Little Fork River Watershed Restoration and Protection Strategy Report

MINNESOTA POLLUTION CONTROL AGENCY

wq-ws4-21a

November 2017

Project Partners

Emmons & Olivier Resources, Inc.

Meghan Funke, PhD

Jason Ulrich

Jason Naber

Minnesota Pollution Control Agency

Mike Kennedy

Nolan Baratono

Jesse Anderson

Itasca County Soil and Water Conservation District

Kim Yankowiak

Terry Schaedig

Andy Arens

Koochiching County Soil and Water Conservation District

Jolén Simon

Pam Tomevi

North St. Louis Soil and Water Conservation District

Phil Norvich

Sam Soderman (by contract from Koochiching County SWCD)

Table of Contents

Project Partners ... 2

Key Terms ... 4

Executive Summary ... 5

What is the WRAPS Report? ... 7

User's Guide ... 9

1. Watershed Background & Description ... 11

2. Watershed Conditions ... 12

2.1 Condition Status ... 13

2.2 Water Quality Trends ... 15

2.3 Stressors and Sources ... 15

2.4 TMDL Summary ... 18

2.5 Protection Considerations ... 19

3. Prioritizing and Implementing Restoration and Protection ... 21

3.1 Targeting of Geographic Areas ... 21

3.2 Civic Engagement ... 29

3.3 Restoration & Protection Strategies ... 30

4. Monitoring Plan ... 54

5. References and Further Information ... 55

Appendices ... 56

Appendix A: Stream Assessment Status ... 57

Appendix B: Lake Assessment Status ... 66

Appendix C: WRAPS Meeting Notes ... 70

Appendix D: LiDAR Terrain Analysis and BMP Siting ... 73

Key Terms

Assessment Unit Identifier (AUID): The unique water body identifier for each river reach comprised of the USGS eight-digit HUC plus a three-character code unique within each HUC.

Aquatic life impairment: The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met.

Aquatic recreation impairment: Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus, chlorophyll-a, or Secchi disc depth standards are not met.

Hydrologic Unit Code (HUC): A Hydrologic Unit Code (HUC) is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the Minnesota River Basin is assigned a HUC-4 of 0702 and the Pomme de Terre River Watershed is assigned a HUC-8 of 07020002.

Impairment: Water bodies are listed as impaired if water quality standards are not met for designated uses including aquatic life, aquatic recreation, and aquatic consumption.

Index of Biotic integrity (IBI): A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the waterbody. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

Protection: This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the waterbodies.

Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

Source (or Pollutant Source): This term is distinguished from 'stressor' to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

Stressor (or Biological Stressor): This is a broad term that includes both pollutant sources and non-pollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

Executive Summary

The Little Fork River Watershed is located in northeastern Minnesota and drains an area of 1,179,520 acres (1,843 square miles). The watershed is the largest watershed by area in the larger Rainy River-Lake of the Woods Basin. From its start, the Little Fork River travels approximately 160 miles before it flows into the Rainy River, 11 miles west of International Falls. The watershed is sparsely populated and commonly referred to as remote and wild. The two major communities in the watershed are Littlefork (population 623) and Cook (population 504). The primary economic activities within the watershed are logging of second-growth timber and tourism. The Little Fork River is designated as a State Water Trail by the Minnesota Department of Natural Resources (DNR). The Watershed is divided between two ecoregions, Northern Lakes and Forests (NLFs) and Northern Minnesota Wetlands (NMWs). The southern portion of the watershed is primarily dominated by mixed forest. The northern portion is woody wetlands and peat bogs. Fifty-two percent of the land in the watershed is publicly owned (including several state forests), 44% is privately or corporately owned, and the remaining 4% is Bois Forte Band of Chippewa Reservation land.

Vast tracts of forests and wetlands, along with limited development pressure, have helped sustain the Little Fork River Watershed as a high quality aquatic resource. However, nonpoint source pollution contributes to excess levels of turbidity (i.e., sedimentation) throughout the watershed. Increased runoff (water yield) from the land, and impacts to the stream channel from historical logging in the 1890s through 1937, are contributing to the current erosion of riverbanks and excessive stream turbidity. The protection of these surface waters is critical for sustaining the local economy, natural heritage, and character of this unique watershed.

From 2008 through 2009, a holistic process was completed to monitor and assess all of the surface water bodies (i.e., streams, lakes) in the Little Fork River Watershed to determine if they meet water quality standards for aquatic life use, recreation use, and consumption use.

Fifty-four locations were sampled for biology at the outlets of subwatersheds of varying sizes in the Little Fork River Watershed. Forty-three stream segments in the watershed (Assessment Unit Identifier (AUIDs)) were assessed for aquatic life use. Thirty-seven of the forty-three stream segments fully support aquatic life use. The remaining six segments did not support aquatic life use and were determined to be impaired. In five of these impaired segments, the cause was determined to be excess turbidity (or sediment) in the water. In the sixth segment, the impairment was due to a poor fish community. Of the six impaired segments, two are being deferred at this time and will be addressed during Cycle 2 of the WRAPS process in the Little Fork River Watershed, starting in 2018. One of the deferred segments (AUID 09030005-502, the Little Fork River from Lost Lake to Rice River) is impaired for aquatic life use by turbidity (or sediment). There was conflicting data from the four biological monitoring stations along this stretch of river and it was determined, by the local partners, that this segment should be studied further. The other deferred segment (AUID 09030005-517, the Rice River from Johnson Creek to the Little Fork River) is impaired for aquatic life use due to a poor fish community. Of the three biological stations in this segment, one of the stations (station number 05RN010) had conflicting information. Local partners decided to develop a comprehensive monitoring plan for further investigation.

In addition, 12 stream reaches and 15 lakes were assessed for aquatic recreation use. All of the 12 stream reaches and the 15 lakes meet the aquatic recreation use standard.

Overall, the results from the intensive watershed monitoring and holistic assessment process reveals that the Little Fork River Watershed remains as one of Minnesota's watersheds in very good condition. Protection strategies for the Little Fork River Watershed are important in maintaining existing high quality water resources. The Little Fork River partners utilized all available knowledge about the water resources in the watershed to identify and focus implementation strategies. As detailed in Sections 3.2 and 3.3, the following geographic areas (i.e., subwatersheds) are designated as the highest priority for initial implementation of strategies for water quality protection (Appendices D and E). However, all strategies outlined in Section 3.4 will be encouraged and pursued, as implementation funds are available.

Streams

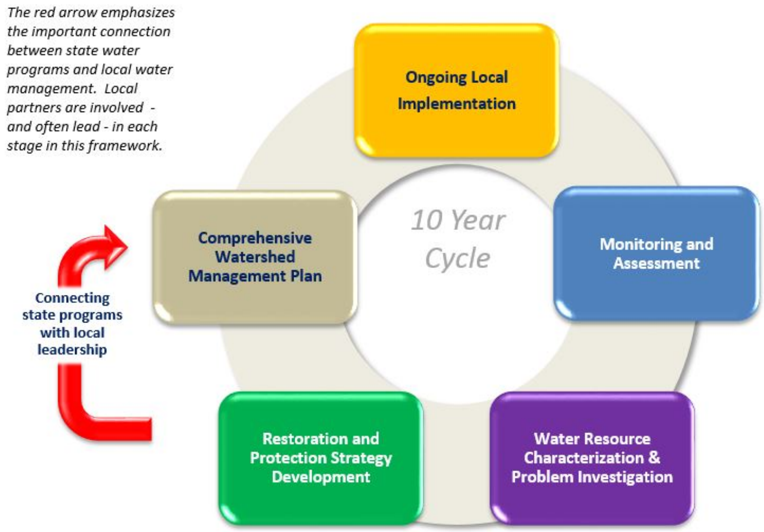
- Dark River (HUC 09030005-0304); high value native brook trout stream
- Rice River (HUCs 0903005-0103, -0105, -0106); declining water quality trends and fish population
- Little Fork River (the main stem including the following HUC-12s – 0903005-0607 (Deadmans Rapids), -0605 (no name), -0603 (Franklin Lake-Little Fork River), -0503 (Lower Valley River), -0601 (Town of Silverdale-Littlefork), -0308 (Lower Sturgeon River), -0306 (Upper Sturgeon River); declining water quality trends due to increased turbidity in the water, protection of sturgeon spawning habitats.

Lakes

- Upper Sturgeon River (HUC 0903005-0306); high recreational value Sturgeon Lake chain of lakes, including McCarthy Beach State Park, and declining water quality trends.

Issues of concern in Cycle 2 of the WRAPs in the Little Fork River Watershed, starting in 2018, include: climate change and its effects on stream and lake water quality; addressing the two deferred stream segments with aquatic life use impairments (i.e., segments of the Rice River and the Little Fork mainstem); and developing a strategic approach to the sediment issues by subwatershed in the Little Fork River Watershed. Site specific opportunities are included in best management practices (BMPs) Siting Analysis or Appendix E, a separate document in the WRAPS package.

What is the WRAPS Report?



The State of Minnesota has adopted a watershed approach to address the state's 80 major watersheds, denoted by an 8-digit hydrologic unit code or HUC. The Minnesota Watershed Approach incorporates **water quality assessment, watershed analysis, civic engagement, planning**, **implementation**, and **measurement of results** into a 10-year cycle that addresses both restoration and protection.

Along with the watershed approach, the Minnesota Pollution Control Agency (MPCA) developed a process to identify and address threats to water quality in each of these major watersheds. This process is called WRAPS or the Watershed Restoration and Protection Strategy. WRAPS reports have two parts: impaired waters will have strategies for restoration, and waters that are not impaired will have strategies for protection.

Waters not meeting state standards are listed as impaired and Total Maximum Daily Load (TMDL) studies are performed, as they have been in the past. TMDLs are developed for impaired waters in each watershed as part of Minnesota's watershed approach and folded into WRAPS. In addition, the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health, including both protection and restoration efforts. A key aspect of this effort is to develop and utilize watershed-scale models and other tools to identify strategies and actions for point and nonpoint source pollution that will cumulatively achieve water quality targets. For nonpoint source pollution, this report informs local planning efforts, but ultimately the local partners decide what work will be included in their local plans. This report also serves to at least partially address Environmental Protection Agency's (EPA's) Nine Minimum Elements, helping to qualify applicants for eligibility for Clean Water Act Section 319 implementation funds.

Purpose	• Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
	• Summarize Watershed Approach work done to date including the following reports:
	  • *Water Quality Assessment of Select Lakes within the Little Fork River Watershed, Aug 2010*
	  • *Little Fork River Watershed Monitoring and Assessment - September 2011*
	  • *Little Fork River Watershed Total Maximum Daily Load - June 2017*

Scope	• Impacts to aquatic recreation and impacts to aquatic life in streams • Impacts to aquatic recreation in lakes
Audience	• Local working groups (local governments, SWCDs, watershed management groups, etc.) • State agencies (MPCA, DNR, BWSR, MDH, MDA) • Local citizens • Tribal partners

User's Guide

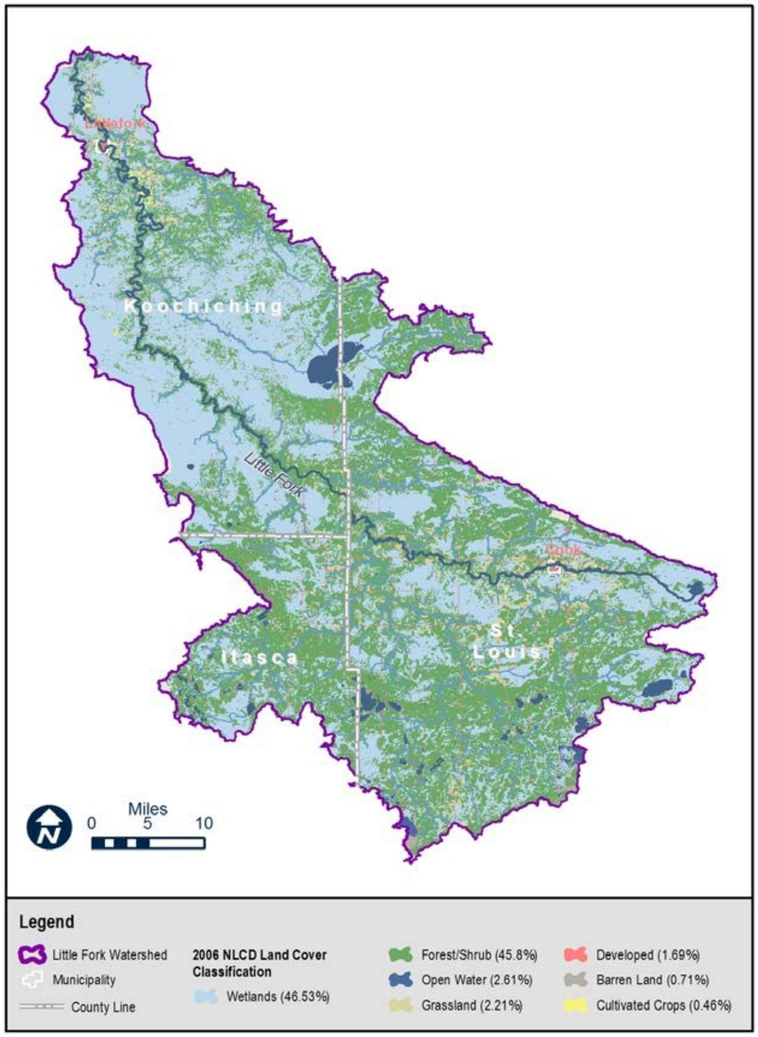
This Watershed Restoration and Protection Strategy (WRAPS) Report summarizes past monitoring, water quality assessments, and other water quality studies that have been conducted in the Little Fork River Watershed. In addition, it outlines ways for local groups doing local water planning to prioritize projects that can be implemented in the watershed to improve water quality. The WRAPS report contains a large amount of information. The purpose of the following table is to provide a Quick Reference guide for users to quickly identify what information can be found in each section of the report.

