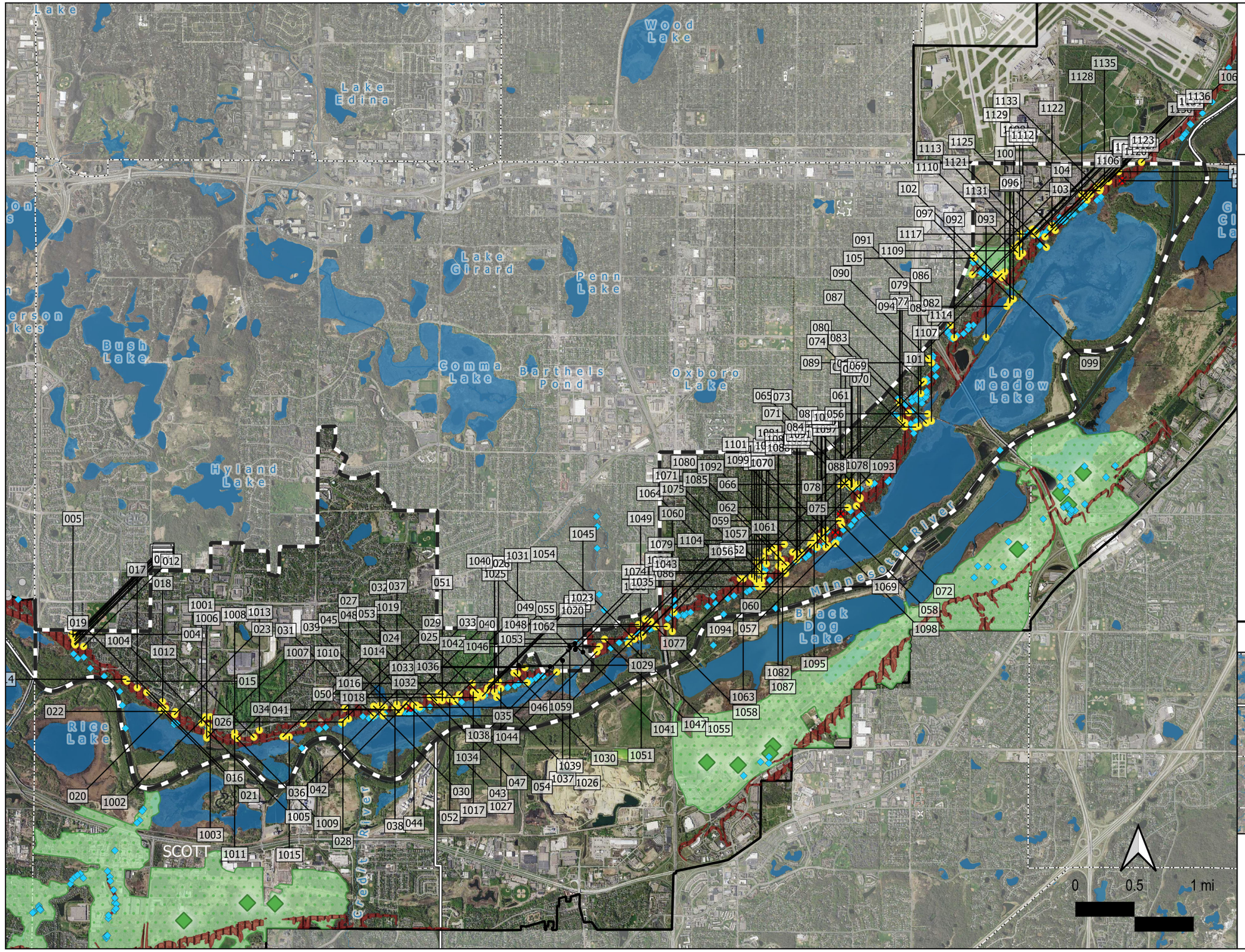
5.0 CITY OF BLOOMINGTON

The City of Bloomington, Minnesota (Bloomington), located in Hennepin County, is a fully developed city. Bloomington's primary land use is single-family residential with secondary land uses including commercial, industrial, and institutions, as well as large areas of parkland (Barr Engineering Co. 2018). When contacted, Bloomington provided summary information on past restoration activities related to the 2008 Inventory.

The 2008 Inventory identified 243 gully locations in Bloomington. Of these, 11 sites were removed from the Project because they were outside of the District's boundary; seven more were removed after determining they were not applicable to the Project. Two were removed because they were not gullies (one was a dump site, the other a depression); two were storm drain inlets; and three were duplicates of an existing site (**Figure 10**). Of the remaining 225 points, 65 appeared to be pipe outfalls and 28 were identified as potential restoration sites.

The remaining 225 locations determined to be gullies or pipe outfalls in Bloomington were surveyed, including 30 that were suspected (based on communications with the City of Bloomington and recent aerial photos) of having been restored. Thirty-three locations were deemed N/A because no evidence of erosion existed, the locations were neither gullies nor pipe outfalls, or there were areas of groundwater seepage or pipe fragments. Access to three sites proved impossible because of heavy vegetation. A total of 211 locations were surveyed in Bloomington that were gullies, pipe outfalls, or both (**Figure 11**).

Figure 10: Bloomington 2008 Gully Locations



LEGEND

2008 Gully Inventory Waypoints copy

- Inside LMRWD
- Outside LMRWD Boundary
- Non-Applicable Points
- Outside Bloomington
- MnDNR Spring Inventory
- Calcareous Fens
- Public Waters
- Public Waterbodies

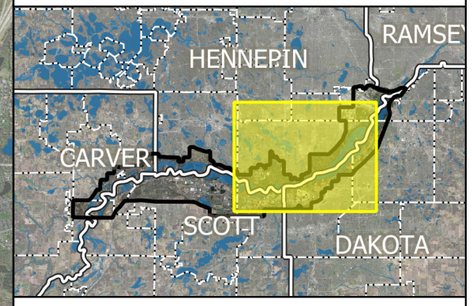
LMRWD Overlay Districts

- High Value Resource Area Overlay District
- Steep Slopes Overlay District [SSOD]

Political Boundaries

- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

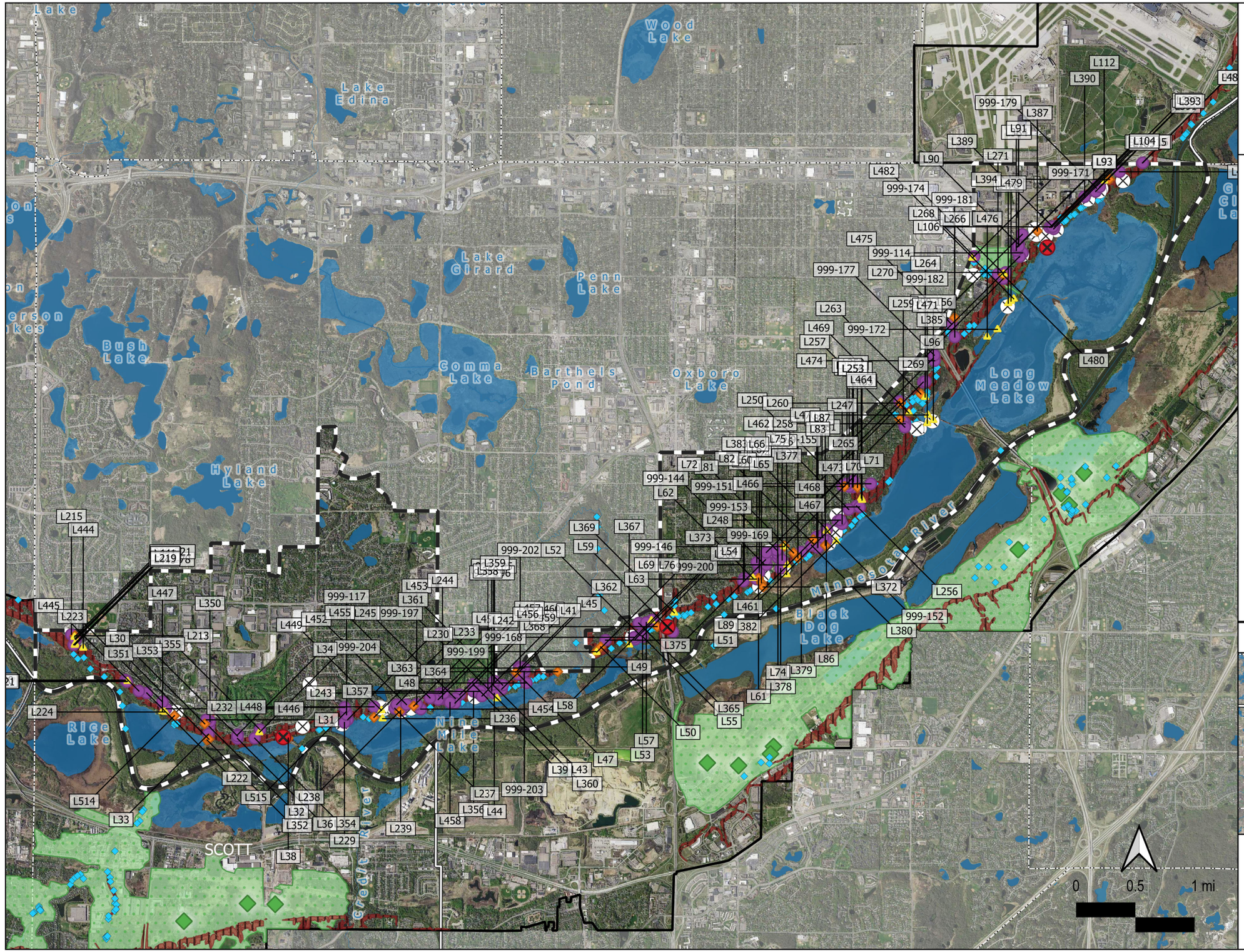
LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 11: Bloomington 2020 Gully Locations



