVR65	35	0	1.25	36.25
CVR94	35	0	1.25	36.25
EGN6	21	10	5.25	36.25
EGN8	18	10	8.25	36.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR36	28	7	1	36
SHK58	23	10	3	36
BVL67	23	10	2.75	35.75
EGN13	22	10	3.75	35.75
BLM158	28	7	0.5	35.5
BVL40	23	10	2.5	35.5
CVR90	27	7	1.5	35.5
BLM112	28	4	3.25	35.25
BLM168	28	4	3.25	35.25
BVL4	23	10	2.25	35.25
CVR63	33	0	2.25	35.25
BLM135	25	7	3	35
CVR46	27	7	1	35
BLM152	27	4	3.75	34.75
BLM170	26	7	1.75	34.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
EDP18	27	7	0.75	34.75
BLM100	33	0	1.5	34.5
BLM141	26	7	1.5	34.5
CVR13	33	0	1.5	34.5
CVR22	27	7	0.5	34.5
EDP19	30	4	0.5	34.5
EDP21	30	4	0.5	34.5
MDH54	23	7	4.5	34.5
BLM117	27	4	3.25	34.25
BVL48	21	10	3.25	34.25
CHH2	33	0	1.25	34.25
CHH8	33	0	1.25	34.25
CVR70	33	0	1.25	34.25
MDH11	21	10	3.25	34.25
BLM54	28	4	2	34

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BVL65	23	0	11	34
BLM105	26	4	3.75	33.75
CVR100	32	0	1.5	33.5
SVG26	29	4	0.5	33.5
BLM140	28	4	1.25	33.25
BLM80	26	7	0.25	33.25
BLM83	26	4	3.25	33.25
MDH20	20	10	3.25	33.25
MDH35	29	0	4.25	33.25
MDH55	20	10	3.25	33.25
BLM69	17	10	6	33
CVR53	25	7	1	33
CVR54	25	7	1	33
SHK49	32	0	1	33
BLM90	25	7	0.75	32.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BVL51	20	10	2.75	32.75
CVR88	31	0	1.75	32.75
MDH14	19	10	3.75	32.75
BVL44	19	10	3.5	32.5
CVR50	31	0	1.5	32.5
BVL20	19	10	3.25	32.25
BLM121	26	4	2	32
CVR91	24	7	1	32
CVR96	31	0	1	32
BLM153	24	4	3.75	31.75
BLM28	27	4	0.75	31.75
CVR55	24	7	0.75	31.75
EDP23	27	4	0.75	31.75
EGN43	19	10	2.75	31.75
FSN12	22	7	2.75	31.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
BLM122	25	4	2.5	31.5
SVG28	18	10	3.5	31.5
BLM134	21	7	3.25	31.25
BLM138	25	4	2.25	31.25
BLM59	23	7	1.25	31.25
CHH10	29	0	2.25	31.25
CHH7	30	0	1.25	31.25
CVR48	23	7	1.25	31.25
EGN12	26	0	5.25	31.25
EGN4	23	0	8.25	31.25
MDA1	21	7	3.25	31.25
SHK50	30	0	1	31
SHK62	18	7	6	31
BLM94	23	4	3.75	30.75
BVL54	20	0	10.75	30.75

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
CVR88	29	0	1.75	30.75
EDP14	23	7	0.75	30.75
SVG29	26	4	0.75	30.75
BLM51	22	7	1.5	30.5
CVR16	29	0	1.5	30.5
CVR41	29	0	1.5	30.5
EDP11	29	0	1	30
SVG27	25	4	0.75	29.75
BLM132	19	7	3.5	29.5
FSN2	26	0	3.25	29.25
EGN32	12	10	7	29
SHK48	28	0	1	29
BLM157	21	7	0.5	28.5
CVR60	21	7	0.5	28.5
CVR61	19	7	1.5	27.5

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
FSN10	17	7	3.5	27.5
MDH28	23	0	4.25	27.25
SHK55	26	0	1	27
BLM63	18	7	1.25	26.25
FSN4/5	18	0	7	25
BLM146	19	4	1.75	24.75
BVL57	18	0	6.5	24.5
CVR101	23	0	1.5	24.5
BLM118	17	4	3.25	24.25
SHK51	23	0	1	24
BLM64	15	7	1.5	23.5
JKT10	17	4	2.25	23.25
BLM58	14	7	1.25	22.25
CVR80	14	7	1.25	22.25
EGN10	8	10	4.25	22.25

Gully ID	Erosion Score Points	Impact Tier Points	MPCA Points	Overall Ranking Score
SHK39	21	0	1	22
CVR28	14	7	0.5	21.5
SHK44	16	0	1	17

Appendix B
Gully Ranking Process

Gully Ranking Overview

As part of the 2023 Gully Inventory and Condition Assessment Project, Young Environmental Consulting Group, LLC (Young Environmental) developed a quantitative method of scoring gullies to assess the urgency for gully restoration. This document is intended to describe the steps used to rank and prioritize gullies based on the erosion potential of the gully as well as variables that influence the feasibility of restoration. This ranking method may be used for all gullies, including new or already surveyed gullies, that are being evaluated for potential restoration.