Table 1: WRAPS Report Quick Reference Guide

Section	Title	Description	Pages
Summaries of Past Monitoring and Water Quality Studies			
1	Watershed Background	A brief description of the Little Fork River Watershed.	11
2.1	Water Quality Assessment	A summary of how fishable, swimmable and usable the lakes and streams are in the watershed.	13
2.2	Water Quality Trends	A summary of lakes and streams with improving or declining water quality based on at least 10 years of monitoring data.	15
2.3.1	Stressors of Biological Impairments	A summary of factors that cause fish and invertebrate communities in streams to become unhealthy (also known as stressors).	15
2.3.2	Pollutant Sources	A summary of sources of pollutants (such as phosphorus, bacteria or sediment) to lakes and streams, including point sources (such as sewage treatment plants) or nonpoint sources (such as runoff from the land).	16
2.4	TMDL Summary	A summary of TMDL studies in the watershed. A TMDL is a calculation of how much pollutant a lake or stream can receive before it becomes unfishable, unswimmable, or unusable.	18
Ways to Prioritize Projects that Protect or Restore Water Quality			
2.5	Protection Considerations	A summary of common water quality issues in the watershed.	19

Section	Title	Description	Pages
3.1	Civic Engagement	A summary of input meetings with local partners in the watershed on the development of the WRAPS report.	21
3.2	Targeting of Geographic Areas	A summary of the results from different tools that were used to identify, locate and prioritize restoration and protection projects in the watershed.	29
3.3	Restoration & Protection Strategies	Tables identifying projects in the watershed that restore or protect water quality. These projects are divided into individual tables for each of the 11 smaller watersheds.	30
4	Monitoring Plan	A plan for ongoing water quality monitoring to fill data gaps, determine changing conditions, and gauge implementation effectiveness.	54
Supporting Information			
5	References	A bibliography of reports referenced in the WRAPS document.	55
Appendix A	Stream Assessment Status	Detailed results from the 2012 MPCA monitoring and assessment indicating which streams are supporting or not supporting water quality standards.	57
Appendix B	Lake Assessment Status	Detailed results from the 2012 MPCA monitoring and assessment indicating which lakes are supporting or not supporting water quality standards.	66
Appendix C	WRAPS meeting notes	Meeting notes from two meetings held in both Littlefork and Side Lake that brought together forestry professionals, local partners and agencies, and interested citizens to discuss water quality concerns, protection considerations, and priority areas in the watershed.	70
Appendix D	GIS Terrain Analysis Tool	Approach and results from LiDAR Terrain and BMP siting analyses	73
Appendix E	GIS Terrain Analysis Tool: Detailed Results	Detailed mapping results from LiDAR Terrain and BMP siting analyses	PDF

1. Watershed Background & Description



The Little Fork River Watershed is located in northeastern Minnesota and drains a 1,843 square mile area. The river travels approximately 160 miles before its confluence with the Rainy River, 11 miles west of International Falls. The watershed is sparsely populated and is commonly referred to as remote and wild. The two largest population centers in the watershed are the cities of Cook (population 623) and Littlefork (population 504).

Prior to intensive logging beginning in the 1890s, the Little Fork River Watershed was densely covered with vast stands of mixed conifers and hardwoods. During the time of logging, the river served as an important means of transporting the harvested logs downstream to the Rainy River. Today, the primary economic activities within the watershed are logging of second-growth timber and tourism. In 2006, the Minnesota Pollution Control Agency (MPCA) published “Effects of Historical Logging on Geomorphology, Hydrology, and Water Quality in the Little Fork River Watershed.” In 2008, the intensive watershed monitoring 10-year cycle started in this watershed.

Additional Little Fork River Watershed Resources

USDA Natural Resources Conservation Service Rapid Watershed Assessment for the Little Fork River Watershed: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mn/technical/dma/rwa/?cid=nrcs142p2_023646

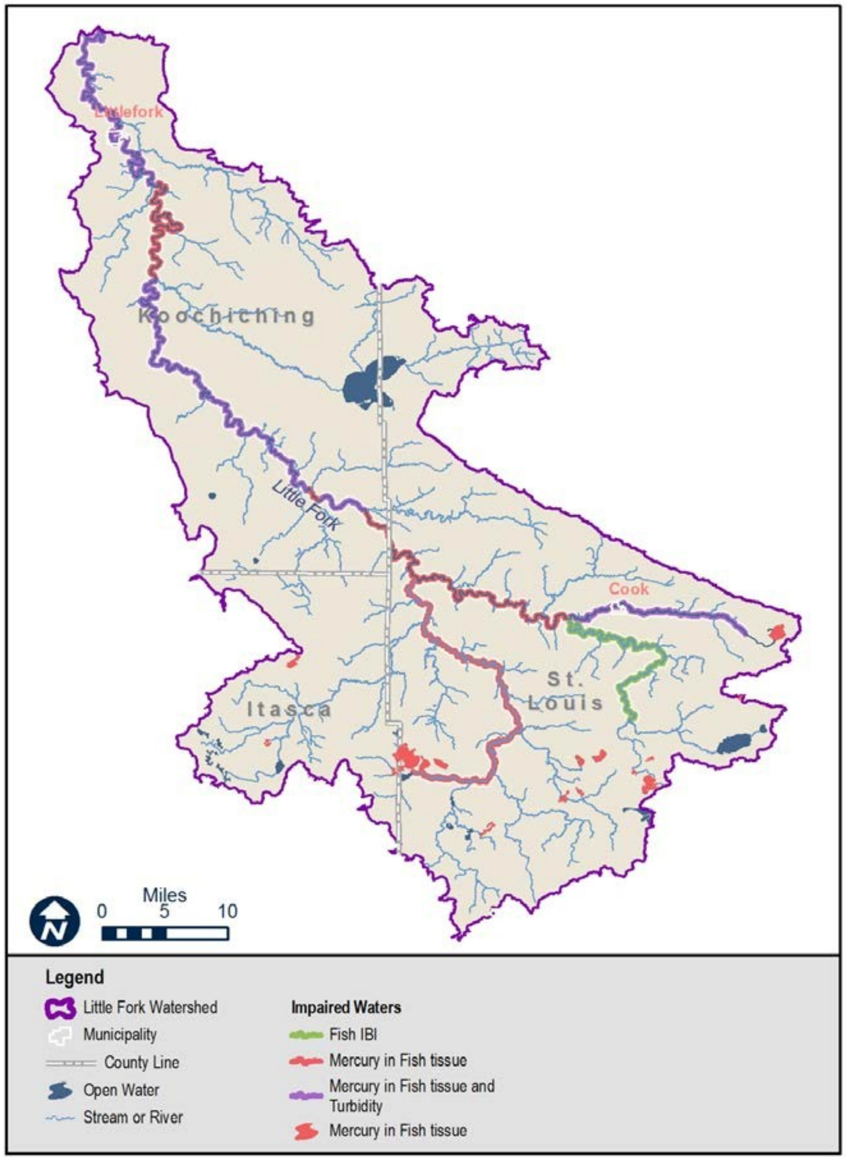
Minnesota Department of Natural Resources Watershed Assessment Mapbook for the Little Fork River Watershed: http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/wsmb76.pdf

Minnesota Pollution Control Agency Little Fork River Watershed: https://www.pca.state.mn.us/water/watersheds/little-fork-river

Koochiching Soil and Water Conservation District: http://koochichingswcd.org/

Itasca Soil and Water Conservation District: http://itascaswcd.org/

2. Watershed Conditions



Vast tracts of forests and wetlands, along with limited development pressure, have helped sustain the Little Fork River Watershed as a high quality aquatic resource. However, nonpoint source pollution contributes to excess levels of turbidity throughout the watershed. Increased runoff (water yield) from the land, and impacts to the stream channel from historical logging in the 1890s through 1937, are contributing to the current erosion of river banks and excessive stream turbidity.

Fifty-two percent of the land in the watershed is publicly owned, including several state forests. Privately- and corporately-owned land make up 44% of the watershed, and the Bois Forte Band of Chippewa Reservation land makes up the remaining 4% of the watershed.

Of the 43 stream reaches (also called Assessment Unit IDs or AUIDs) that were assessed in the Little Fork River Watershed, 37 were found to be supporting of aquatic life use (i.e., healthy fish and macroinvertebrate community indices, low turbidity, dissolved oxygen (DO) levels supporting fish, and/or moderate pH), while six were non-supporting. The single aquatic life biological impairment was found on the Rice River, while the remaining aquatic life impairments were due to high turbidity and located along the Little Fork River. All 12 stream reaches that were assessed for aquatic recreation use (i.e., bacteria levels unsafe for human contact) were fully supporting, and all 15 lakes that were assessed for aquatic recreation use (i.e., nutrient/eutrophication levels appropriate for swimming and fishing) were fully supporting.

2.1 Condition Status

This section summarizes impairment assessments for streams and lakes in the Little Fork River Watershed. Waters that are not listed as impaired will be subject to protection efforts (See Section 2.5 and 3.3). Some of the waterbodies in the Little Fork River Watershed are impaired by mercury and Polychlorinated Biphenyls (PCBs) in fish tissue. However, this report does not cover toxic pollutants. For more information on Minnesota's Fish Contaminant Monitoring Program, please see: https://www.pca.state.mn.us/sites/default/files/p-p2s4-05.pdf.

Streams

Streams are assessed for aquatic life and aquatic recreation uses. Aquatic life use impairments include:

- Low fish or macroinvertebrate index of biotic integrity (Fish or Invertebrate IBI; which means an unhealthy fish or macroinvertebrate community is present),
- DO levels too low to support fish or macroinvertebrate life,
- Turbidity/total suspended solids (TSS) levels too high to support fish or macroinvertebrate life,
- pH levels too low or too high to support fish or macroinvertebrate life, and
- Chlorides levels too high to support fish or macroinvertebrate life.

Aquatic recreation use impairments include Escherichia coli, (*E. coli*), a bacteria indicator of fecal pollution levels. Appendix A includes a complete summary of the stream impairment assessments by designated use and pollutants for all assessed AUIDs.

Table 2: Stream Aquatic Life Use and Aquatic Recreation Use Assessment and Impairment Summary

Subwatershed	Total Stream	Aquatic Life Use				Aquatic Recreation Use			
		FS	NS	IF	NA	FS	NS	IF	NA
Upper Little Fork River	**7**	6	1			1			6
South Branch Little Fork River	**4**	2	1		1	1			3
Bear and Dark River	**7**	6		1		1			6
Sturgeon Lake	**2**	2				1			1
Sturgeon River	**5**	4			1	2			3
Bear River	**6**	4			2	1			5
Middle Little Fork River	**9**	6	1		2	2			7
Lower Middle Little Fork River	**1**		1			1			
Nett Lake	**3**	3				1			2
Beaver Brook	**2**	2				1			1
Lower Little Fork River	**4**	2	2			1			3
TOTAL	**50**	**37**	**6**	**1**	**6**	**13**			**37**

FS = Fully Supporting: found to meet the water quality standard
NS = Not Supporting: does not meet the water quality standard and therefore, is impaired
IF = the data collected was insufficient to make a finding
NA = not assessed

Lakes

Lakes are assessed for aquatic recreation uses based on ecoregion specific water quality standards for total phosphorus (TP), chlorophyll-a (chl-*a*), and secchi transparency depth. To be listed as impaired, a lake must not meet water quality standards for TP and either chl-*a* or secchi depth. Appendix B includes a complete summary of the lake assessment and aquatic recreation use impairments.