LEGEND

- 2020 Pipe Outfall Surveys
- 2020 Combination Surveys
- 2020 Gully Surveys
- 2020 Inaccessible Waypoints
- 2020 Non-Applicable Waypoints
- MnDNR Spring Inventory
- Calcareous Fens
- Public Waters
- Public Waterbodies

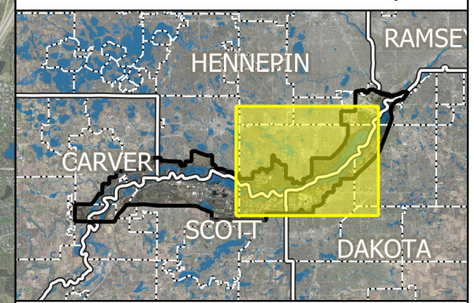
LMRWD Overlay Districts

- High Value Resource Area Overlay District
- Steep Slopes Overlay District [SSOD]

Political Boundaries

- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

5.1 Previous Restoration Efforts

As previously mentioned, Bloomington was the only community to provide detailed information regarding its work with the previous gully inventory and restoration efforts completed since 2008.

- **LMRWD Parkers Picnic Area/City Project 2008-901 Storm Sewer Maintenance (2008):** Bloomington repaired three gullies located between Columbus Road and Long Meadow Lake that were caused by a 12-inch outfall from the road. The District approved and contributed $22,265 to restore the ravine. The project included fill, grading, plantings, and erosion control (Lower Minnesota River Watershed District 2008).
- **Bloomington Minnesota River Valley Washout (2008):** The District contributed $98,214 for streambank restoration on an unnamed stream near Lyndale Avenue and the Minnesota River (Lower Minnesota River Watershed District 2008).
- **Long Meadow Lake Outfall Project (2012):** Bloomington repaired eight gully locations as part of Project 2012-904, off Old Shakopee Road East and Long Meadow Lake.
- **Storm Sewer Maintenance Project (2014):** Bloomington repaired one gully as part of its annual storm sewer maintenance project (Project 2014-901) off of 102nd Street East.
- **Overlook Lake Stormwater Outfall Project (2014):** Bloomington repaired two gullies as part of Project 2014-902 between Overlook Drive and Nine Mile Lake.
- **City Project 2016-902 Storm Sewer and Pond Maintenance Project (2016):** Bloomington repaired two gullies as part of a maintenance project within Wildwood Park.

Bloomington also identified several areas that may have been impacted by recent developments, which were included in the Project. The following comments were documented during the field survey on the restored projects mentioned above:

- **City Project 2008-901 Storm Sewer Maintenance (2008)**
  As part of the 2008 Storm Sewer Maintenance Project 2008-901, Bloomington repaired three gullies referred to here as L78, L79, and L80 (Sites 1089 through 1091 from the 2008 Inventory). The site has been restored and exhibits low erosion potential. Heavy vegetation stabilized the gully channel and the west bank. There were patches of bare soil and shallow slumps along the east bank below a walking trail, but no other significant problem indicators. The pipe outfall that formed the head cut of the pre-restoration gully had been removed, and a new pipe outfall discharged closer to the gully toe. The new pipe outfall was recorded as New Feature 999-154. Additionally, an incised channel seemed to be downcutting below the outlet pipe. Because of the

erosion history of the site and the incised channel, a new Gully 999-155 was noted to bring attention to potential erosion in the future.

- **Long Meadow Lake Outfall Project (2012)**
  As part of Project 2012904, the Bloomington repaired eight gullies referred to here as Sites L98, L386, L99, L100, L101, L387, L103, and L388 (Sites 1114 through 1121 in the 2008 Inventory). L387 did not show signs of restoration during the field survey. A blue tiling pipe hanging at the head cut matched the description from the 2008 Inventory, and the water discharged into a steep marlstone gully channel rated as having moderate erosion potential. However, the other seven sites seemed restored. Sites L98, L386, L99, L100, L101, L103, and L388 were deemed N/A because no head cut, channel, or other gully characteristic was found in the area. Heavy vegetation stabilized the multiple groundwater seeps emerging from the soil in the wetland, and no problem indicators around the sites were observed.
- **City Project 2014-901 Storm Sewer Maintenance Project (2014)**
  As part of project 2014-901, Bloomington repaired a gully referred to here as Site L249 (Site 061 in the 2008 Inventory). During the field survey, the storm drain referenced in the 2008 Inventory was observed, but there were no other signs of erosion. Nearby gullies L461 and L248 (2008 Inventory sites 060 and 059, respectively) did not show signs of restoration, and were rated as having moderate erosion potential due to sections of instability along the banks and at the head cut.
- **Overlook Lake Stormwater Outfall Project (2014)**
  As part of project 2014-902, Bloomington repaired a gully and a pipe referred to here as sites L450 and L236 (2008 Inventory sites 036 and 035, respectively). L450 showed signs of restoration during the field survey. The field survey was conducted after a storm event in Bloomington, when a significant quantity of stormwater was observed discharging from Pipe L236. The view of Pipe L236 was obstructed, and safety concerns precluded close inspection of the outlet pipe and drainage channel.
- **City Project 2016-902 Storm Sewer and Pond Maintenance Project (2016)**
  As part of project 2016-902, Bloomington repaired two gullies referred here as L366 and L56 (Sites 1054 and 1056 in the 2008 Inventory). At Site L366, the field team found groundwater upwelling but did not find the stormwater outlet referenced in the 2008 Inventory. L366 did not show signs of restoration and had moderate erosion potential. Problem indicators included leaning trees and incision caused by groundwater. Site L56 showed signs of restoration, but the stormwater grate noted in the 2008 Inventory was not found. However, the area around the

waypoint was a heavily vegetated channel with no discernable banks or head cut, and therefore, no erosion or problem indicators were identified.

5.2 Field Survey Discussion

Heavy vegetation consistently made access difficult moving between sites in Bloomington. Additionally, many of the gullies were located on or directly behind private property. As a result, more resident interactions occurred in Bloomington than in any other city. Some interactions were negative, where opposition to the field survey was expressed. Nevertheless, there were many positive interactions with residents who detailed concerns and observations about gullies close to their property.

One resident said that Site L453 exemplified the usual steep channel slopes of many Bloomington gullies, but instability and degradation seemed to be eroding it away. Another resident expressed concern about Site L457. Although rated as moderate erosion potential, any further erosion would move the gully banks closer to the resident's house.