Ranking Process

There are two parts to the gully ranking process.

Part 1 classifies the gullies into four separate categories based on the initial field screening, accessibility, property type, and safety concerns, as shown in Figure 1. It is possible that a landform may be incorrectly identified as a gully, so it is important to confirm that the landform being evaluated has identifiable gully features prior to being included in the ranking process. All gullies that have defining gully features and are deemed accessible are sorted into one of the four categories. Each category is given a restoration priority level of High, Moderate, or Low as shown in the legend in Figure 1. Gullies within the public safety concern list are given the highest restoration priority due to 1) the presence of a safety concern and 2) the location on public property. Because cities and other local government units manage public property, there is less complexity in jurisdiction and partnership to manage and restore gullies. Projects on private property often have complexities that could lead to legal or statutory conflicts. In contrast, gullies located on private land with no safety concerns are categorized as lower restoration priority due to the complexity of project planning on private land and the lack of safety concerns near the gully.

Part 2 consists of assigning points to each gully to rank gullies within their given categories. Detailed descriptions of the process for Part 1 and Part 2 are found in the following sections.

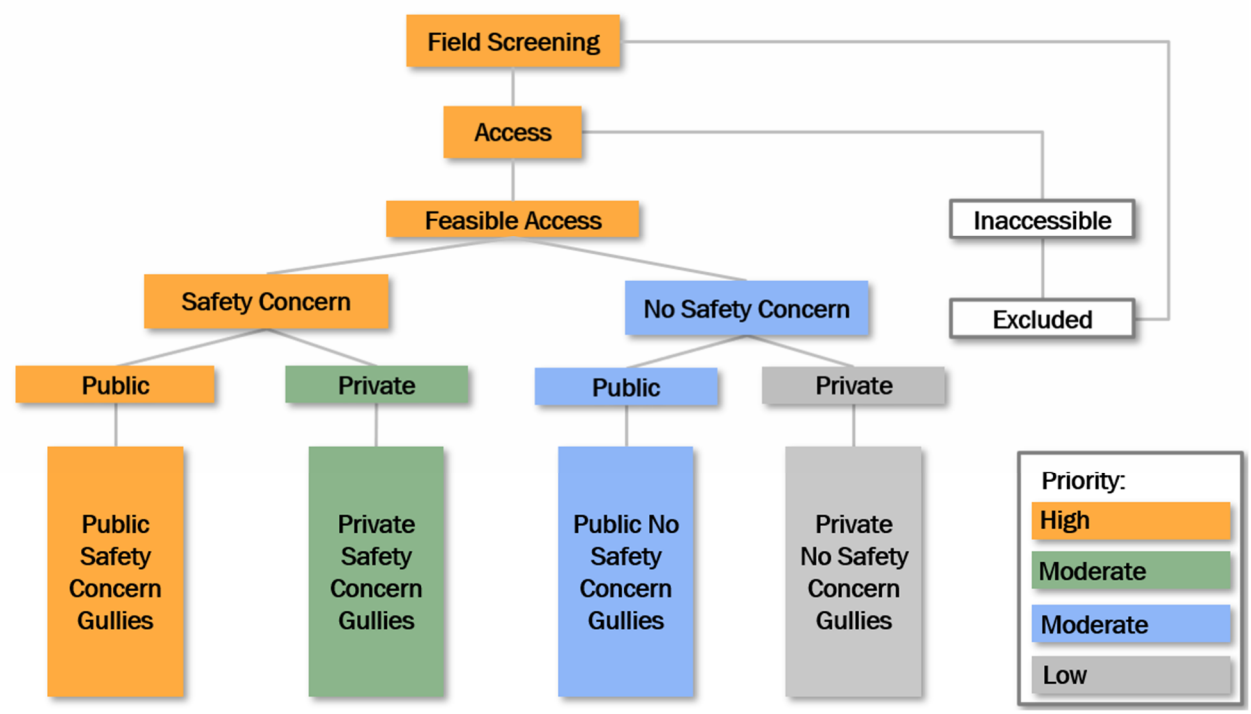

Figure 1. Lower Minnesota River Watershd District Overview Gully Categorization Flow Chart

Part 1: Organization of gullies into their appropriate category

Field Screening: During fieldwork, it must be determined if gully sites do not have gully-defining features. Gullies may have been repaired or have self-stabilized or been misrepresented during desktop analysis, and do not have the defining features of a gully. To determine if a gully should be included in the ranking, fieldwork staff should consider:

1. Does the gully have gully-defining features such as overhanging banks, a headcut, slumping, or signs of erosion?
2. Has the gully already been repaired or has it self-stabilized since last assessed?