The Little Fork River Watershed lies within the NLFs and MNW ecoregions. There are approximately 121 natural lakes greater than 10 acres in the watershed, with most located in the Bear River and Sturgeon Lake Subwatersheds. In general, lake water quality data are sparse in the watershed, with most lakes having little or no historical water quality data collected. Only 19 lakes have assessment level data (i.e., at least 8 samples collected over at least 2 years from a 10-year period). Little Fork River Watershed lakes were assessed relative to the NLF Class 2B ecoregion standards. The assessment cycle average TP concentrations for all lakes are below this value (30 µg/L). Likewise, chl-*a* is below the standard for all lakes except Bear. Based on these results, all assessed lakes are meeting eutrophication criteria for NLF 2B waters (i.e. those waters that support a cool and warm water fishery). The Secchi transparency (i.e., water clarity) standard in four lakes (Bear, Little Sturgeon, West Sturgeon, and South Sturgeon) is not being met, but this is due to natural bog staining, and not in response to elevated chl-*a* concentrations. The Sturgeon chain of lakes will be suggested to be a focus area of Little Fork River WRAPS Cycle 2, starting in 2018.

Table 3: Lake Aquatic Recreation use Assessment and Impairment Summary for lakes >10 acres

Subwatershed	Total Lakes	Aquatic Recreation Use				Major Lakes
		FS	NS	IF	NA	
Upper Little Fork River	**2**			1	1	Lost
South Branch Little Fork River	**12**	1		3	8	Big Rice, Little Rice, Sand
Bear and Dark River	**16**	2		2	12	Clear, Dark, Fourteen, Leander
Sturgeon Lake	**31**	8		6	17	Sturgeon, Little Sturgeon, Perch, Side, Long
Sturgeon River	**5**				5	
Bear River	**38**	8		23	7	Bear, Horsehead, Kelly, Little Bear, Napoleon, Owen, Raddison, Thistledew, Walters
Middle Little Fork River	**13**			9	4	
Lower Middle Little Fork River	**3**				3	
Nett Lake	**1**				1	Nett
Beaver Brook	**0**					
Lower Little Fork River	**0**					
TOTAL	**121**	**19**		**44**	**65**	

FS = Fully Supporting: found to meet the water quality standard
NS = Not Supporting: does not meet the water quality standard and therefore, is impaired
IF = the data collected was insufficient to make a finding
NA = not assessed

2.2 Water Quality Trends

Long-term water quality and flow records are collected near the confluence of the Little Fork River with the Rainy River. A long-term water quality record was available from the Little Fork River at the MN-11 Bridge (at the confluence of the Little Fork River and Rainy Rivers) located 0.5 miles west of Pelland (MPCA station S000-179) from 1971 to 2013. A seasonal test for trends was conducted with a statistical software program to identify statistically significant trends in the water quality of the Little Fork River at MN-11. There was a statistically significant increasing trend in nitrate and a statistically significant decreasing trend in TP concentrations sampled in the fall (September through November season) and, on average, for the entire calendar year. This corresponds to expected changes in nutrient export from forested watersheds during reforestation following a logging event.

The 2006 report by Jesse Anderson (MPCA) and others, Effect of Historical Logging on Geomorphology, Hydrology, and Water Quality in the Little Fork River Watershed, discusses long-term trends in stream flow. Briefly, they found that peak flows increased from 1931 to 1952, were stable from 1953 to 1968, and decreased from 1969 to 2005. These trends in flow were the result of land cover changes (logging and reforestation) and not precipitation changes.

Table 4: Water quality trends of the Little Fork River near the confluence with the Rainy River

Parameter	Data Range	Season	Trend
Biochemical Oxygen Demand	1971-2010	All	No statistically significant trends
Nitrite/ Nitrate	1982-2010	January – December September – November	**Increasing**, and statistically significant
Kjeldahl Nitrogen	1982-2010	All	No statistically significant trends
Total Phosphorus	1971-2010	January – December September – November	**Decreasing**, and statistically significant
Total Suspended Solids	1971-2010	All	No statistically significant trends

2.3 Stressors and Sources

To develop appropriate strategies for restoring or protecting waterbodies, the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological stressor identification is done for streams with either fish or macroinvertebrate biota impairments, and encompasses both evaluation of pollutants and non-pollutant-related factors as potential stressors (e.g. altered hydrology, fish passage, habitat). Pollutant source assessments are done where a biological stressor ID process identifies a pollutant as a stressor as well as for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources.

Stressors of Biologically-Impaired Stream Reaches

The Rice River (09030005-517, Johnson Creek to the Little Fork River) is the only stream reach in the Little Fork River Watershed that was assessed as not supporting aquatic life due to a low scoring (unhealthy) fish community during a single visit at one station in 2005. A study was conducted in 2012 on the Rice River to determine the primary stressors to aquatic life. Additional biological monitoring was conducted in 2012 to determine the extent of the biological impairment along the Rice River. The 2012 scores for the fish community were significantly higher than in 2005 and indicated a healthy fish community. Analysis of the stream connections, hydrology, geomorphology, water chemistry, and biology in 2012 do not indicate that there is a chronic water quality problem putting stress on the fish community, nor do they point to sporadic, recurring events that degrade water quality temporarily. Additional study will be conducted to determine if the 2005 low fish community score was an isolated event or an indicator of long-term impairment. The Rice River will be a focus area of Little Fork River WRAPS Cycle 2, starting in 2018.

Point Sources

Point sources are defined as facilities that discharge stormwater or wastewater to a lake or stream and have a National Pollutant Discharge Elimination System (NPDES) or State Disposal System (SDS) Permit. There are 4 municipal wastewater facilities, 3 industrial wastewater treatment facilities, and 16 industrial stormwater facilities that require NPDES permitting located in the Little Fork River Watershed (Figure 1, Table 5).

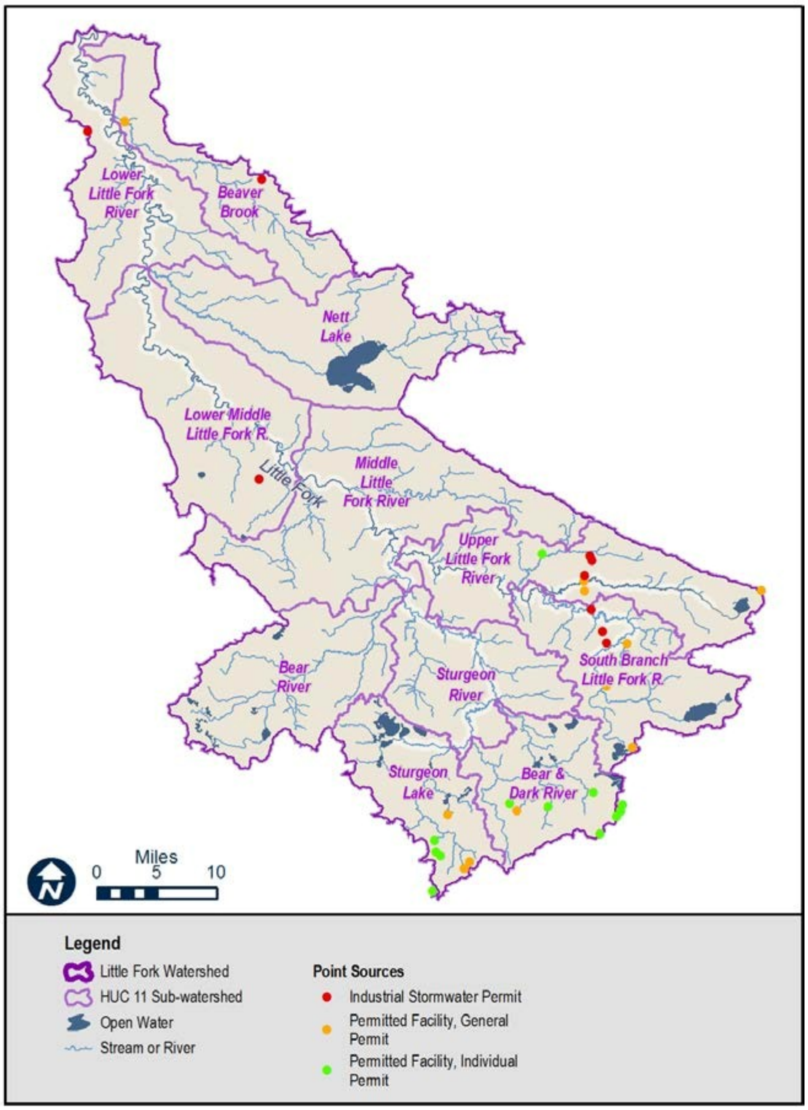


Figure 1: NPDES permitted Point Sources in the Little Fork River Watershed

Table 5: NPDES permitted Point Sources in the Little Fork River Watershed

Subwatershed	Point Source Name	Permit #	Type	Pollutant reduction needed beyond current permit conditions/limits?
Upper Little Fork River	ISD 2142 Pre-Kindergarten to Grade 12 N School	MN0069850	MWW	No
	Cook WWTP	MNG580179	MWW	No
	KGM Contractors Inc	MNG490090	ISW	No
	Cook Transfer Station ISW	MNR05342P	ISW	No
	Hillwood Products Inc - ISW	MNR0535M3	ISW	No
South Branch Littlefork R.	Ulland Brothers - Aggregate	MNG490069	ISW	No
	KGM Contractors Inc	MNG490090	ISW	No
	Seppi Brothers Concrete Products Corp	MNG490256	ISW	No
	Hill Biomass Inc - ISW	MNR053469	ISW	No
	Hancock Fabrication Inc - ISW	MNR0534DT	ISW	No
	Cook Municipal Airport - ISW	MNR0535GV	ISW	No
Bear & Dark River	Central Iron Range Sanitary Sewer District WWTP	MN0020117	MWW	No
	US Steel - Minntac Mining Area	MN0052493	IWW	No
	US Steel Corp - Minntac Tailings Basin Area	MN0057207	IWW	No
	St Louis County Land Dept - Aggregate	MNG490177	ISW	No
Sturgeon Lake	Hibbing Taconite Co - Tails Basin Area	MN0049760	IWW	No
	Ulland Brothers - Aggregate	MNG490069	ISW	No
	St Louis County Land Dept - Aggregate	MNG490177	ISW	No
	M&C Inc	MNG490214	ISW	No
Lower Middle Littlefork R.	Wanner Engineering Inc - ISW	MNR0535WQ	ISW	No
Beaver Brook	Littlefork WWTP	MNG580081	MWW	No
	Boise Remote Site 17 Landfill - ISW	MNR05344Y	ISW	No
Lower Little Fork River	Green Forest Inc - ISW	MNR0536KD	ISW	No

MWW = municipal waste water, IWW = industrial waste water, ISW = industrial storm water

Nonpoint Sources

Nonpoint sources of pollution, unlike pollution from industrial and sewage treatment plants come from many diffuse sources. Nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes and streams. Common nonpoint pollutant sources in the Little Fork River Watershed are:

Upland erosion: Sediment delivery from uplands can occur via several pathways: sheet, rill and gully erosion. Upland areas that are overgrazed, cleared, or otherwise disturbed are susceptible to sheet erosion. Rills and gullies are more likely to form where disturbed soils are located on steep slopes, and all types of soil erosion can be accelerated when flow volume increases.

Stream bank erosion: Stream bank erosion occurs when stream flow cuts into the banks of the active channel, eroding soil grains, or when stream bank integrity is compromised causing sediment to slough off banks into the channel. When flow volume increases, so does the erosive power of a stream.

Near bank erosion: Near bank erosion occurs when upper banks of valley walls fail. Examples include gullies, landslides, rotational bank failures, and mass wasting. These types of erosion have the potential to release very large amounts of sediment in single events.

Stream bed erosion: Stream bed erosion occurs when stream flow cuts into the bottom of the channel making it deeper. This leads to incision or down-cutting of the channel within the valley and can lead to the stream becoming entrenched.

Upstream tributaries: Tributaries and upstream reaches can contribute sediment to impaired reaches, and the magnitude of sediment transported depends on the soil and land use characteristics of the watershed.

Table 6: Nonpoint Sources in the Little Fork River Watershed. Relative magnitudes of contributing sources are indicated.

Subwatershed	Impaired Streams/ Reaches (AUID) impacted by pollutant of concern		Pollutant Source				
			Upland erosion	Stream bank erosion	Near bank erosion	Stream bed erosion	Upstream tributaries
Middle Little Fork River	Little Fork River (-506) Willow R to Valley R	TSS	™	›	˜	›	™
Lower Middle Little Fork River	Little Fork River (-508) Prairie Ck to Nett Lk R	TSS	™	›	˜	›	˜
Lower Little Fork River	Littlefork R (-510) Cross R to Beaver Brook	TSS	™	›	›	›	˜
Lower Little Fork River	Littlefork R (-501) Beaver Brook to Rainy R	TSS	™				˜

Key: ˜ = High › = Moderate ™ = Low.

Note: All sources listed in the table were identified in completed TMDL studies. The symbols in the table differentiate the relative ranking of implementation targeting for the more significant sources.

2.4 TMDL Summary

A TMDL is a calculation of how much pollutant a lake or stream can receive before it becomes unfishable, unswimmable, or unusable. These studies are required by the Clean Water Act for all impaired lakes and streams. There are four impaired streams in the Little Fork River Watershed with completed TMDL studies. Table 7 summarizes the individual TMDL wasteload and load allocations and percent reductions needed to meet water quality standards and goals for each impaired stream.