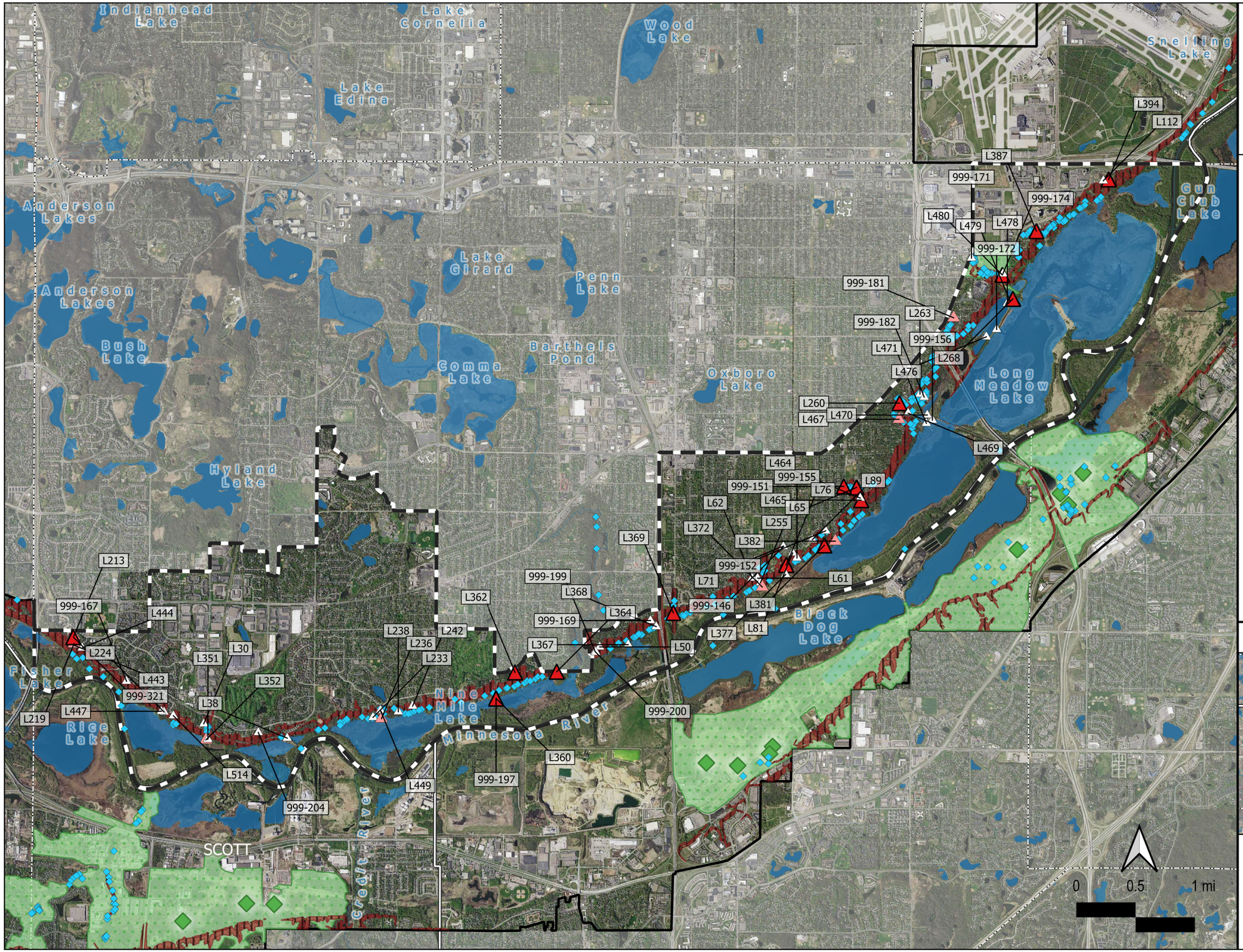
5.3 Findings

Data were collected along the hillslopes above the wetlands adjacent to the Minnesota River. Often, groundwater intersected with the land surface, and groundwater upwelling was evident in the form of seeps at this interface.

Of the 68 pipe outfalls surveyed in Bloomington, there were 16 in need of immediate repair. Within public parks in Bloomington, the field survey captures all types of existing pipe material with a range of sizes from less than 6 inches to over 48 inches. Pipes generally either drained water beneath trails or discharged water into streams, lakes, or the wetlands surrounding the Minnesota River. In Bloomington's residential areas, small pipes were observed in retaining walls at the head cuts of the gullies. Many of these pipes caused little to no channel incision or slumping around their outlet (**Figure 12**).

Variety in gully erosion potential exists along the Bloomington's hillslopes. Most of the gullies in Bloomington exhibited low or moderate erosion potential and consisted of sandy soils. The most common gully type in Bloomington consisted of a bowl-shaped groundwater seep emerging as the head cut. The groundwater formed a small stream that either destabilized the soil and led to incision and overhanging banks or became vegetated and showed few problem indicators. Sites with high erosion potential did not contain seeps or groundwater and, other than the steepest of slopes, the cause of the severity was unknown (**Figure 13**).

Figure 12: Bloomington 2020 Pipe Outfall Conditions



LEGEND

2020 Pipe Outfalls

- Needs Immediate Attention
- Potential/Future Repair Needed
- Good Condition/No Repair Needed
- MnDNR Spring Inventory
- Calcareous Fens
- Public Waters
- Public Waterbodies

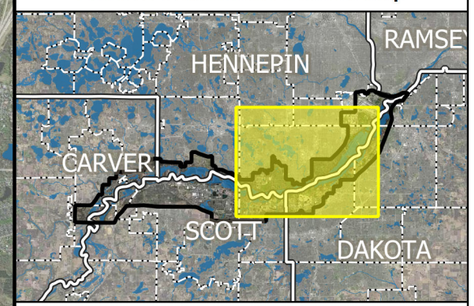
LMRWD Overlay Districts

- High Value Resource Area Overlay District
- Steep Slopes Overlay District [SSOD]

Political Boundaries

- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 13: Bloomington 2020 Gully Conditions

LEGEND

2020 Gully Condition

- High Erosion Potential
- Moderate Erosion Potential
- Good Condition/No Repair Needed
- MnDNR Spring Inventory
- Calcareous Fens
- Public Waters
- Public Waterbodies

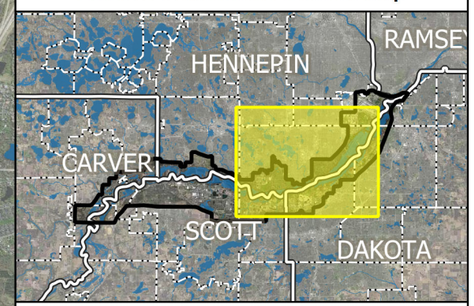
LMRWD Overlay Districts

- High Value Resource Area Overlay District
- Steep Slopes Overlay District [SSOD]

Political Boundaries

- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



0 0.5 1 mi

Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

5.4 Bloomington Gully Progression

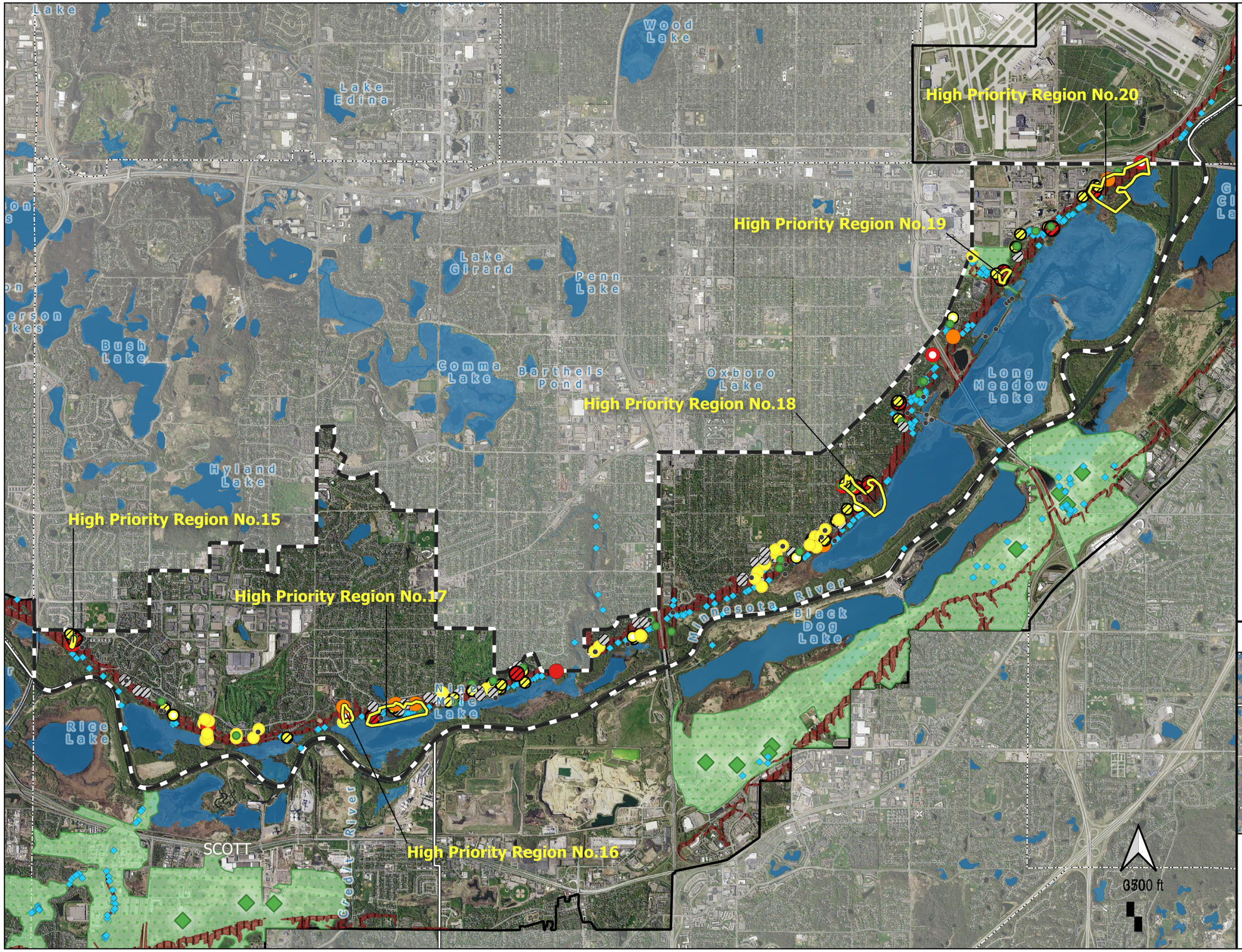
Using the 2008 benchmark data, most of the gullies in Bloomington have either decreased or remained consistent in their erosion potential when compared with the 2020 assessments. Most sites, in 2020, are either ranked as having moderate or low erosion potential; **Table 5-1** provides an overall summary of the erosion potential within the Bloomington area in both 2008 and 2020.

Table 5-1: City of Bloomington Gully Erosion Potential Summary

	2008 Benchmark Condition	2020 Condition
High Erosion Potential	39	24
Moderate Erosion Potential	47	97
Low Erosion Potential	68	53
	154	**174**

To better assess the erosion progression of an individual site, the change in erosion potential is mapped in **Figure 14**. Priority was placed on sites that increased in severity, going from low to high or moderate erosion potential. The improved data collected as part of the Project may have also played a role causing sites to have increased severity ratings; those sites are now ranked more appropriately based on more detailed data rather than on any significant progressive change.