Sorting: If a gully does not have gully-defining features, it is excluded from the ranking and potential project list.

Accessibility: Prior to ranking, each gully must be evaluated for accessibility. For a gully to be restored, it must be accessible by fieldwork staff to assess a gully's condition. Sites that are deemed inaccessible by fieldwork staff are excluded from the ranking process. To determine the accessibility of a gully, the reviewer must consider:

1. Is the gully accessible on foot?
2. Are slopes extremely steep or unstable that may limit the ability for fieldwork staff to safely reach the gully?

Sorting: If a gully is not accessible by foot due to safety concerns, the gully is categorized as inaccessible and excluded from the ranking and potential project list.

Infrastructure/Safety: Each gully must be categorized by its proximity to infrastructure to assess whether there is a safety concern. Many high-erosion potential gullies are found to be actively eroding near man-made infrastructure and areas with significant foot traffic. This encroachment is considered a safety hazard due to the potential for both infrastructure and people to fall into the eroding gullies. Thus, gullies found to be within 50 feet of residential homes, garages, sheds, private non-residential buildings, roads, trails, and railroad tracks are determined to be more urgent candidates for future restoration projects. Gullies beyond 50 feet from infrastructure were/are not considered an immediate safety concern.

Sorting: Gullies within 50 feet of infrastructure are categorized as having a safety concern.

Property Type: The final categorization of gullies is by property type. Gullies located on private property are typically more difficult for watershed districts to restore due to legal and statutory complexities. However, it is important to notify property owners of potential gully risks on their property and monitor their progression, which is why they are still included in the ranking. Gullies on public property are considered a higher priority because public entities hold jurisdiction over these gullies, and it is typically easier to form partnerships and establish funding for gully restoration. Gullies are separated into two categories: private or public property.

Sorting: Gullies are categorized by their property type (private or public) and are separated into their own list.

At the end of Part 1, all gullies should be categorized into one of four lists: Public Safety Concern, Private Safety Concern, Public No Safety Concern, and Private No Safety Concern

Part 2: Assigning points to gullies within their given categories

In Part 2 of the gully ranking process, gullies are assigned point values that rank the gullies within their respective categories. Gullies are assigned points using the erosion potential score, LMRWD impact tier, and the number of Minnesota Pollution Control Agency (MPCA) sites within a one-mile radius (Table 1) to determine the final gully ranking score for each gully. Gullies with higher overall ranking scores in each of their respective categories are prioritized for restoration within their respective categories with Public Safety Concern gullies receiving the highest priority over the other categories.

Table 1. Criteria for Gully Ranking and Assigning Points

Gully Element	Description of Points
Erosion Potential Score	Erosion score calculated using the Survey123 gully inventory survey
LMRWD Impact Tiers	Tier A: 10 pts
	Tier B: 7 pts
	Tier C: 4 pts
	Tier D: 0 pts
MPCA Sites	Active Investigation or Cleanup Sites within 1 mile of gully site (¼ point per site)
Overall Ranking Score	Max Score = 61 + number of MPCA Sites

Erosion Score: Using the Survey123 program, an erosion potential score is calculated by assessing the condition of various features of the gully. Features that are assessed include depth, length, material type, and presence of water. The severity of these features is assigned a point value, as shown in Table 2. These points are then summed into the final erosion score that quantifies the erosion potential of the gully.

Scoring: Erosion potential score is taken directly from the Survey123 results and added into the final gully ranking score.