Table 7: Allocation summary for completed stream TMDLs in the Little Fork River Watershed

Stream/ Reach (AUID)		Flow Zone	Allocations (TSS in kg/day)					
			Wasteload Allocation		Load Allocation			
			WWTFs	Regulated Stormwater	Upstream Outflow	Watershed Runoff	Margin of Safety	Percent Reduction
Little Fork River (Willow River to Valley River, 09030005-506)	TSS	Very High	281	20	4,350	233,059	26,412	50%
		High	281	4	1,354	50,984	5,847	0%
		Mid	281	2	551	21,683	2,502	0%
		Dry	281	1	176	10,840	1,255	0%
		Very Dry	281	<1	0	4,436	524	0%
Little Fork River (Prairie Creek to Nett Lake River, 09030005-508)	TSS	Very High	--	76	237,710	84,241	35,781	48%
		High	--	12	52,624	13,842	7,387	14%
		Mid	--	4	22,516	5,069	3,066	0%
		Dry	--	2	11,298	2,505	1,534	0%
		Very Dry	--	1	4,717	842	618	0%
Little Fork River (Cross River to Beaver Brook, 09030005-510)	TSS	Very High	--	78	322,027	74,825	44,103	85%
		High	--	18	66,479	17,890	9,376	44%
		Mid	--	10	27,590	8,821	4,047	0%
		Dry	--	4	13,805	3,792	1,956	0%
		Very Dry	--	1	5,560	485	672	0%
Little Fork River (Beaver Brook to Rainy River, 09030005-501)	TSS	Very High	125	28	396,929	26,665	47,083	67%
		High	125	8	84,387	8,670	10,354	48%
		Mid	125	2	36,421	2,556	4,345	0%
		Dry	125	2	17,601	1,034	2,084	0%
		Very Dry	125	<1	6,045	331	722	0%

2.5 Protection Considerations

Bank De-stabilization from Historical Logging Activities

Clearcutting of old growth forests in the early 1900s resulted in a gradual increase in peak flows, culminating in highest peak flows 5 to 10 years following the 1937 logging of the last major stand of old growth forest in the Little Fork River Watershed. These high peak flows, in addition to log drives used to transport timber downstream, resulted in an initial destabilization of stream banks throughout the watershed that are continuing to result in bank failures today.

These bank failures are the result of the main stem of the Little Fork trying to re-establish a connection between the main channel and the flood plain. River systems in general go through an evolutionary cycle where they transform themselves in dimension, pattern, and profile to meet their sediment transport needs in the system. These erosional and depositional processes often take 100 years or more depending on the soil types.

It is imperative to understand the position in the evolutionary cycle the Little Fork is currently in, and what it is changing to next in the various phases of this erosional and depositional cycle. Once this is accomplished, we can then envision short-term bank stabilization projects and stream channel restoration. However, with 100 plus miles of stream in impairment status, this process will require large amounts of money and other resources to stabilize.

Forest Riparian Buffers

Bank failure in many places along the main stem of the Little Fork, and major tributaries, is causing sediment inputs to the stream as the stream tries to re-connect to the channel.

Reforestation activities in the buffer zone is a high priority for protection in this watershed. The mature trees in the buffer zone, on top of slumps, can reduce soil weight through evapotranspiration and reduce impacts of slumping of the stream banks.

Agricultural Riparian Buffers

Areas of insufficient or no riparian buffers exist on several agricultural operations within the watershed that would prevent excess flow and sediment loads to the streams.

Increased use of BMPs and standards, such as manure management and cattle exclusions from stream crossings to provide a healthy riparian buffer zone, especially along the mainstem of the Little Fork River, would prevent excess flow and sediment loads to the streams. Guidance for these practices can be found in the 2015 State Buffer Law and the web sites of other natural resource agencies (e.g., the Board of Water and Soil Resources, DNR).

Forest Loss

Forest loss significantly exceeded forest gain within the watershed from 2000 through 2012 (Global Forest Change 2013), which can result in increased stormwater runoff. Reforestation activities can be targeted in the Little Fork River Watershed to produce desired results, such as slower run-off, which in turn helps with erosion issues.

Geology Contributions to Stream Bank Failures

The geology of the Little Fork River Watershed is a significant contributor to bank failures and high sediment concentrations. Glacial Lake Aggasiz and other post-glacial lakes deposited heavy clay layers, which are now covered by fluvial sediments (Gran 2007). These soils are susceptible to gradual bank erosion and sometimes large bank failure events.

The most effective method for sediment reduction in systems like the Little Fork is restoring the stream channel to a stable form and specifically connecting the channel with the floodplain. However, this type of work in a large system is very expensive and can take many years.

Climate Change

In the last 30 years, the climate of the Little Fork River Watershed has changed significantly. There have been significant increases in annual precipitation, with fewer but larger rainfalls (Seeley 2012). These more intensive storm events result in increased flows, which accelerates erosion. In addition, fewer storms are increasing the occurrence frequency of seasonal droughts resulting in several first, second, and third order streams exhibiting characteristics of wetlands, which likely has little effect on erosion but could significantly change the composition of the aquatic biological community in the future (Baratono 2004 through 2012). These increases in precipitation will necessitate updated engineering for road crossings, stormwater management, and other water control structures. Upgrading culverts and other water crossings to handle larger capacities of flow, as well as reducing stresses on the biological community would be beneficial for the health of the Little Fork River ecosystem. Likewise, stormwater management may play an increasing role in the Little Fork River's ability to improve. Rain gardens, grassed waterways, wetlands, and more heavily engineered retention systems would benefit the river by reducing the flow volume in pulses after these rain events. By allowing the precipitation to infiltrate or be more evenly distributed into the river, reductions in sediments and nutrients can be achieved.

Finally, warming and the resulting increase in ice-free days (Seeley 2012, Johnson 2006) are forcing changes to the aquatic community. Fish are spawning earlier (Schneider 2010) and cooler water species are being replaced by warm water tolerant species (Serieyssol 2008).

3. Prioritizing and Implementing Restoration and Protection

The Clean Water Legacy Act (CWLA) requires that WRAPS reports summarize priority areas for targeting actions to improve water quality, and identify point and nonpoint sources of pollution with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions. In addition, the CWLA requires including an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

This section of the report provides the results of such prioritization and strategy development. Because much of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users and residents of the watershed, it is imperative to create social capital (trust, networks and positive relationships) with those who will be needed to voluntarily implement BMPs. Thus, effective ongoing civic engagement is fully a part of the overall plan for moving forward.

The implementation strategies, including associated scales of adoption and timelines, provided in this section are the result of watershed modeling efforts and professional judgment based on what is known at this time and, thus, should be considered approximate. Furthermore, many strategies are predicated on securing the necessary funding and other resources. As such, the proposed actions outlined are subject to adaptive management—an iterative approach of implementation, evaluation and course correction.

3.1 Targeting of Geographic Areas

The following section describes the specific tools and analyses that were used in the Little Fork River Watershed to identify, locate and prioritize watershed restoration and protection actions related to stream sediment reduction. The results are intended to serve as a rough roadmap to stimulate BMP planning and implementation discussions amongst stakeholders. Follow-up field reconnaissance will be the next part of the process to validate the identified areas potentially needing work.

HSPF Watershed Model

Hydrological Simulation Program--Fortran (HSPF) is a large-basin watershed model that simulates runoff and water quality in urban and rural landscapes. An HSPF watershed model was created for the Little Fork River Watershed for use with TMDL analyses. The model was constructed and calibrated using data from 1995 through 2009, focusing on simulation of flow and sediment. Although model simulations are based on a more generalized, larger scale perspective of watershed processes (and thus, less useful with regards to finer scale prioritization compared to the LiDAR based analyses discussed below), their value lies in the estimation of river flows and water quality in areas where limited or no observed data has been collected, as well as estimations of the locations and proportions of watershed sources -- specific combinations of land use, slopes and soils -- comprising pollutant loading at downstream locations (e.g., city of Littlefork) where more substantial observed data are available. In this study, HSPF results were used to help estimate locations and relative rankings of landscape sediment sources.

LiDAR Terrain Analyses

Geographic Information System (GIS) analyses using Light Detection and Ranging (LiDAR) high resolution elevation data are invaluable tools for estimation of magnitudes and spatial distributions of hydrologic, hydraulic and erosional processes, especially when relevant observed data is lacking as is the case with the Little Fork River Watershed. Landscape erosion is an important stream sediment source in the watershed (i.e., sediment carried in runoff from forests, agricultural fields and grasslands to nearby streams). However, research indicates that the majority of the stream sediment comes from near-channel sources -- stream bank/bluff erosion and gully/ravine erosion (Anderson 2006; Anderson 2004 - 2008; Gran 2007) -- owing to the unique geological context and legacy of logging in the Little Fork River Watershed. Terrain analyses of varying types were conducted to help target local sediment source areas of both landscape and near-channel erosion for BMP implementation. The GIS methodology and results are summarized below and in greater detail in Appendices D and E.

Approach

An area of focus was selected that encompassed the Little Fork River Watershed upstream of the confluence with the Nett Lake River (36 HUC12 watersheds). This area was selected to emphasize the incised main channel reaches just upstream of the confluence, both in terms of near-channel source areas in the upstream landscape and channel areas that influence its erosional processes.

Within this area of focus, the watershed was split up into quarter sections ("QS"; roughly 160 acre, 2640 feet on a side) for landscape sediment source assessment and ranking. This QS analysis served to constrain the BMP analysis to critical landscape areas thought to contribute the most flow and sediment to the channel network. A GIS terrain analysis framework for targeting sediment source areas and potential BMP sites was developed by Jason Ulrich (EOR) by adapting the Agricultural Conservation Planning Framework (ACPF; version 1 Beta, 2015) developed by Mark Tomer and others at the United States Department of Agriculture – Agricultural Research Station (USDA-ARS) to forested landscapes in northern Minnesota. The ACPF is a LiDAR-based analysis framework that determines source areas on the landscape, but also targets potential parcel-scale sites for a set of specific agricultural BMPs. However, only the ACPF riparian buffer and grassed waterway tools were judged to pertain to the Little Fork River Watershed non-agricultural landscape, therefore, were the primary BMPs sited using the analysis.

The adapted ACPF was run by EOR for 36 HUC-12 watersheds in the Little Fork River Watershed (see maps in Appendix D and E). Of the 1000s of buffer and grassed waterway BMP features initially sited by the analysis, the number was reduced to a more manageable amount by considering only the most critical sites. Critical BMP features were determined by requiring: (1) intersection with runoff risk, and (2) intersection with the perennial stream channel. This insures that potential BMPs are applied to areas with the highest potential runoff of sediment. See Appendix E for a HUC-12 breakdown of all targeted BMP features.

This is a starting point to understand the differences between sources of sediment. If most of the sediment is sourced from near channel, then several land-based BMPs can be of help to reduce sediment. If most of the sediment is sourced from the channel itself, land-based BMPs will be of little help. In-channel BMPs would then be a focus. Cycle 2 of WRAPs, starting in 2018, will help focus and hone in future efforts.

Results

As mentioned above, potential locations of riparian buffers and grassed waterways were constrained such that the most critical areas were targeted for maximum practicality and cost-effectiveness. Analyses resulted in approximately 1,100 targeted features across the 36 HUC-12s. Overall, the incised area of the Little Fork River mainstem (Gran's Reaches III and IV) provided the most "critical" opportunities for BMP implementation as siting analyses were heavily influenced by high slopes present there. Results of the analyses were intended to provide a basis for discussion on BMP planning and implementation within these watersheds. More detailed descriptions and HUC-12 maps are presented in Appendices D and E.

Additional Analyses

Stormwater attenuation should be a priority throughout the watershed. Figure 2, from Gran's Report (2007), shows the primary areas of active bank erosion are located in Reaches III and IV and to a lesser degree in Reaches II and V. Priority Management Zones for restoration activities would focus on these areas with an emphasis on Reaches III and IV. In addition, part of Gran's analysis consisted of a stream power based erosion index (EI) analysis using a 30-meter digital elevation model (DEM) that depicted stream channels and gullies with high erosion potential. As part of EOR's analysis, Gran's EI work was re-done using three-meter LiDAR DEM data resulting in improved accuracy and resolution of potential erosive features (this analysis is not included in this report but is included in the GIS deliverables and is available for future local water planning).

Overall, addressing the near-channel component of sediment erosion is a difficult and expensive undertaking, as much of the erosion is occurring over a broad area within the stream channel itself. Several possible next steps could be undertaken to improve understanding of near-channel sources and provide actionable knowledge for future BMP planning. Foremost, perhaps, is to achieve a better understanding of where erosion is occurring from a sediment budget perspective – how do individual reaches, sub-reaches, and tributaries comprise the total near-channel sediment load observed downstream (e.g., city of Littlefork, confluence with Rainy River). Some ways this could be accomplished include:

- Field channel surveys and stream bank/bluff erosion assessments, Rosgen Bank Erosion Hazard Index (*BEHI*), Rosgen (BANCS) modeling, placement of sediment pins, fine-scale LiDAR mapping) of the main stem and tributaries that factor in geological and channel successional realities that are important for assessing practicality of potential stream restoration projects.
- Detailed GIS assessment of channel widening and river meandering rates by comparing historical photos to current. This can be accomplished relatively easily using on-line digital photo resources.