Figure 14: Bloomington Erosion Progression and HPRs



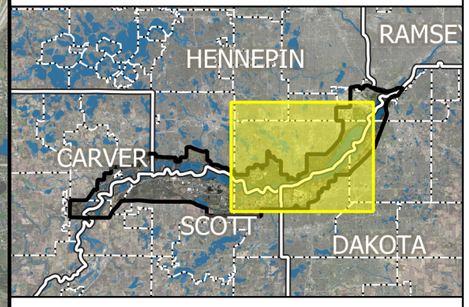
LEGEND

- High Priority Region

Erosion Progression (2008 --> 2020)

- Low --> High
- Moderate --> High
- High --> High
- New Site High
- Low --> Moderate
- Moderate --> Moderate
- New Site Moderate
- Low --> Low
- New Site Low
- Improved
- Non-Gully
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

5.5 Bloomington High-Priority Sites

Within Bloomington, the high-priority sites stretched across the southern border of the city within or next to the District's Steep Slopes Overlay District. As shown in **Figure 14**, gullies also lay next to known spring sites; groundwater was a principle cause of erosion at many of these sites.

Many of the high-priority gullies in Bloomington were not connected and drained directly to the Minnesota River. Because of this, and the distance between many sites, six HPRs were created. There were eight high-priority sites that did not fit into the created regions and were described individually, although many shared similar characteristics. The rationale for the priority region groupings is described below:

- **HPR 15:** These two gullies were grouped together because they were located within the same long stream channel.
- **HPR 16:** These two gullies were grouped together because they were located along the same channel and they shared similar characteristics.
- **HPR 17:** These three gullies were grouped together in one region due to geographical proximity and ease of access.
- **HPR 18:** All three gullies were found within Mound Springs Park, and were grouped together due to geographic proximity.
- **HPR 19:** These three gullies were all located within the Ike's Creek high-value resource area.
- **HPR 20:** This region includes all the gullies that lay near the Minnesota Valley National Wildlife Refuge Visitor Center and could be accessed along the Long Meadow Lake Trail.

The remaining gullies were not close enough together to be grouped into any region. These individually discussed gullies include Sites L32, L47, L364, L381, L18, L260, 999-117, L266, and L105

5.5.1 HPR 15

HPR 15 is made up of two sites: L216 and L219 (**Figure 15**). The gully system started with groundwater upwelling beginning at L216 that steadily grew to become a stream channel with a low amount of fast-moving water. Further downstream in the channel, a significant knickpoint with a depth over 4 feet formed the head cut of L219. The subsequent erosion along L219 was far more severe than the erosion noted at site L216. Despite the difference in severity, the gullies within the system shared similar problem indicators. Both sites showed evidence of slumping, loss of bank vegetation, and overhanging banks. Although some vegetation was present—especially along the banks of L216—it did not look heavy enough to stabilize the area. The wide bottom width at Site L216 narrowed downstream from the knickpoint, and L219 was characterized as having a V-shaped channel. In addition to the problem indicators at L216, L219 exhibited degradation, incision, and pistol-butted trees.

The cause of the gully system appears to have been groundwater upwelling. Channel incision and slope were found to have contributed to erosion past the knickpoint in L219.

Site L216 was benchmarked as having high erosion potential based on the photo depicting bare soil along the banks and a note commenting on the groundwater-fed stream. The top width of the gully appeared wider than pictured in 2008. **Figure 16** depicts a side-by-side comparison of the tree debris, sandy channel, and unstable banks along L216 in 2008 (a) and 2020 (b).

In the 2008 Inventory, no waypoint or pictures existed along the section of the channel recorded as L219. Because this site was not noted in the 2008 Inventory, it is unknown how quickly the gully has progressed to reach its current state. **Figure 17** illustrates the state of this gully observed during the field survey. **Figure 17a** shows overhanging roots along the top perimeter of the left bank, with bare sandy soil below. **Figure 17b** shows a tree falling into the V-shaped channel with undercut right banks.

Figure 15: Bloomington High Priority Region No. 15

LEGEND

- High Priority Region

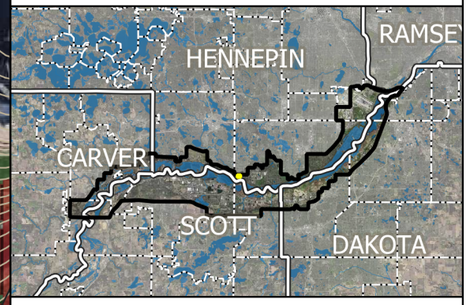
High Priority Sites

- Low --> High
- Moderate --> High
- High --> High
- New Site High

Other 2020 Locations

- Surveyed Gully
- Surveyed Pipe Outfall
- Hennepin Co. 2-ft Contours
- MnDNR Spring Inventory
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 16. Comparison of erosion within the L216 stream channel in 2008 (a) and 2020 (b).

Figure 17. Photos from the 2020 field survey to L219. Person for scale in 'b' emphasizes depth of incision.

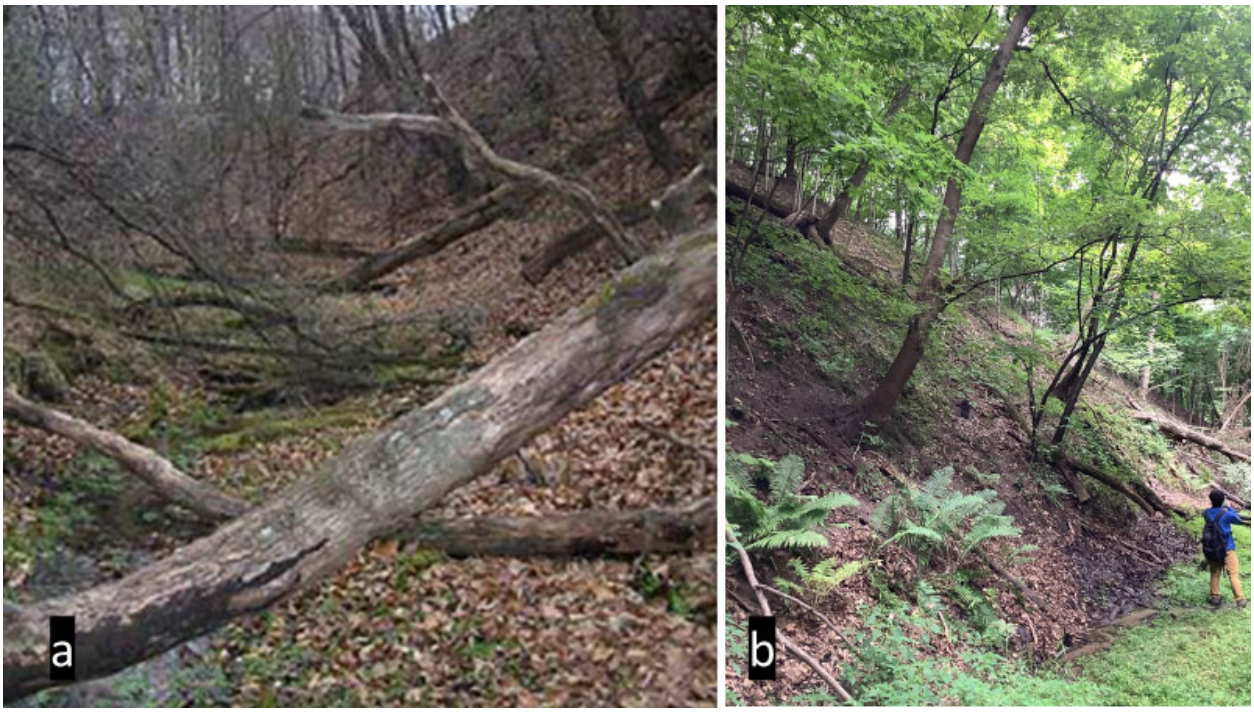
5.5.2 Gully L32

Gully L32 is a stand-alone site located near Auto Club Road. The gully is formed from groundwater seeps emerging at the head cut. The upwelling water eventually formed a stream, at which point the gully began to stabilize. The groundwater seeps that form the head cut of L32 were located in a deep channel, and three deep gullies that were not considered high-priority sites branched out from L32.

This site consisted of a U-shaped channel with both a wide top and bottom width. The channel was generally flat and consisted of sand. Bare soil was noted along the banks and some vegetation was noted within the center of the channel. The gully was rated with high erosion potential because once the groundwater seeps emerged and formed the channel, it undercut banks along the bottom perimeter of the channel and almost completely vertical banks slopes were observed. The trees were leaning at an angle that threatened the stability of the gully. One major section containing an eroding slump was also noted during the field survey.

A comment from the 2008 Inventory stated that the area "overall looked good." The corresponding picture, as illustrated in **Figure 18a**, highlighted some steep bank slopes but did not note any clear erosion. This led to the site's being benchmarked as having low erosion potential. However, as **Figure 18b** illustrates, there is incision along the channel and a significant number of leaning and fallen trees that indicate soil movement. The erosion progression since 2008 was hard to judge solely from the 2008 picture.