Table 2. Erosion Potential Features and Point Values

	Low Erosion Potential		Moderate Erosion Potential		High Erosion Potential	
	Description	Pts	Description	Pts	Description	Pts
Length	Gully length less than 50 feet	1	Gully length between 50 and 100 feet	3	Gully length greater than 100 feet	5
Depth	Gully depth less than 3 feet	1	Gully depth between 3 and 15 feet	3	Gully depth greater than 15 feet	5
Bottom Width	Bottom width greater than 5 feet wide	1	Bottom width 1 to 5 feet wide	3	Less than 1 feet wide or V-shaped	5
Bottom Condition	Gully bottom is armored, bedrock, or heavily vegetated	1	Some vegetation present	3	No vegetation, or bare soil	5
Gully Material	General gully material is bedrock or gravel, cobbles, or boulders	1	Fine-grained cohesive material	5	Sand	10
Gully Shape	Trapezoid	1	U-shaped	3	V-shaped	5
Bank Angle	Obtuse (> 90 degrees or flat)	1	Mid-range (45 to 90 degrees)	3	Acute (< 45 degrees or undercut)	5
Bank Condition	Heavy vegetation	1	Some vegetation present	3	Bare soil	5
Seeps	No seeps identified	0	-	-	Observed evidence of groundwater upwelling, springs, or water seepage in gully	1
Stormwater Runoff	No stormwater outfalls identified	0	-	-	Drainage feature or stormwater outfall observed	1
Degradation	Low	0	Moderate	-	Severe	1
Aggradation	Low	0	Moderate	-	Severe	1
Trees	No leaning trees noted	0	-	-	Leaning trees or fallen trees observed in channel	1

	Low Erosion Potential		Moderate Erosion Potential		High Erosion Potential	
	Description	Pts	Description	Pts	Description	Pts
Slumping	No slumps or flattened banks noted	0	-	-	Slumping or flattened banks observed	1

LMRWD Impact Tiers: Gullies have the potential to contribute large amounts of sediment to downstream water and natural resources, therefore, their contribution to nearby resources must be evaluated. Sediment deposition in these resources is generally quantified by measuring total suspended solids (TSS) or turbidity. High volumes of TSS may lead to recreational and habitat impairments. To determine which sites are of higher priority for restoration, LMRWD impact tiers were created to categorize the gully sites based on proximity and impact to LMRWD natural resources. The impact tiers from the previous gully prioritization exercise completed in 2021 were modified to further categorize and rank impacts to LMRWD water resources. The primary difference is that the steep slopes overlay district (SSOD) was removed from the tiers because nearly all the gullies that were surveyed in 2023 were already located in the SSOD (Table 3).

Table 3. Compairson of Previous and Current Impact Tiers

Previous Impact Tiers (Current Impact Tier)	Previous Impact Tier Description	Current Impact Tiers Description
Tier I – Critical Impact (A)	High value resource area or steep slope overlay district (SSOD)	High value resource area
Tier II – Serious Impact (B)	Impaired waterbody or direct tributary watershed to Tier I	Impaired waterbody or tributary to a high value resource
Tier III – Marginal Impact (C)	Strategic resource or direct tributary watershed to Tier II	Strategic resource or tributary to impaired water bodies
Tier IV – Low Impact (D)	All other resources	All other resources

The new impact tiers are categorized as A through D where Tier A is of the highest priority due to its proximity to valuable LMRWD resources. Point values for each tier are assigned by giving the highest tier (Tier A) approximately one fifth of the maximum erosion potential score (51 points), to ensure that the erosion potential score remains the primary driver of the gully ranking score. The new impact tiers, their description and associated point values are shown in Table 4.

Table 4. LMRWD Impact Tiers and Associated Point Values

Impact Tiers	Tier Description	Point Value
Tier A – Critical Impact	Gullies are within the watershed of high value resources such as calcareous fens and trout streams	10 points
Tier B – Serious Impact	Gullies are within the watershed of Minnesota Pollution Control Agency impaired water bodies[1] or within the watershed of tributaries to high value resources	7 points
Tier C – Marginal Impact	Gullies within the watershed of strategic resources or tributary to impaired water bodies	4 points
Tier D – Low Impact	Gullies in the LMRWD that do not fall into any previous category	0 points

These impact tiers are related to the LMRWD Watershed Management Plan's goals, policies, and management strategies to ensure that the recommended gully restoration projects fall in line with the LMRWD's mission to manage and protect the Minnesota River and other water resources within the district. The gully locations (displayed as pink triangles) in their respective tiers are shown in Figure 2.