- Developing field bank height ratios (BHR) to locate specific head cut locations.
- Detailed GIS assessment of reaches and tributaries to support field surveys to identify the locations and the extent of incisions and knickpoints, including bank and bluff heights. This analysis combined with the estimated erosion rates (discussed above) are relevant for estimating/ranking total bank-eroded volumes.
- Modeling hydraulic, erosional, depositional, and transport processes related to sediment to better understand and target primary sources, as well as assess the role that seasonal/annual variations in flow regime play. Field checking modeling outputs to ensure model scenerios match field observations is an important part of this work.

Additional tools used in the analysis process of targeting geographical areas of the watershed are sumarized in Table 8.

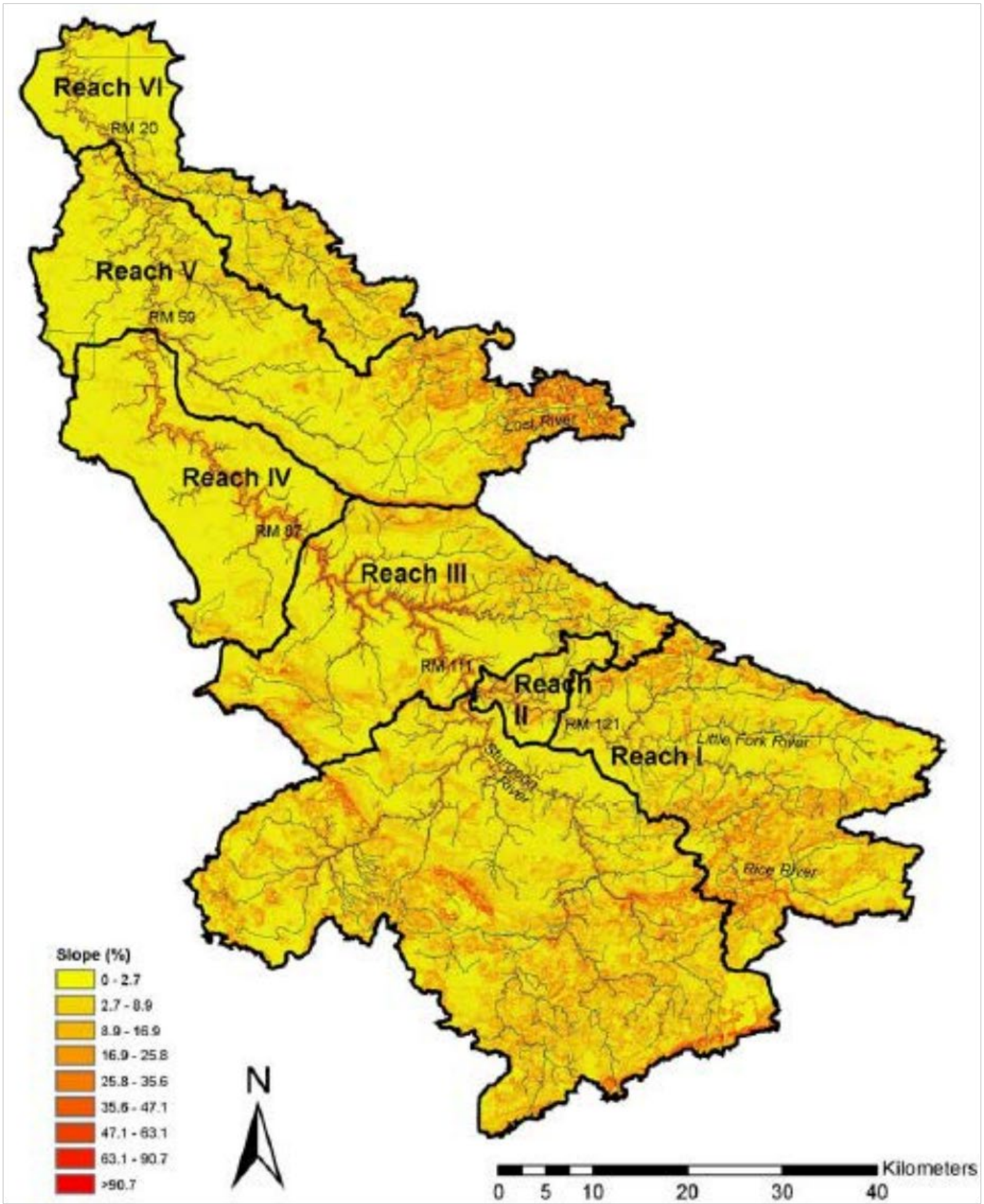


Figure 2: Geomorphic subdivisions for the Little Fork River Watershed overlain on a slope map. The steeper areas (deep red) along the main stem in reaches II, III, and IV correspond to areas of active bank erosion. Reproduced from Gran 2007.

Table 8: Summary of tools used to develop restoration and protection opportunities

Tool	Description	How can the tool be used?	Notes	Link to Information and data
Ecological Ranking Tool (Environmental Benefit Index - EBI)	This dataset consists of three GIS raster data layers including soil erosion risk, water quality risk, and habitat quality. The 30-meter grid cells in each layer contain scores from 0-100. The sum of all three scores is the EBI score (max of 300). A higher score indicates a higher priority for restoration or protection.	The three layers can be used separately, or the sum of the layers (EBI) can be used to identify priority areas for restoration or protection projects. The layers can be weighted or combined with other layers to better reflect local values.	These data layers are available on the BWSR website. In addition, a GIS data layer that shows the 5% of each 8-digit watershed in Minnesota with the highest EBI scores is available for viewing in the MPCA 'water quality targeting' web map, and download from MPCA.	BWSR MPCA Web Map MPCA download
Zonation	This tool serves as a framework and software for large-scale spatial conservation prioritization, and a decision support tool for conservation planning. The tool incorporates values-based priorities to help identify areas important for protection and restoration.	Zonation produces a hierarchical prioritization of the landscape based on the occurrence levels of features in sites (grid cells). It iteratively removes the least valuable remaining cell, accounting for connectivity and generalized complementarity in the process. The output of Zonation can be imported into GIS software for further analysis. Zonation can be run on very large data sets (with up to ~50 million grid cells).	The software allows balancing of alternative land uses, landscape condition and retention, and feature-specific connectivity responses. (Paul Radomski, DNR, has expertise with this tool.)	Software Examples
Restorable Wetland Inventory	A GIS data layer that shows potential wetland restoration sites across Minnesota. Created using a compound topographic index (CTI) (10-meter resolution) to identify areas of ponding, and USDA NRCS SSURGO soils with a soil drainage class of poorly drained or very poorly drained.	Identifies potential wetland restoration sites with an emphasis on wildlife habitat, surface and ground water quality, and reducing flood damage risk.	The GIS data layer is available for viewing and download on the Minnesota 'Restorable Wetland Prioritization Tool' web site.	Restorable Wetlands

National Hydrography Dataset (NHD) & Watershed Boundary Dataset (WBD)	The NHD is a vector GIS layer that contains features such as lakes, ponds, streams, rivers, canals, dams and stream gages, including flow paths. The WBD is a companion vector GIS layer that contains watershed delineations.	General mapping and analysis of surface-water systems. These data have been used for fisheries management, hydrologic modeling, environmental protection, and resource management. A specific application of this data set is to identify riparian buffers around rivers.	The layers are available on the USGS website.	*USGS*
Light Detection and Ranging (LiDAR)	Elevation data in a digital elevation model (DEM) GIS layer. Created from remote sensing technology that uses laser light to detect and measure surface features on the earth.	General mapping and analysis of elevation/terrain. These data have been used for erosion analysis, water storage and flow analysis, siting and design of BMPs, wetland mapping, and flood control mapping. A specific application of the data set is to delineate small catchments.	The layers are available on the Minnesota Geospatial Information Office website.	*MGIO*
Hydrological Simulation Program – FORTRAN (HSPF) Model	Simulation of watershed hydrology and water quality for both conventional and toxic organic pollutants from pervious and impervious land. Typically used in large watersheds (greater than 100 square miles).	Incorporates watershed-scale and nonpoint source models into a basin-scale analysis framework. Addresses runoff and constituent loading from pervious land surfaces, runoff and constituent loading from impervious land surfaces, and flow of water and transport/ transformation of chemical constituents in stream reaches.	Local or other partners can work with MPCA HSPF modelers to evaluate at the watershed scale: 1) the efficacy of different kinds or adoption rates of BMPs, and 2) effects of proposed or hypothetical land use changes.	*USGS*

It is very important before land based BMPs occur, that a full understanding of the specific sediment sources (near channel percentage vs. in channel percentage) is understood. If systemic approaches to the sediment issues are not adhered to, it is likely that “spot” fixes of various slumps will not help the overall situation regarding sediment in the Little Fork system and resources will be wasted.

Biological Protection Ranking

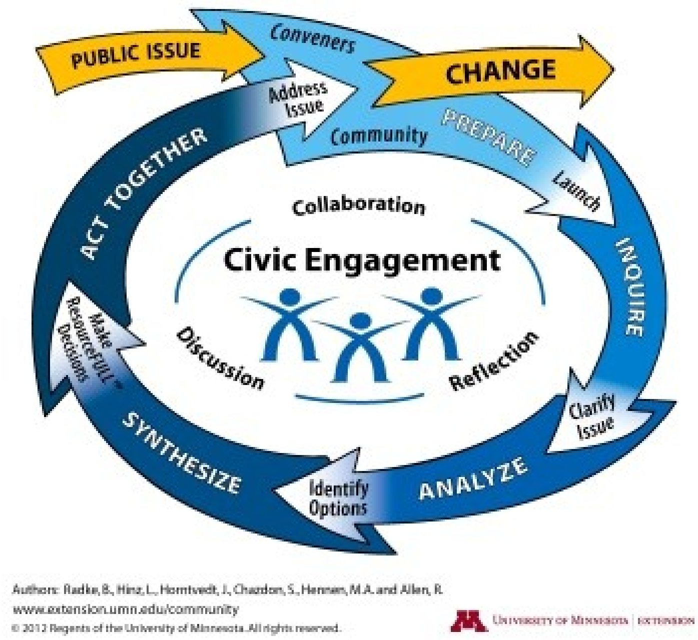
Based on the MPCA's 2010 assessment of aquatic life, most subwatersheds in the Little Fork River Watershed are doing well biologically. However, it is important to take into consideration areas that may need some extra support to help sustain a high functioning aquatic environment, or to help the threatened aquatic environment. For the purposes of this report, protection needs rankings were determined by the average of the Fish – Index of Biological Integrity (F-IBI), Macroinvertebrate - Index of Biological Integrity (M-IBI) and Habitat scores for each assessed reach. The lower scoring reaches are those most in need of protection from a biological perspective. The highest priorities for protection are shown in Table 9. The biological metrics used for this protection needs assessment are based on sound science and are quantifiable. Thus, the high priority stream rankings in Table 9 identify good watersheds to begin protection activities. However, readers are encouraged also consider additional metrics that point to loss of connectivity, increases in flooding, erosion of stream banks or an increase of trees falling into the river, more sediment or algae in the stream, or changes in the fish community. Future planning efforts should consider identifying stressors that point to the possibility of future stream degradation. For example, land use changes, increased development along a stream, and road construction or increases to impervious surface, may all increase stormwater runoff.

Table 9: Stream Fish and Macroinvertebrate Community Protection Ranking for Reaches with a Score in the Lower 10th Percentile.

Subwatershed	Priority Rank	Stream name	Reach number	Site number	F-IBI	M-IBI	MSHA	Average score	Comments
Upper Little Fork River	1	Flint Creek	613	08RN016	63	14	44	40	
Bear River	1	Bear River	513	05RN094	45	46	55	49	
Upper Little Fork River	2	Little Fork River	502	08RN015	51	42	57	50	**Turbidity Impairment**
Upper Little Fork River	2	Flint Creek	588	08RN051	57	46	49	51	
Upper Little Fork River	2	Little Fork River	502	05RN088	49	56	52	52	**Turbidity Impairment**
Upper Little Fork River	2	Unnamed Creek	665	08RN040	61	39	57	52	
Middle Little Fork River	2	Willow River	519	08RN018	64	40	53	52	
Upper Little Fork River	2	Unnamed Creek	586	05RN174	64	40	60	55	
Beaver Brook	2	Unnamed Creek	669	08RN026	87	23	62	57	

3.2 Civic Engagement

A key prerequisite for successful strategy development and on-the-ground implementation is meaningful civic engagement. This is distinguished from the broader term 'public participation' in that civic engagement encompasses a higher, more interactive level of involvement. Specifically, the University of Minnesota Extension's definition of civic engagement is "Making 'resourceFULL' decisions and taking collective action on public issues through processes that involve public discussion, reflection, and collaboration." A resourceFULL decision is one based on diverse sources of information and supported with buy-in, resources (including human), and competence. Further information on civic engagement is available at: http://www1.extension.umn.edu/community/civic-engagement/.