Figure 18. Photo 'a' is from 2008, depicting the L32 channel and right bank. Photo 'b' illustrates erosion along the left bank of the channel in 2020.



5.5.3 HPR 16

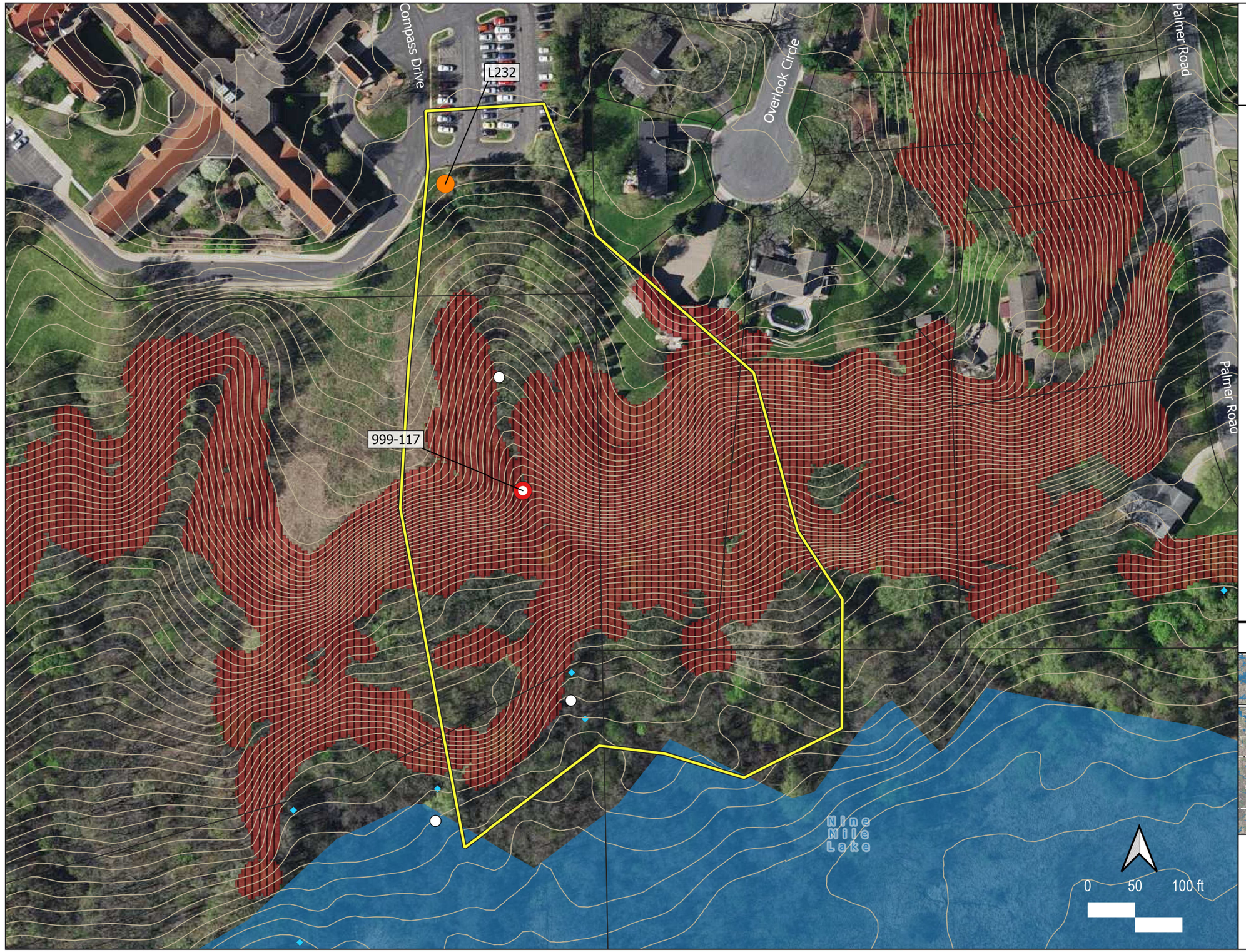
HPR 16 includes Gullies L232 and 999-117 (**Figure 19**). The points were both located on the Minnesota Masonic Home property. Both sites are located within the same stream channel. Gully L232 marked the start of the channel and began as a narrow, incised head cut next to a parking lot. The head cut was covered by geotextile fabric and riprap, but active erosion along the incised banks was observed. The gully continued into a forested area, where multiple head cut and finger gullies formed off the main channel, despite evidence of riprap stabilization along some sections of the channel. Dense canopy in the forest and slope of the terrain were noted as possible contributors to the erosion at both sites. No water was observed within either gully during the field survey.

Gully L232 was benchmarked with moderate erosion potential based on the picture, where some loss of bank vegetation and incision is visible, as well as the accompanying description "gully bank erosion," which noted active erosion. Although it was difficult to tell from the 2008 Inventory, it looked as though the gully had continued to widen and destabilize the soil, causing some trees to fall into the channel. The gully in its current state appears to have progressed from moderate to high erosion potential. **Figure 20** illustrates the photo taken during the 2008 Inventory and **Figure 21** illustrates the current head cut (a) and the main gully channel (b).

Gully L232 turned into a moderate gully downstream until a large knickpoint formed the head cut of Gully 999-117. At that point, the severity of the gully dramatically increased. Gully 999-117 shared many of the same problem characteristics as Site L232, such as incision, leaning trees, overhanging banks, and bare soil. However, L232 was shallow, while Gully 999-117 was deeper and had a narrower V-shape. Small knickpoints apparent throughout the channel also caused the field team to mark degradation as a problem indicator. Additionally, the trees along the channel of 999-117 were more severely undercut than those along L232. The cause of the deep incision in this gully is unknown. However, as pictured in **Figure 22**, the substrate type switched from sand to clay for one portion of 999-117, with completely bare banks.

Gully 999-117 was not noted in the 2008 Inventory; its erosion progression is therefore unknown. **Figure 22** illustrates the severely eroded conditions at the head cut (a) and along the left bank (b) seen during the field visit.

Figure 19: Bloomington High Priority Region No. 16



LEGEND

- High Priority Region

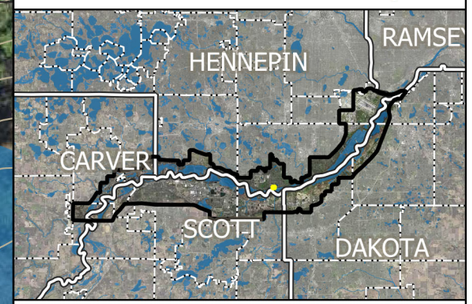
High Priority Sites

- Low --> High
- Moderate --> High
- High --> High
- New Site High

Other 2020 Locations

- Surveyed Gully
- Surveyed Pipe Outfall
- Hennepin Co. 2-ft Contours
- MnDNR Spring Inventory
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 20. Photo of Gully L232 in 2008.

Figure 21. Photos of Gully L232 in 2020. In photo 'a' the head cut recedes into grass near a parking lot and is covered by geotextile fabric. In photo 'b' the gully channel widens further downstream.

Figure 22. Severe erosion at Gully 999-117. Photo 'a' was taken looking downstream at the head cut. Photo 'b' was taken looking downstream at an incised section of the gully.

5.5.4 HPR 17

HPR 17 consists of Gullies L453, L451, and L233 (**Figure 23**). All three gullies drain down toward the Minnesota River, with head cuts accessible from the road.

Gullies L451 and L453 were both residential gullies, meaning their head cuts were located on or directly next to private properties, and so any future erosion would impact residential property.

Gully L451 was visited the day after a storm event, and heavy vegetation and unstable slopes prevented close analysis or accurate pictures of erosion within the gully. Nevertheless, the field survey documented a medium depth and bottom width; the channel slope looked flat, and the gully formed a U-shape. Exposed sandy soil below slumps and fallen tree debris within the channel were noticed. Although sections of heavy vegetation around the gully banks may have been stabilizing the area, loss of bank vegetation, incision, slumping, overhanging banks, and leaning trees were evident as problem indicators. At least one slump was destabilizing a large tree along the bank. Additionally, there was active erosion at the head cut, despite grass clippings in place for stabilization. No significant cause, other than possible channel incision, was observed. The site was benchmarked with moderate erosion potential because the photos taken at the time showed a wide, partially vegetated gully channel.

Gully L453 was directly behind a residential backyard. The homeowner seemed interested in possible restoration. Gully L453 exemplified one of the most extreme cases of gullies along steep slopes in Bloomington. The gully itself began at a head cut in the backyard and became heavily incised. About mid-gully, the channel slope turned into a 45-degree angle for at least 30 horizontal feet. Along this section, an incised V-shape channel consisting of bare banks, as well as degradation within the channel, was present. The general gully material was sand; fallen tree debris, along with buckthorn, was seen throughout the channel.

No groundwater was observed; any cause other than steep slopes is unknown. Problem indicators included degradation, incision, leaning trees, and a loss of bank vegetation.

L453 was benchmarked as having high erosion potential. Photos from the 2008 Inventory matched descriptions that noted a “pronounced gully” with “significant erosion.” **Figure 24** compares the 2008 Inventory with the 2020 condition.