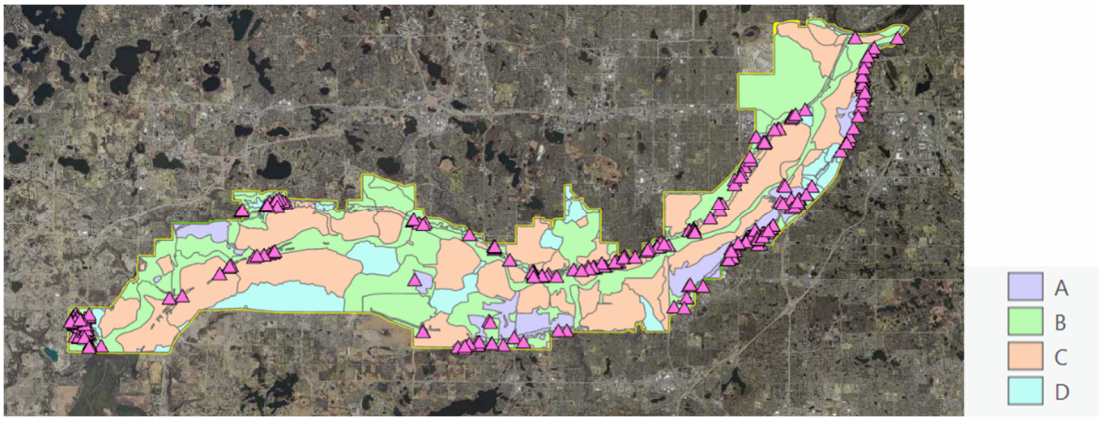

Figure 2. Gully Sites and LMRWD Impact Tiers

Scoring: Gullies are separated into their given tier based on their proximity to LMRWD Resources. Each Tier (A-D) is given a point value that contributes to the total ranking score for each gully.

MPCA Water Quality Sites: The MPCA has a database titled "What's in my Neighborhood", which allows the public to see locations of businesses that have applied for and received various types of environmental permits and registrations from the MPCA. Additionally, the MPCA has

[1] All impaired waterbodies are included in this analysis regardless of the specific impairment parameter. This assumes that impaired waterbodies have a fragile ecosystem that is at higher risk for degradation even if the waterbody is not impaired for parameters that are directly related to sediment discharge and gully erosion such as TSS and Turbidity.

identified potentially contaminated sites. These sites are classified as Active Investigation or Cleanup sites within the database and are sites where hazardous substances may be or have been present and the MPCA is working to identify risks and appropriate remediation strategies. Active investigation or cleanup sites were included in the gully ranking by assigning a quarter, 0.25, or 1/4 point to each MPCA site that is located within a one-mile radius from the gully site. A greater number of MPCA sites within the radius moves the gully higher in the ranking due to potential for hazardous waste to be exposed by the gully or conveyed through the gully. Figure 3 shows the gully sites (displayed as pink triangles) in relation to the MPCA sites (displayed as purple dots).

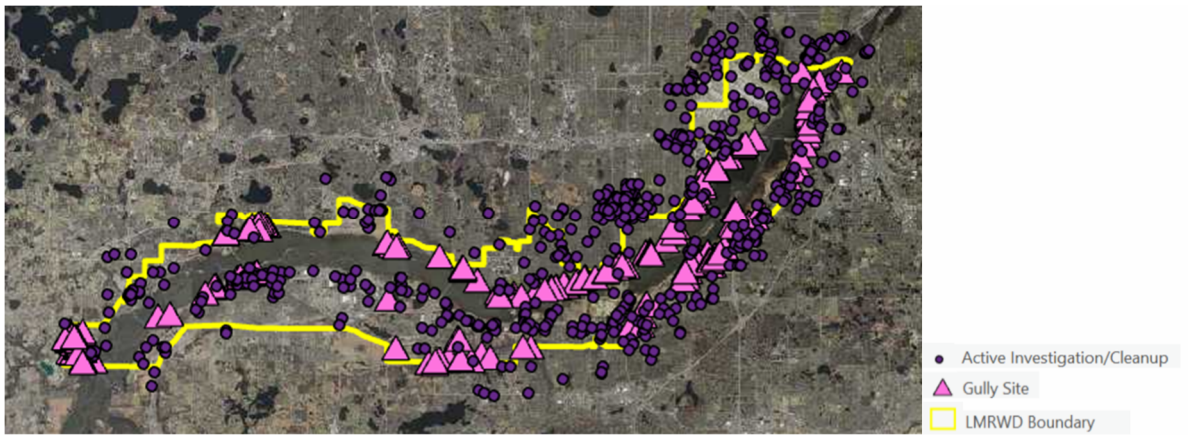

Figure 3. Gully Sites and MPCA Water Quality Sites

Scoring: Each gully (pink triangle) is given a one-mile radius. Each MPCA active investigation or cleanup site (purple dot) within the radius of a gully is assigned 0.25 of a point. These points are then added into the total ranking score.

At the end of Part 2, all gullies should be ranked based on their overall ranking score within their respective categories.