Accomplishments and Future Plans

The Little Fork River Watershed is made up of numerous local partners who have been involved at various levels throughout the project. The technical committee has been meeting since 2012 and is made up of members representing the MPCA, DNR, Minnesota Department of Health (MDH), Minnesota Department of Agriculture (MDA), Koochiching and Itasca Counties, as well as their respective Soil and Water Conservation Districts (SWCDs) within the watershed.

The MPCA along with the local partners and agencies in the Little Fork River Watershed recognize the importance of public involvement in the watershed process. Several formal meetings held are listed below; in addition, many one-on-one and small group meetings were held throughout the watershed during the time of this work.

Summary of local involvement:

- Kick-off meetings (9/30/13 – Cook; 10/22/13 – Littlefork; 07/11-07/14/13 – Littlefork Fair)
- TMDL meetings (1/14/15 – Littlefork; 1/15/15 - Cook)
- WRAPS Public and Consensus meetings (3/18/15 – Littlefork; 03/19/15 – Side Lake)

In March of 2015, two meetings were held in both the City of Littlefork and Side Lake (see consensus meetings in Appendix C) to bring together forestry professionals, local partners and agencies, and interested citizens to discuss water quality concerns, protection considerations, priority areas in the watershed, and restoration and protection projects. Notes from these meetings are included in Appendix C.

Some projects in the strategies table below are being implemented based on the timetables listed. Sampling will begin again for the next Intensive Watershed Monitoring cycle in 2018.

Public Notice for Comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice from July 23, 2017 to August 23, 2017

3.3 Restoration & Protection Strategies

This section provides detailed tables identifying water restoration and protection strategies for individual lakes and streams in each HUC -11 subwatersheds (Figure 3) that restore or protect water quality. These projects are divided into sections by HUC -11 subwatersheds, and include the following information:

- County location
- Water quality conditions and goals
- Strategies
- Estimated scale of adoption needed for each strategy to result in measurable improvements in water quality
- Interim 10-year milestones for implementation of each strategy
- Governmental units with primary responsibility for implementation
- Estimated timeline for full implementation of each strategy

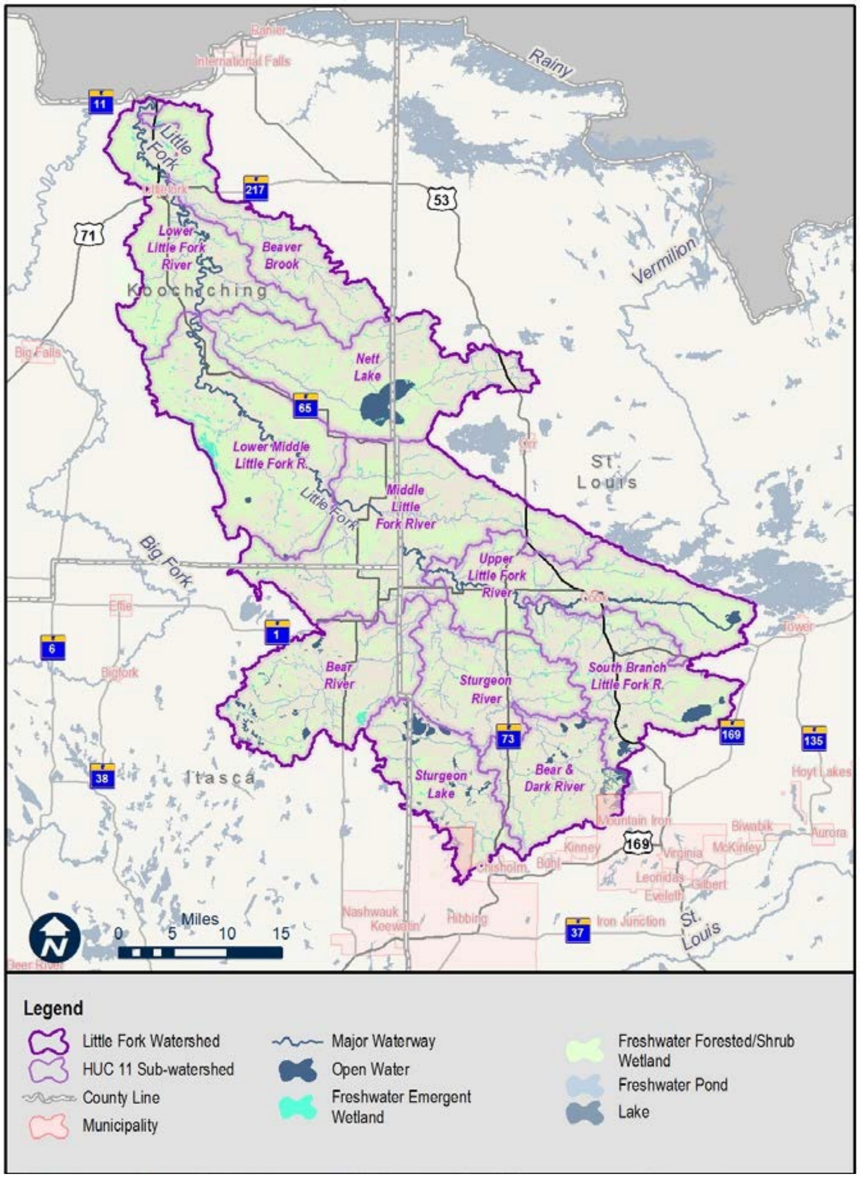


Figure 3: The HUC-11 Subwatersheds of the Little Fork River Watershed

Watershed-wide

Table 10: Strategies and actions proposed for the Little Fork River Watershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Target	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
All	All	TSS			Erosion control	Control erosion at canoe carry-downs along Little Fork River	Identify and prioritize erosion at canoe carry-downs; Implement at least one erosion control project		X	X	X								20 years
	All	TSS	Variable		Forest management	Ensure that no more than 60% of timberlands within any HUC 12 watershed are less than 15 years old at any one time	Ensure that no more than 60% of timberlands within any HUC 12 watershed are less than fifteen years old at any one time					X			X				Ongoing
	All	TSS			Culvert and bridge crossing management	Koochiching SWCD will complete a culvert inventory county-wide including Little Fork River Watershed. A prioritized approach in sync with the WRAPS cycle will be adopted.	Contact local road authority regarding needed connectivity improvements and work with MPCA technical staff and DNR	X	X			X							3 years
	All	TSS	Variable		Culvert and bridge crossing management	Prioritization of culvert and bridge crossing inventory to determine what needs repair and replacement to ensure connectivity	Develop a prioritization hierarchy for culverts and bridges in need of replacement in the County by watershed.	X	X			X							3 years
	All	TSS	Variable		Conservation easements	Protect riparian habitat along the river	Identify sensitive riparian habitats, such as County Road 22 near the town of Littlefork		X	X	X	X						X	30 years
	All	TSS	Variable		Civic engagement	Engage Bois Forte tribe in watershed issues	Begin regular meetings between MPCA, DNR, SWCD and the Bois Forte Band.	X	X	X									Ongoing
	All	TSS	Variable		Diagnostic study	Complete research project on the interaction between forested buffer strip width, water quality, and logging operations	Begin regular meetings between MPCA, DNR, SWCD, and Bois Forte Band.	X							X				10 years
	All	TSS	Variable		Education	Plan and conduct civic engagement and workshop activities to communicate watershed status, including shoreline management, SSTS workshops, etc.	Contact 25% of landowners		X										20 years
	All	TSS	Variable		Education	Create an editorial series about watershed issues in the Little Fork River Watershed to be distributed via radio and newspaper media. SWCDs could contribute storylines on a rotation with different messages of interest to the community regarding Water Quality.	Release at least 6 stories per year (Monthly to Bi-Monthly)		X	X	X								20 years
	All	TSS	Variable		Stream restoration	Restore channelized sections of stream	Complete at least one stream restoration project	X	X	X	X	X							20 years
	All	TSS	Variable		Stream restoration	Protect Sturgeon spawning habitat	Inventory Sturgeon spawning restoration potential in the Little Fork River system	X				X							20 years
	All	TSS	Variable		Dam management	Modify or remove dams on River for fish passage and erosion control	Assess feasibility of modifying dam, working with cooperators		X	X	X								20 years
	All	TSS	Variable		Beaver control	Reduce beaver population by trapping only in coordination with the Cooperator	Reduce beaver damage in terms of erosion and vegetation growth		X	X	X								20 years

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Target	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
All	**All**	TSS	Variable		State School Forest Management	Protect riparian habitat along the river	Identify areas to be protected, and keep them from being sold off for mining and drilling		X	X	X								20-30 year
	All	TSS	Variable		Stormwater Reduction	Work with farmers and other landowners to install stormwater retention structures such as Rain Gardens, Vegetated Filter Strips, Vegetated Swales, or Retention Ponds. Particularly important if slopes near a tributary or the main stem are in close proximity.	Contact 5 landowners		X	X	X			X					15 years
	All	TSS	Variable		Riparian/shoreline protection	25% increase amount of buffers	Develop shoreline buffer incentive program		X	X	X								20 years
	Little Fork River Corridor	TSS	Variable		Erosion control	Control erosion at (5) canoe carry-downs, (4) campsites, and (2) boat access points along Little Fork River. Seeding, Water bars, or stabilization structures as needed.	Complete at least 5 sites		X	X	X	X							20 years
	Little Fork River Corridor	TSS	Variable		Erosion Control	Implement Stream Bank Restoration BMPs in 303d sections to reduce flow velocity, and erosion within the main stem channel. Utilize methods such as vegetated swales, Toe wood Placement, Whole Tree Revetment, and bank stabilization with Willow Waddles.	Complete at least 5 projects	X	X	X	X	X	X	X	X			X	20 years
Itasca	**All**	TSS	Variable		Stormwater Reduction	Work with farmers and other landowners to install stormwater retention structures such as Rain Gardens, Vegetated Filter Strips, Vegetated Swales, or Retention Ponds. Particularly important if slopes near a tributary or the main stem are in close proximity.	Complete at least 5 projects			X				X					15 years
	All	TSS	Variable		Wetland Impact Study	Promote restoration of impacted wetland hydrology from historic filling, draining, and agricultural conversion.	Complete study			X		X	X					X	20 years
	All	TSS	Variable		Wetland Road Impacts Remediation	Remediate with culvert replacement/upgrade, or alternative methods.	Inventory and Identify areas where roads have impeded cross-flow and hydrologic function of wetlands.			X		X	X				X		20 years
	All	TSS	Variable		White Cedar Restoration Program Expansion	Implement projects to restore hydrologic function of cross-flow by improving culverts	Extend inventory of established White Cedar stands on private lands, and continue on public lands.			X						X			15 years
	All	TSS	Variable		Shore stabilization	Shore stabilization & stormwater management w/ landowners. Work closely w/ 2 landowners/yr.	2 landowner projects cost shared.			X									Ongoing
	All	TSS	Variable		Stormwater management	Shore stabilization & stormwater management w/ landowners. Work closely w/ 2 landowners/yr.	2 landowner projects cost shared.			X									Ongoing

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Target	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
Itasca	**All**	TSS	Variable		Forest management	Forest management assistance to private landowners. Work with 1 landowner/yr.	4 forest stewardship plans written.			X									Ongoing
	All	TSS	Variable		Forest Stewardship Plans	2013-2014 Little Fork Headwaters Forest Stewardship grant w/ Koochiching SWCD; 19 Forest Stewardship plans written. Continue to promote plan implementation.	Encourage plan updates by 2024, and provide updates as requested.			X								X	10 years
	All	TSS	Variable		Forest Stewardship Plans	2016-2018 Little Fork Headwaters Forest Stewardship grant w/ Koochiching SWCD; estimated 25 Forest Stewardship plans written. Continue to promote plan implementation.	Encourage plan updates by 2028, and provide updates as requested.			x								X	10 years
	All	TSS	Variable		Erosion control	Implement erosion control BMPs	Inventory and identify stream sections that are experiencing erosion on smaller order tributaries to the Bear River			X									20 years
	All	TSS	Variable		Planning	Provide County Environmental Services shore land mitigation planning assistance Condition planning assistance to 1 landowner/yr.	4 condition plans written/approved.			X									Ongoing
	All	TSS	Variable		Septic System Compliance Program	Septic System inventory, outreach/education about the MN Septic Loan Program, and increase enforcement of compliance requirements	Increase SSTS compliance in Itasca County by at least 50%	X		X			X						Ongoing
	All	TSS	Variable		Education	Increase public awareness of erosion, septic, AIS, and other issues facing water quality across the watershed. Focus on extending aid and services to the community whenever possible to implement BMPs on private property.	Increase cost-shared or otherwise implemented BMPs on Private property by at least 10%			X									Ongoing
	All	TSS	Variable		Reforestation	10 acres near the Bear River in Carpenter Township	10-year plan for forest management and conservation easement in place							X					30 years