The last gully in HPR 17, Gully L233, was a shallow, incised, U-shaped channel forming downstream of a pipe outfall. Bare soil was noted along the gully bottom and banks, and there was a moderate level of slow-moving water in the gully at the time of the field visit. Sand was the main substrate within the gully.

The storm pipe outfall causing the gully drained below Palmer Road. The pipe appeared to be stable and vegetated and was surrounded by riprap. However, downstream from the pipe and riprap, the new incised channel was collected as a new Gully 999-192. Problem indicators in the gully included degradation, aggradation, incision, slumping, and overhanging banks. Active erosion at the head cut was also noted.

The 2008 Inventory noted that a storm pipe was observed with the comment, "Storm sewer drain pipe outlet." However, there was no mention of an incised channel beneath the pipe. The erosion potential was initially noted as low, because neither the picture nor the comments mentioned any erosion. Gully L233 looks to have formed in the time since the 2008 Inventory. **Figure 25** compares the pipe outfall from the 2008 Inventory with the incised channel currently at the site.

Figure 23: Bloomington High Priority Region No. 17

LEGEND

- High Priority Region

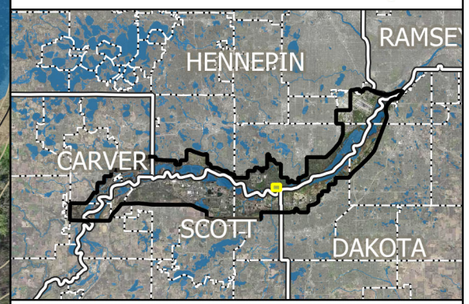
High Priority Sites

- Low --> High
- Moderate --> High
- High --> High
- New Site High

Other 2020 Locations

- Surveyed Gully
- Surveyed Pipe Outfall
- Hennepin Co. 2-ft Contours
- MnDNR Spring Inventory
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Completed Project
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map

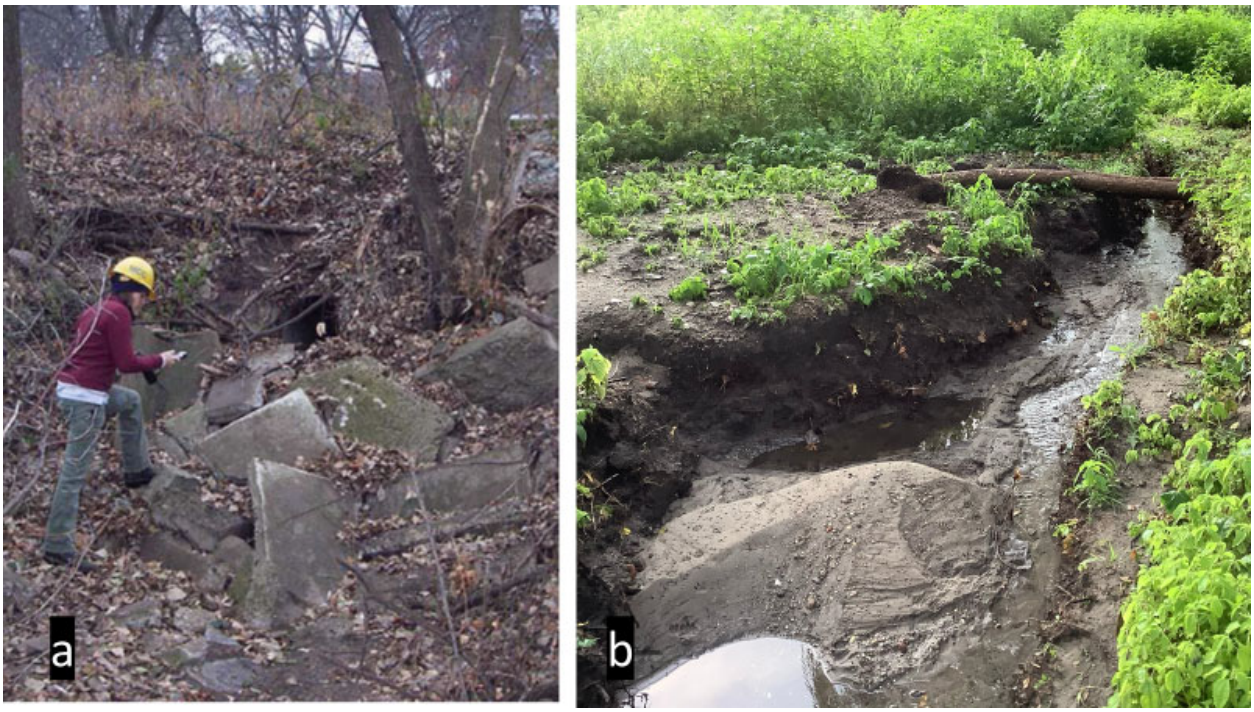


Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 24. Comparison of gully L453 in 2008 (a) and 2020 (b). Both photos were taken looking upstream at the steep gully channel.

Figure 25. Comparison of Gully L233 from 2008 (left) to 2020 (right). The 2008 photo depicts the pipe outfall filled with riprap. and the 2020 photo shows the incised channel formed below the pipe outlet.



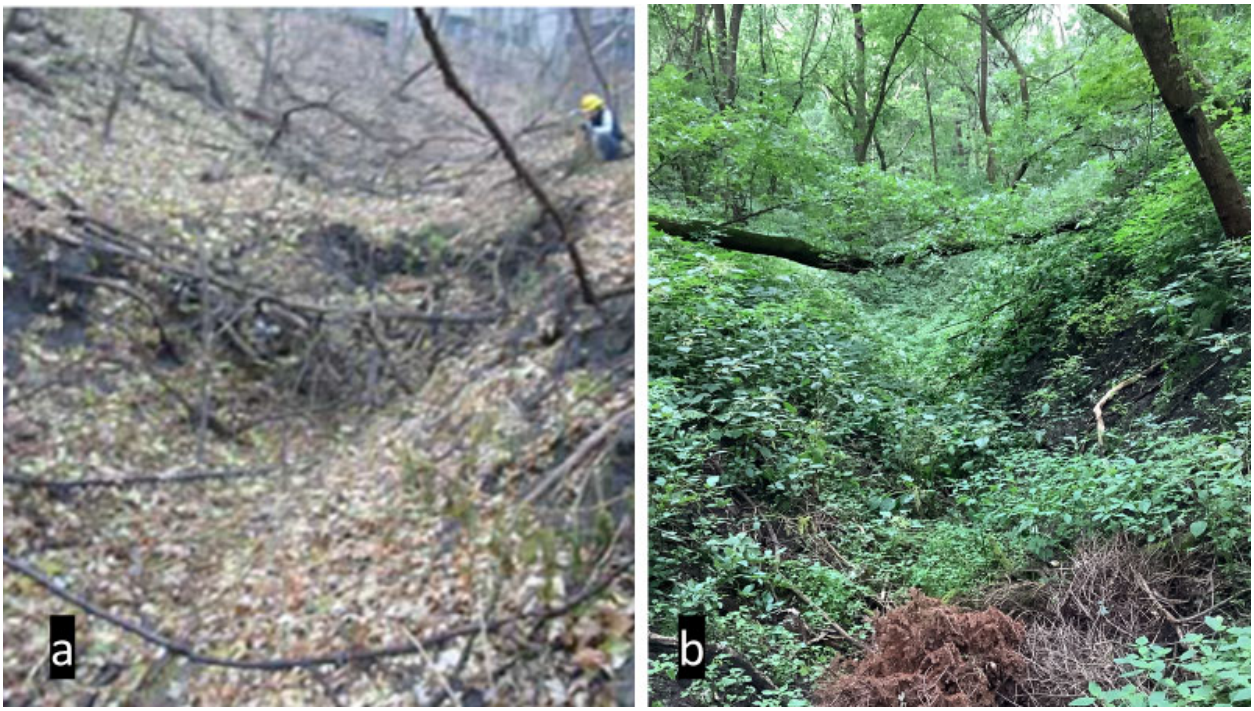
5.5.5 High-Priority Site L47

Gully L47 was located within a residential backyard along Overlook Drive. The gully was heavily vegetated along both the bottom and the banks. The channel slope was flat, but the gully bottom was narrow and had a V shape. As with many of the other Bloomington gullies, sand was the general material.

An actively eroding head cut, as well as steep bank slopes that led into an incised channel, were noted. Mass wasting seemed to be occurring as the slopes weakened and the channel continued to down-cut. Because of these problem indicators, the site was noted with a high erosion potential. Both slope and channel incision were noted as the apparent causes.

The high erosion potential designation for the site was consistent with the benchmarked 2008 Inventory. Site L47 was benchmarked with a high erosion potential ranking due to the incision evident in the photo and a description of a "deep-cut gully about 60 yards in length." **Figure 26** illustrates the continued degradation in the channel since the 2008 Inventory. Although vegetation covers the banks, leaning trees and an incised V-shape channel are visible in the 2020 picture (b).

Figure 26. Comparison of Site L47 between 2008 (a) and 2020 (b). Photo 'b' was taken looking downstream from the head cut.