Upper Little Fork River Subwatershed

Table 11: Strategies and action proposed for the Upper Little Fork River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis	**Little Fork River** (502) Headwaters to Rice River	F-IBI M-IBI DO Turbidity/ TSS	FS FS FS Not supporting	TSS < 45 mg/L	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					15 years
	Little Fork River (504) Beaver Creek to Sturgeon River	F-IBI M-IBI DO Turbidity/ TSS	FS FS FS FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Unnamed creek (586) Headwaters to Little Fork River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Beaver Creek (518) Unnamed creek to T62 R20WS6, west line	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Flint Creek (613) Unnamed creek to unnamed creek	F-IBI M-IBI DO Turbidity/ TSS	FS IF ND ND	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Flint Creek (588) Unnamed creek to unnamed creek	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Unnamed creek (665) Unnamed creek to Sturgeon River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Lost Lake (69-0581)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long- term trends. Continue to monitor Water	at least 2 years additional data	X			X	X							Ongoing

South Branch Little Fork River Subwatershed

Table 82: Strategies and actions proposed for the South Branch Little Fork River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis	**Rice River** (517) Johnson Creek to Little Fork River	F-IBI M-IBI DO Turbidity/ TSS	Not supporting FS IF FS	Consistent fish IBI scores >50	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X	x	x	X	x	x			15 years
	Rice River (515) Headwaters to Johnson Creek	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
	Little Fork River (503) Rice River to Beaver Creek	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
	Johnson Creek (530) Little Sand Lake to T60 R18WS6, north line	F-IBI M-IBI DO Turbidity/ TSS	NA NA NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
	Aerie (69-0701)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Auto (69-0731)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Big Rice (69-0669)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Little Rice (69-0612)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Little Sand (69-0732)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Sand (69-0736)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing

Bear & Dark River Subwatershed

Table 13: Strategies and actions proposed for the Bear and Dark River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis	**Dark River** (592) Unnamed creek to unnamed creek	F- M- D Turbidity/ TSS	FS FS NA FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X											
St. Louis	**Dark River** (591) Unnamed creek to Dark Lake	F- M- D Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
St. Louis	**Dark River** (525) T60 R19WS30, east line to T60 R20WS10, north	F- M- D Turbidity/ TSS	NA NA NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
St. Louis	**Sturgeon River, East Branch** (596) McNiven Creek to Slow Creek	F- M- D Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
St. Louis	**Sturgeon River, East Branch** (528) Slow Creek to Sturgeon River	F- M- D Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
St. Louis	**McNiven Creek** (597) Unnamed creek to unnamed creek	F- M- D Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
St. Louis	**Boriin Creek** (633) Headwaters to East Branch Sturgeon River	F- M- D Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
St. Louis	Clear (69-0799)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
St. Louis	Dark (69-0790)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Fourteen (69-0793)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
	Leander (69-0796)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Thirteen (69-0794)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing

Sturgeon Lake Subwatershed

Table 14: Strategies and actions proposed for the Sturgeon Lake Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis, Itasca	Watershed-wide	Phosphorus	N/A	N/A	Septic System Management	Convert SSTS to sewered in the Side Lake Area	Renew discussions about implementing a town sewer system for the Side Lake area community.	X		X	X	X	X						30 years
					Lake monitoring	Continue to monitor zooplankton communities in Beatrice, and extend to other Side Lake area lakes. Monitor 1-2 of the seven Side Lake area lakes yearly on a rotation to get biological data that may support the chemistry data for decreasing clarity.	Get at least one year of zooplankton community data for each of the seven Side Lake area lakes of interest			X	X	X	X						Ongoing
	Sturgeon River (527) Headwaters to East Branch Sturgeon River	F-IBI	FS	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures					X	X		X		X		15 years
		M-IBI	FS																
		DO	ID																
		Turbidity/ TSS	FS		Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
	Shannon River (603) Unnamed creek to Shannon Lake	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
		M-IBI	FS																
		DO	NA																
		Turbidity/ TSS	NA																
	Beatrice (31-0058)	Phosphorus	Fully supporting	Maintain or improve water quality	Nutrient management	Work with landowners on shoreland stabilization, buffers, & storm- water management. 1 landowner every two years (Shoreland/Stormwater)	1 additional land owner project cost- shared			X									20 years
					Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established and begin to look at project planning for reducing nutrient loading.			X									Ongoing
					Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
	Day (69-0906)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Dewey (69-0912)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Hobson (69-0923)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Island (69-0911)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Little Sturgeon (69-1290)	Phosphorus	Fully supporting	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years
	Little Sturgeon (69-1290)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading			X	X								Ongoing
	Long (Main Basin) (69-0859-01)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing
	Long (North Basin) (69-0859-02)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X			X	X							Ongoing

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
	Middle Sturgeon (69-0939-02)	Phosphorus	Not assessed	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years
					Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading				X								Ongoing
	Perch (69-0932)	Phosphorus	Fully supporting	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years
					Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading			X									Ongoing
	Shannon (69-0925)	Phosphorus	Not assessed	Maintain or improve water quality	Erosion control	Work With USFS to stabilize the road cut slope on the northern side of the lake.	Implement BMPs for stabilizing sandy slopes as possible				X				X				20 years
	Side (69-0933)	Phosphorus	Fully supporting	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
					Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading			X									Ongoing
	South Sturgeon (31-0003)	Phosphorus	Fully supporting	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years
	South Sturgeon (31-0003)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading			X									Ongoing
	Sturgeon (69-0939-01)	Phosphorus	Fully supporting	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years
					Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading			X									Ongoing
					Nutrient management	Work w/ landowners on shoreland stabilization, buffers, & storm-water management. 1 landowner per year.	One landowner cost share practice installed			X									20 years

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
	West Sturgeon (69-0939-03)	Phosphorus	Fully supporting	Maintain or improve water quality	Diagnostic study	Diagnostic study of soils and groundwater impacts on internal Phosphorus loading of area lakes. Identify loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan.	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of the Side Lake Area Lakes.	X		X	X	X							25 years
					Lake monitoring	Continue Monitoring Water Quality yearly to Bi-Annually, and continue to establish trends in new and historical data. 1 volunteer for lake sampling and SWCD Water Specialist reporting time, and associated laboratory costs.	Trends established, and begin to look at project planning for reductions in nutrient loading			X									Ongoing

Sturgeon River Subwatershed

Table 15: Strategies and actions proposed for the Sturgeon River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis	**Sturgeon River** (527) Headwaters to East Branch Sturgeon River	F-IBI M-IBI DO Turbidity/ TSS	FS FS IF FS	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures					X	X		X		X		15 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
	Sturgeon River (523) East Branch Sturgeon River to Dark River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures					X	X		X		X		15 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
	Sturgeon River (524) Dark River to Bear River	F-IBI M-IBI DO Turbidity/ TSS	FS FS IF FS	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures					X	X		X		X		15 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X			X					25 years
	Paavola Creek (627) Unnamed creek to Sturgeon River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X		X	X					25 years
	Sand Creek (550) Headwaters to Sturgeon River	F-IBI M-IBI DO Turbidity/ TSS	NA NA NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X			X		X	X					25 years

Bear River Subwatershed

Table 16: Strategies and actions proposed for the Bear River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis, Itasca	**Bear River** (513) Headwaters to Sturgeon River	F-IBI M-IBI DO	FS FS IF	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures			X	X	X	X		X		X		15 years
		Turbidity/ TSS	FS		Culvert management	Culvert Replacement crossing the Bear River on the Wasson Lake Forest Rd. Replace existing culvert (36" dia. X 32') with a larger culvert (42"x48"x34') that will allow for aquatic organism passage, and reduce flow velocity.	Completed by MNDNR summer of 2012. Continued effectiveness monitoring may be implemented.					X							15 years
					Stream monitoring	Monitor streams for 10 years for basic Water Quality parameters, and establish baseline trends	at least 4 years additional data	X				X							Ongoing
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
	Unnamed creek (662) Unnamed creek to unnamed creek	F-IBI M-IBI DO	FS FS NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures					X	X		X		X		15 years
		Turbidity/ TSS	ND		Stream monitoring	Monitor streams for 10 years for basic Water Quality parameters, and establish baseline trends	at least 4 years additional data	X				X							Ongoing
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
	Bearskin River (663) Unnamed creek to Bear River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures				X	X	X		X		X		15 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
	Bear River Creek (664) Headwaters to Stony Brook	F-IBI M-IBI DO	FS FS NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures				X	X	X		X		X		15 years
		Turbidity/ TSS	NA		Stream monitoring	Monitor streams for 10 years for basic Water Quality parameters, and establish baseline trends	at least 4 years additional data	X			X	X							Ongoing
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X		X	X			X					25 years

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
	Venning Creek (568) T61 R23WS35, east line to Bear River	F-IBI M-IBI DO	NA NA NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures			X		X	X		X		X		15 years
		Turbidity/ TSS	NA		Stream monitoring	Monitor streams for 10 years for basic Water Quality parameters, and establish baseline trends	at least 4 years additional data	X		X		X							Ongoing
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X		X	X			X					25 years
	Stony Brook (558) T60 R22WS4 south line to Bear River Creek	F-IBI M-IBI DO	NA NA NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures			X		X	X		X		X		15 years
		Turbidity/ TSS	NA		Culvert management	MNDNR Replaced one culvert crossing Stony Brook Summer of 2012. Culvert is now a larger diameter to reduce flow velocity.	Continued monitoring of culvert effectiveness					X							15 years
					Stream monitoring	Monitor streams for 10 years for basic Water Quality parameters, and establish baseline trends	at least 4 years additional data	X		X		X							Ongoing
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X		X	X			X					25 years
Itasca	Bear (31-0157)	Phosphorus	Fully supporting	Maintain or improve water quality	Buffers	Continue to monitor 340sq ft. buffer planted & cost shared 2008.	Continue to monitor 340sq ft buffer planted & cost shared 2008.			X									20 years
					Buffers	Use 2008 installed buffer to promote additional shoreland conservation projects.	1 additional project cost shared.			X									20 years
					Nutrient management	Shoreline stabilization & Storm water Management w/ Landowners. Use direct mailings to increase awareness of cost- share programs, and fund availability through the SWCD for project implementation	1-5 additional projects cost-shared			X									20 years
					Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality at least Bi-Annually.	at least 4 years additional data	X		X		X							Ongoing

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
					Diagnostic study	Identify Loading contributions from Groundwater, Soils, Septics, Atmospheric Deposition, Stream interface, wetland influences, and internal load factors such as COD & BOD. Implement load reduction activities identified in Diagnostic Study and Implementation Plan	Complete diagnostic study and implementation plan to investigate nutrient loading and water quality dynamics of Bear Lake.	X		X		X							25 years
	Button Box (31-0175)	Phosphorus	Insufficient data	Maintain or improve water quality	Nutrient management	Shoreline stabilization & Storm water Management w/ Landowners. Work closely with 1 landowner every 5 years.	1 additional land owner project cost- shared			X									20 years
					Lake monitoring	Monitor water quality and continue to build towards establishing baseline trends. Monitor Water Quality for at least two years (Water Quality).	1 additional year of water quality monitoring			X									Ongoing
	Horsehead (31-0155)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Kelly (31-0299)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Little Bear (31-0156)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Little Moose (31-0162)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality for at least 10 years and continue to build towards establishing baseline trends	5 additional years of water quality data	X		X		X							Ongoing
	Long (31-0296)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Lost (31-0289)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality for at least 10 years and continue to build towards establishing baseline trends	5 additional years of water quality data	X		X		X							Ongoing
	Napoleon (31-0290)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
	Otter (31-0301)	Phosphorus	Fully supporting	Maintain or improve water quality	Conservation easements	Phase 4 BWSR RIM Reserve wild rice lakes eligible Lk. Promote program to four eligible landowners on lake.	1 perpetual easement completed.			X									30 years
					Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Owen (31-0292)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality for at least 10 years and continue to build towards establishing baseline trends	5 additional years of water quality data	X		X		X							Ongoing
	Raddison (31-0284)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Thistledew (31-0158)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality for at least 10 years and continue to build towards establishing baseline trends	5 additional years of water quality data	X		X		X							Ongoing
	Walters (31-0298)	Phosphorus	Fully supporting	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X		X		X							Ongoing
	Wilson (31-0320)	Phosphorus	Insufficient data	Maintain or improve water quality	Lake monitoring	Monitor water quality for at least 10 years and continue to build towards establishing baseline trends	5 additional years of water quality data	X		X		X							Ongoing