5.5.6 Gully L364

Gully L364 was located along the border of the LMRWD and the Nine Mile Creek Watershed District. The gully ultimately discharged into the wetlands close to the Minnesota River.

This site consisted of a long pipe outlet that fed into a gully. The pipe was unstable and in some areas was hanging above the soil by over a foot. Headward erosion was exposing the pipe even further. There was some riprap below the pipe outfall, but it did not look to be stabilizing the banks or head cut. The gully that formed from the pipe outfall had a medium depth and a flat U-shaped channel. The gully bottom and banks were both bare.

Active erosion, mainly in the form of undercut banks, led to a high erosion potential rating. Other problem indicators included incision, leaning trees, and a loss of bank vegetation.

The L364 site was benchmarked as having low erosion potential because the 2008 Inventory only noted the stormwater pipe outlet and no signs of erosion other than a shallow channel visible in the photo. Although unclear from the 2008 photo, all the headward erosion along the pipe appears to have occurred since the 2008 Inventory. **Figure 27** offers a comparison in erosion around the pipe outfall between 2008 (a) and 2020 (b).

Downstream from the pipe outfall, the main gully channel was also actively eroding. Although the gully was shallow and had a wide bottom width, future erosion appeared imminent due to the incised banks and overhanging vegetation. **Figure 28** illustrates erosion within the channel.

Figure 27. A comparison of the pipe outfall and gully head cut between 2008 (a) and 2020 (b).

Figure 28. Photo 'a' is looking downstream from the head cut toward riprap and a widened gully channel. Photo 'b' is looking downstream toward the toe of the gully at overhanging banks.

5.5.7 Gully L381

Gully L381 is located west of Mound Springs Park. This gully discharges into the wetlands surrounding Mound Springs Park. Gully L381 exists because of an unstable drainage feature. The hanging pipe outfall emptied into a pond-like area that was filled with water at the time of the site visit. A gully channel continued downstream from the pond. Riprap near the head cut did not seem to be stabilizing the area.

The area around the pipe outfall showed problem indicators such as overhanging banks and leaning trees with exposed roots. As the channel began to narrow, overhanging continued as a main problem indicator, in addition to incision and slumping. The channel was U-shaped with bare soil for its entire length.

Gully L381 was benchmarked as having high erosion potential based on a photo depicting overhanging banks and description of a pipe outfall with some bank erosion. The length of the channel was not noted in the 2008 Inventory; it is therefore difficult to determine the progression of erosion for the entire channel. However, overhanging banks and exposed soil around the immediate discharge area remained consistent from 2008 to 2020. **Figure 29** and **Figure 30** illustrate the erosion around the pipe outfall and gully since the 2008 Inventory was completed.

Figure 29. Photo from the 2008 Gully Inventory illustrating the pipe outfall and scour.

Figure 30. Photos from 2020 Inventory. Photo 'a' is looking upstream at the gully channel. Photo 'b' is looking downstream at the pipe outfall and pond.

5.5.8 High-Priority Region 18

HPR 18 is made up of three sites: 999-151, L255, and L466 (**Figure 31**). All three sites are located within Mound Springs Park.

Gully 999-151 and Gully L255 exhibited very similar characteristics. Both gullies had a medium depth with a narrow bottom width. Additionally, both gullies formed because of an unstable pipe outfall with a small diameter. Gully 999-151 was significantly shorter than Gully L255, which was located directly behind the Meadow Woods Assisted Living facility. L255 was more severe than Gully 999-151 and there were multiple knickpoints in the channel contributing to degradation. Near the head cut, slumps were visible and overhanging trees were at risk of falling in. In addition to the pipe outfall, a groundwater seep occurred close to the toe of L255. A steep hillslope exacerbated the erosion at Site L255.

Gully L255 was benchmarked as having a high erosion potential due to a photo depicting steep banks with bare soil and a description of "severe erosion." This ranking is consistent with the ranking from the Project. During the 2020 field survey, new knickpoints near the toe of the gully and deeper incision within the gully channel were evident. **Figure 32** shows pictures from the 2008 and 2020 assessments.

Site L466 was located near to the other two sites. The site was described as a "deep gully with severe erosion" in the 2008 Inventory and benchmarked as a high erosion potential site. However, the condition of this deep gully could not be accurately assessed as part of the Project because of heavy vegetation.

Figure 31: Bloomington High-Priority Region No. 18

LEGEND

- High Priority Region

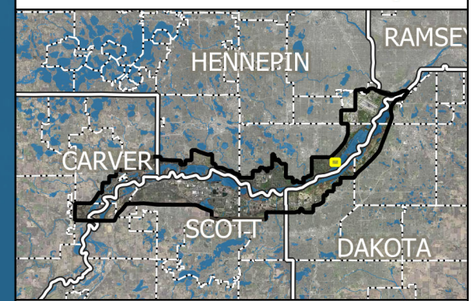
High Priority Sites

- Low --> High
- Moderate --> High
- High --> High
- New Site High

Other 2020 Locations

- Surveyed Gully
- Surveyed Pipe Outfall
- Hennepin Co. 2-ft Contours
- MnDNR Spring Inventory
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Completed Project
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 32. Comparison of site L255 between 2008 (a) and 2020 (b).

5.5.9 Gully L260

Gully L260, located close to the Old Cedar Ave. Bridge, is a deep gully with a medium bottom width. The head cut of the gully was a wide arc where groundwater seeps contributed to slumping and headward erosion. The general gully material consisted of sand, while the channel was armored. A moderate amount of fast-moving water was present within the gully channel at the time of the visit.

The apparent causes for L260 were an unstable hanging metal pipe, as well as multiple groundwater seeps around the head cut area. Problem indicators included overhanging banks, leaning trees, slumping, incision, and a loss of bank vegetation. Tree debris were present in the channel and many trees had exposed roots and appeared close to falling in.

The 2008 Inventory included a picture highlighting bare, incised banks within the gully and noted "severe erosion throughout gully." This caused the site to be benchmarked as having a high erosion potential. Although the channel was more vegetated than shown in the photo of the 2008 Inventory, slumping along the banks and an actively eroding head cut were still visible. **Figure 33** illustrates the difference between the 2008 and the 2020 conditions.

Figure 33. Photo a: Channel incision and bare soil along the banks of L260 in 2008. Photo b: Left bank of Gully Channel L260 in 2020.

5.5.10 Gully L266

Gully L266 was located within a channel parallel to Minnesota State Highway 77. A moderate amount of fast-moving water was observed within the gully at the time of the visit. L266 had a medium depth and wide bottom width, and it consisted of a flat U-shaped channel with bare soil along the bottom and banks. A moderate amount of buckthorn was also observed.

Groundwater seeps are presumed as the primary cause for this gully. Problem indicators including aggradation, degradation, a loss of bank vegetation, incision, overhanging banks, slumping, and leaning trees led to the high erosion potential ranking at this site. Aggradation was found in the form of mid-channel sandbars. Additionally, tributary streams with less severe erosions were noted.

The 2008 Inventory contained comments that this gully had moderate erosion and a spring. The image showed a shallow channel with little evident erosion (**Figure 34a**). The gully appears to have progressed from moderate to high erosion potential since the 2008 Inventory, as evidenced by visible incision and channel widening when comparing the site photos in **Figure 34**.

Figure 34. Comparison of Site L266 between 2008 (a) and 2020 (b). Channel widening and unstable banks are evident in photo 'b'.

5.5.11 HPR 19

HPR 19 contains gullies L270, L269, and L480 (**Figure 35**). These three sites are all located within a channel perpendicular to Ike's Creek.

This area contained one of the most severe sections of erosion seen in Bloomington. Gully L270 had a head cut that receded back into a private farm. This gully had a narrow bottom width and a wide top width, and showed significant slumping, patches of bare sandy soil, overhanging banks, and leaning trees at risk of falling. The channel widened significantly at Point L269, but the same problem indicators remained along the unstable gully banks. When measured using a fence stretcher, the L270 channel appeared to have down-cut approximately 7 feet.

Although groundwater upwelling occurred along the banks of Ike's Creek, no seeps were observed within the gully channel formed by L270 and L269. The specific causes of the severe erosion, outside of slope and channel incision, were unknown.

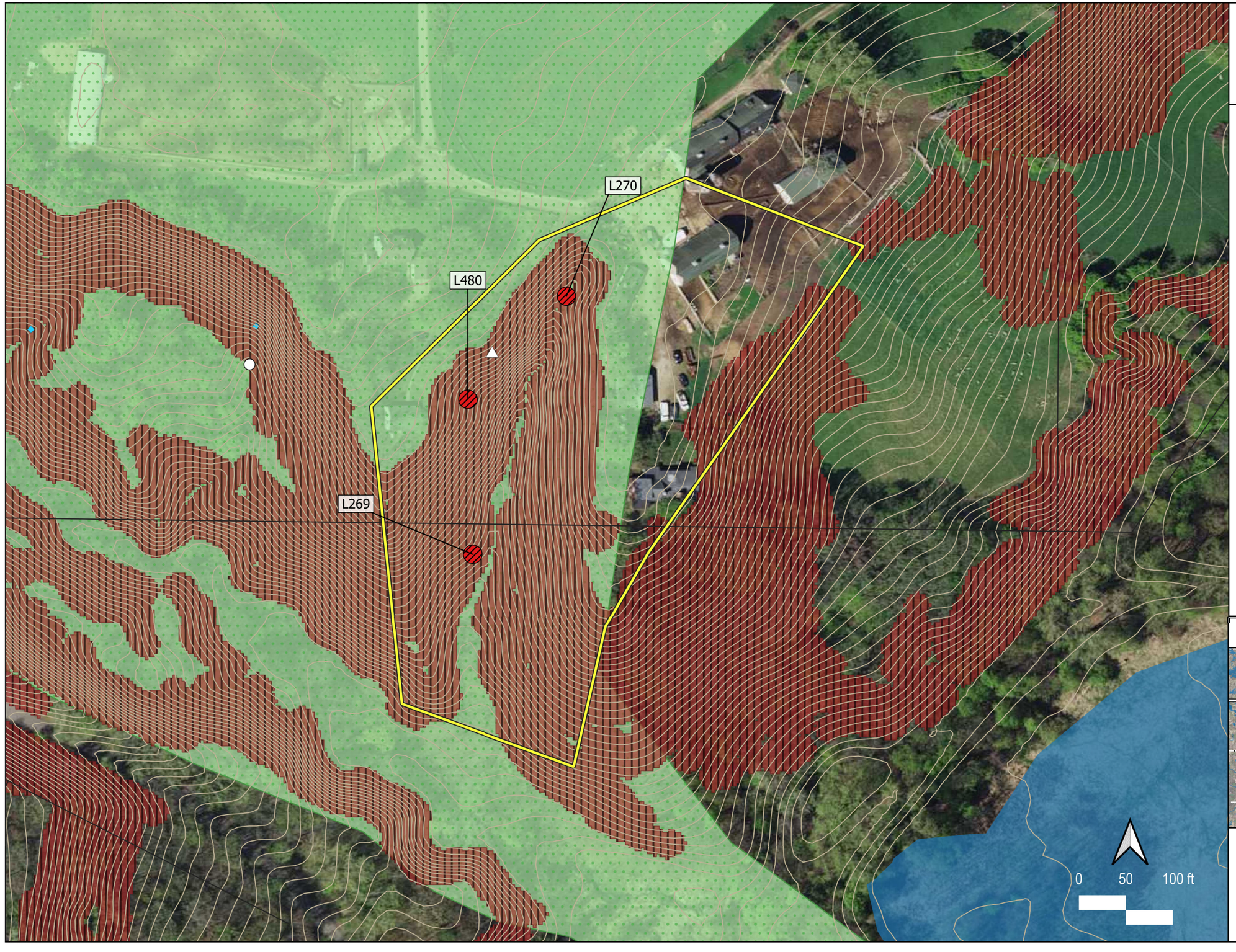
Gully L480 drained into the channel formed by L270 but was formed as an offshoot gully from an unstable clay pipe drainage feature. The resulting gully had a medium depth and equal top and bottom widths. The gully was U-shaped and consisted of bare soil along the bottom and banks. Some buckthorn was observed.

Incision, overhanging banks, slumping, loss of bank vegetation, and leaning trees were the problem indicators of this gully. The team observed the presence of logs along the bottom of the channel, which may have been meant to stabilize the gully.

In the 2008 Inventory, "extreme erosion" was noted at Site L269, and a head cut with overhanging banks was evident in the L270 site picture (**Figure 36a**). Both L269 and L270 were benchmarked with high erosion potential. The erosion potential appears to have remained consistent between the past and current assessment. No stabilization measures were noted, and compared to the 2008 Inventory photos, both gullies appeared to have deepened. **Figure 36** illustrates a narrower V-shape and larger perimeter of overhanging banks at the head cut of L270 in 2020 than in 2008.

The 2008 Inventory noted L480 as "deeply eroded," benchmarking it as having a high erosion potential. That description remained consistent and the site maintains high erosion potential. The gully appears to have widened without stabilizing. Additionally, the 2008 Inventory did not note a pipe draining into the gully, but the pipe was hanging and exposed.

Figure 35: Bloomington High-Priority Region No. 19



LEGEND

- High Priority Region

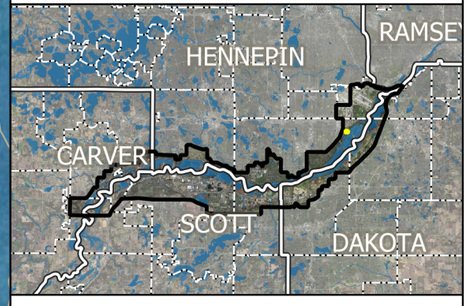
High Priority Sites

- Low --> High
- Moderate --> High
- High --> High
- New Site High

Other 2020 Locations

- Surveyed Gully
- Surveyed Pipe Outfall
- Hennepin Co. 2-ft Contours
- MnDNR Spring Inventory
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Completed Project
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 36. Difference in Site L270 between 2008 (a) and 2020 (b).

5.5.12 Gully L105

Gully L105 is located behind a commercial building along East Old Shakopee Road and drains toward Long Meadow Lake. Gully L105 was a deep trapezoid-shaped gully with a medium bottom width. The channel slope was steep and had bare soil along the gully bottom and partial vegetation along the gully banks. A moderate amount of fast-moving water was observed in the channel.

Problem indicators observed included degradation, incision, slumping, overhang banks, and leaning trees. The gully was caused by a groundwater-fed stream that down-cuts into the channel.

The 2008 Inventory included photographs depicting a V-shaped channel; the field notes described the gully as "cut fairly deep with steep banks along west side/loose soil." This description led a high erosion potential ranking during the benchmark assessment. This ranking is consistent with the current estimation, based on the observed problem indicators. **Figure 37** offers a comparison of Gully L105 between 2008 and 2020. Although there was more vegetation observed in 2020, there were also larger sections of bare soil and incision along the channel than seen in the picture from 2008.

Figure 37. Comparison of Gully L105 between 2008 (a) and 2020 (b).

5.5.13 HPR 20

HPR 20 included gullies L391, L394, and L482, all located near the Minnesota Valley National Wildlife Recreation Area Visitor Center (**Figure 38**). Within this region, the gullies shared similar characteristics, such as steep bank slopes, bare soil caused by a dense canopy, and a lack of groundwater seeps.

Gully L483 did not present any significant problem indicators, such as overhanging tree roots or slumping; however, the gully was rated as having high erosion potential because the banks consisted of bare soil and the bank slopes were almost vertical. These characteristics indicated that the banks were unstable and that the channel would likely continue to incise. In the 2008 Inventory, Gully L483 was noted to have deep erosion, and a deep V-shaped channel was evident in the site pictures. Based on this, the gully was benchmarked as having high erosion potential. Similarly, deep banks slopes were observed in 2020, but whether it has deepened is unknown.

Gully L391 had moderate erosion throughout the channel with a section of severe erosion near the head cut. There was depth variability throughout the reach, and the gully channel was deepest near the head cut area. A U-shaped gully with a flat channel slope was observed. Leaning trees, slumping, and a loss of bank vegetation occurred throughout the gully, while undercut banks and degradation were concentrated closer to the actively eroding head cut.

The 2008 Inventory noted exposed tree roots and some bank erosion at L391. The site was benchmarked as having high erosion potential. It seemed like channel incision destabilized the channel significantly since the 2008 Inventory.

Of the three gullies in the region, Gully L394 presented the most severe problem indicators. The observed gully was deep and V-shaped with a steep channel slope; its banks consisted of bare sandy soil. No water was observed in the gully. A hanging pipe outfall at the head cut of the gully served as a major cause of the downstream erosion. Problem indicators included degradation, incision, slumping, overhanging banks, and leaning trees.

The 2008 Inventory noted an “erosion cut” and concrete debris within the L394 channel. The picture did not seem to show the depth and extent of erosion seen in 2020 and, as such, the site was benchmarked as having a moderate erosion potential. As shown in **Figure 39**, actively eroding banks were observed during the field survey.

Figure 38: Bloomington High-Priority Region No. 20

LEGEND

- High Priority Region

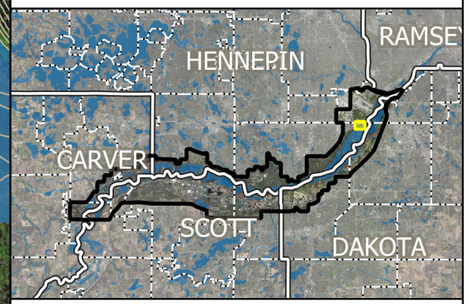
High Priority Sites

- Low --> High
- Moderate --> High
- High --> High
- New Site High

Other 2020 Locations

- Surveyed Gully
- Surveyed Pipe Outfall
- Hennepin Co. 2-ft Contours
- MnDNR Spring Inventory
- Public Waters
- Public Waterbodies
- High Value Resource Area Overlay District
- Steep Slopes Overlay District
- Completed Project
- Bloomington
- LMRWD Boundary
- Cities, Townships, Unincorporated Areas
- County Boundaries

LMRWD Watershed Location Map



Young Environmental Consulting Group, LLC

LOWER MINNESOTA RIVER WATERSHED DISTRICT

Figure 39. A comparison of Site L394 between 2008 (a) and 2020 (b).