Middle Little Fork River Subwatershed

Table 17: Strategies and actions proposed for the Middle Little Fork River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
Koochiching, St. Louis, Itasca	**Little Fork River** (506) Willow River to Valley River	F-IBI M-IBI DO	FS FS NA	TSS < 45 mg/L	Road management	Silverdale area near the gold domed church, on State Highway 65	Possible project for road reconstruction to avoid flooding and road blow-outs		X				X				X		10 years
		Turbidity/ TSS	Not supporting		Stream bank stabilization	Stabilize the stream banks in the main channel of the Little Fork River using vegetative (Swales/Filter Strips/Willow Waddles), rock (Rip Rap),or structural (Toe Wood/ Whole Tree Revetment/Water Bar)methods	Inventory and identify areas that might be able to be stabilized, and design potential rehabilitation methods		X	X									20 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Little Fork River (505) Sturgeon River to Willow River	F-IBI M-IBI DO Turbidity/ TSS	FS FS IF FS	Maintain or improve water quality	Stream bank stabilization	Stabilize the stream banks in the main channel of the Little Fork River using vegetative (Swales/Filter Strips/Willow Waddles), rock (Rip Rap),or structural (Toe Wood/ Whole Tree Revetment/Water Bar)methods	Inventory and identify areas that might be able to be stabilized, and design potential rehabilitation methods				X								20 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Sturgeon River (514) Bear River to Little Fork River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures				X	X	X		X		X		15 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Willow River (519) Headwaters to Little Fork River	F-IBI M-IBI DO Turbidity/ TSS	FS FS IF IF	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures			X		X	X		X		X		15 years
					Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Unnamed creek (587) Unnamed creek to Willow River	F-IBI M-IBI DO Turbidity/ TSS	FS FS NA NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X		X	X			X					25 years
	Unnamed creek (668) Unnamed creek to Willow River	F-IBI M-IBI DO	FS FS NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X		X	X			X					25 years

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
		Turbidity/ TSS	NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	x		x	x			x					25 years
	Prairie Creek (520) Headwaters to Little Fork River	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
		M-IBI	FS																
		DO	NA																
		Turbidity/ TSS	NA																
	Valley River (512) T62 R23WS4, north line to Little Fork River	F-IBI	NA	Maintain or improve water quality	Culvert management	Replace any culverts that are creating a barrier to aquatic passage, scour or erosion	Inventory and identify any candidates for replacement, and begin planning with responsible entities for updates to existing structures			X		X	X		X		X		15 years
		M-IBI	NA																
		DO	NA																
		Turbidity/ TSS	NA		Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Tributary to Valley River (562) T63 R22WS28, south line to unnamed creek	F-IBI	NA	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
		M-IBI	NA																
		DO	NA																
		Turbidity/ TSS	NA																

Lower Middle Little Fork River Subwatershed

Table 18: Strategies and actions proposed for the Lower Middle Little Fork River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
Koochiching	**Little Fork River** (508) Prairie Creek to Nett Lake River	F-IBI M-IBI DO Turbidity/ TSS	FS FS IF Not supporting	TSS < 45 mg/L	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X	X	X			X					25 years
	Franklin (36-0005)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X	X			X							Ongoing
	Myrtle (36-0007)	Phosphorus	Not assessed	Maintain or improve water quality	Lake monitoring	Monitor water quality and continue to build towards establishing long-term trends. Continue to monitor Water Quality.	at least 2 years additional data	X	X			X							Ongoing

Nett Lake Subwatershed

Table 19: Strategies and actions proposed for the Nett Lake Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
St. Louis, Koochiching	**Tributary to Nett Lake** (671) Unnamed creek to unnamed creek	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
		M-IBI	FS																
		DO	NA																
		Turbidity/ TSS	NA																
	Nett Lake River (673) Headwaters to unnamed creek	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
		M-IBI	FS																
		DO	NA																
		Turbidity/ TSS	NA																
	Nett Lake River (672) Unnamed creek to Little Fork River	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X		X			X					25 years
		M-IBI	FS																
		DO	IF																
		Turbidity/ TSS	IF																

Beaver Brook Subwatershed

Table 20: Strategies and actions proposed for the Beaver Brook Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
Koochiching	**Beaver Brook** (522) Headwaters to Little Fork River	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X					X					25 years
		M-IBI	FS																
		DO	IF																
		Turbidity/ TSS	FS																
	Unnamed creek (669) Unnamed creek to Beaver Brook	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X					X					25 years
		M-IBI	IF																
		DO	NA																
		Turbidity/ TSS	NA																

Lower Little Fork River Subwatershed

Table 21: Strategies and actions proposed for the Lower Little Fork River Subwatershed

County Location and Upstream Influence Counties	Waterbody (ID) Location	Parameter (incl. non-pollutant stressors)	Current Conditions (load or concentration)	Water Quality Goals/Targets	Strategies (see key below)	Estimated Scale of Adoption Needed	Interim 10-yr Milestones	MPCA	Koochiching SWCD	Itasca SWCD	North St. Louis SWCD	MN DNR	Twshp/County/City	NRCS	USFS	BWSR	MN DOT	Non-profits	Timeline
Koochiching	**Little Fork River** (510) Cross River to Beaver Brook	F-IBI	FS	TSS < 45 mg/L	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X					X					25 years
		M-IBI	FS																
		DO	IF																
		Turbidity/ TSS	Not supporting																
	Little Fork River (501) Beaver Brook to Rainy River	F-IBI	FS	TSS < 45 mg/L	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X					X					25 years
		M-IBI	FS																
		DO	FS																
		Turbidity/ TSS	Not supporting																
	Cross River (511) Headwaters to Little Fork River	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X					X					25 years
		M-IBI	FS																
		DO	NA																
		Turbidity/ TSS	NA																
	Ester Brook (609) Unnamed creek to Little Fork River	F-IBI	FS	Maintain or improve water quality	Sediment reduction BMPs	See Appendix D	Implement 5 BMPs	X	X					X					25 years
		M-IBI	FS																
		DO	NA																
		Turbidity/ TSS	NA																

4. Monitoring Plan

Data from three monitoring programs will continue to be collected and analyzed for the Little Fork River Watershed:

Intensive Watershed Monitoring collects water quality and biological data throughout each major watershed once every 10 years. This work is scheduled to begin its second iteration in the Little Fork River Watershed in 2018. This data provides a periodic but intensive "snapshot" of water quality throughout the watershed.

https://www.pca.state.mn.us/water/watershed-sampling-design-intensive-watershed-monitoring

The **Watershed Pollutant Load Monitoring Network** intensively collects pollutant samples and flow data to calculate daily sediment and nutrient loads on an annual or seasonal (no-ice) basis. In the Little Fork River Watershed, the Little Fork River in the city of Littlefork has a pollutant load monitoring site.

https://www.pca.state.mn.us/water/watershed-pollutant-load-monitoring-network

The **Citizen Surface Water Monitoring Program** is a network of volunteers who make monthly lake and river transparency readings. Several dozen data collection locations exist in the Little Fork River Watershed. This data provides a continuous record of one water quality parameter throughout much of the watershed.

https://www.pca.state.mn.us/water/citizen-water-monitoring

In addition to the monitoring conducted in association with the WRAPS process, each local unit of government associated with water management may have their own monitoring plan. Furthermore, there are many citizen monitors throughout the watershed collecting both stream and lake data. All data collected locally should be submitted regularly to the MPCA for entry into the EQuIS database system.

http://www.pca.state.mn.us/index.php/data/surface-water.html

5. References and Further Information

Anderson, Jesse, Nolan Baratono, Andrew Streitz, Joe Magner, and E. Sandy Verry. November 2006. Effect of Historical Logging on Geomorphology, Hydrology, and Water Quality in the Little Fork River Watershed. Prepared for the Environmental Outcomes and Regional Divisions, Minnesota Pollution Control Agency.

Anderson, Jesse. August 2010. Water Quality Assessment of Select Lakes within the Little Fork River Watershed. Prepared for the Minnesota Pollution Control Agency Water Monitoring Section, Lakes and Streams Monitoring Unit.

Baratono, Nolan. December 2013. Little Fork River Watershed Stressor Identification. Prepared for the Minnesota Pollution Control Agency.

Gran, Karen B., Brad Hansen, and John Nieber (University of Minnesota). August 13, 2007. Little Fork River Channel Stability and Geomorphic Assessment Final Report. Submitted to the Minnesota Pollution Control Agency Impaired Waters and Stormwater Program.

Minnesota Pollution Control Agency (MPCA). September 2011. Little Fork River Watershed Monitoring and Assessment Report.

Little Fork River Watershed Reports

*All **Little Fork River Watershed** reports referenced in this watershed report are available at the Little Fork River Watershed webpage: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/little-fork-river.html*

Appendices

Appendix A: Stream Assessment Status

Table 22: Assessment status of stream reaches in the Little Fork River Watershed

				Aquatic Life							Aquatic Rec
Subwatershed Name	**AUID (Last 3 digits**	**Stream**	**Reach Description**	**Fish Index of Biotic Integrity**	**Macroinvertebrate Index of Biotic Integrity**	**Dissolved Oxygen**	**Turbidity/TSS**	**Chloride**	**pH**	**Ammonia**	**Bacteria (*E. coli*)**
Upper Little Fork River	502	**Little Fork River**	Headwaters to Rice River	FS	FS	IF	NS	--	IF	--	NA
	504	**Little Fork River**	Beaver Creek to Sturgeon River	FS	FS	--	FS	--	FS	FS	FS
	586	**Unnamed creek**	Headwaters to Little Fork River	FS	FS	--	--	--	--	--	NA
	518	**Beaver Creek**	Unnamed creek to T62 R20WS6, west line	FS	FS	--	--	--	--	--	NA
	613	**Flint Creek**	Unnamed creek to unnamed creek	FS	IF	--	--	--	--	--	NA
	588	**Flint Creek**	Unnamed creek to unnamed creek	FS	FS	--	--	--	FS	--	NA

Subwatershed Name	AUID (Last 3 digits	Stream	Reach Description	Aquatic Life							Aquatic Rec
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic Integrity	Dissolved Oxygen	Turbidity/TSS	Chloride	pH	Ammonia	Bacteria (*E. coli*)
	665	**Unnamed creek**	Unnamed creek to Sturgeon River	FS	FS	--	--	--	--	--	NA
South Branch Little Fork River	515	**Rice River**	Headwaters to Johnson Creek	FS	FS	--	--	--	--	--	NA
	517	**Rice River**	Johnson Creek to Little Fork River	NS	FS	IF	FS	--	FS	FS	FS
South Branch Little Fork River, Cont'd	503	**Little Fork River**	Rice River to Beaver Creek	FS	FS	--	--	--	FS	--	NA
	530	**Johnson Creek**	Little Sand Lake to T60 R18WS6, north line	NA*	NA*	--	--	--	--	--	--
	592	**Dark River**	Unnamed creek to unnamed creek	FS	FS	--	FS	--	--	--	NA

				Aquatic Life							Aquatic Rec
Subwatershed Name	**AUID (Last 3 digits**	**Stream**	**Reach Description**	**Fish Index of Biotic Integrity**	**Macroinvertebrate Index of Biotic Integrity**	**Dissolved Oxygen**	**Turbidity/TSS**	**Chloride**	**pH**	**Ammonia**	**Bacteria (*E. coli*)**
Bear and Dark River	591	**Dark River**	Unnamed creek to Dark Lake	FS	FS	--	--	--	--	--	NA
	525	**Dark River**	T60 R19WS30, east line to T60 R20WS10, north line	NA*	NA*	--	--	--	FS	FS	FS
	596	**Sturgeon River, East Branch**	McNiven Creek to Slow Creek	FS	FS	--	--	--	--	--	NA
	528	**Sturgeon River, East Branch**	Slow Creek to Sturgeon River	FS	FS	--	--	--	--	--	NA
	597	**McNiven Creek**	Unnamed creek to unnamed creek	FS	FS	--	--	--	--	--	NA
	633	**Boriin Creek**	Headwaters to East Branch Sturgeon River	FS	FS	--	--	--	--	--	NA

				Aquatic Life							Aquatic Rec
Subwatershed Name	**AUID (Last 3 digits**	**Stream**	**Reach Description**	**Fish Index of Biotic Integrity**	**Macroinvertebrate Index of Biotic Integrity**	**Dissolved Oxygen**	**Turbidity/TSS**	**Chloride**	**pH**	**Ammonia**	**Bacteria (*E. coli*)**
Sturgeon Lake	527	**Sturgeon River**	Headwaters to East Branch Sturgeon River	FS	FS	IF	FS	--	FS	FS	FS
	603	**Shannon River**	Unnamed creek to Shannon Lake	FS	FS	--	--	--	--	--	NA
Sturgeon River	527	**Sturgeon River**	Headwaters to East Branch Sturgeon River	FS	FS	IF	FS	--	FS	FS	FS
	523	**Sturgeon River**	East Branch Sturgeon River to Dark River	FS	FS	--	--	--	FS	--	NA
	524	**Sturgeon River**	Dark River to Bear River	FS	FS	IF	FS	--	FS	FS	FS
	627	**Paavola Creek**	Unnamed creek to Sturgeon River	FS	FS	--	--	--	--	--	NA

				Aquatic Life							Aquatic Rec
Subwatershed Name	AUID (Last 3 digits	Stream	Reach Description	Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic Integrity	Dissolved Oxygen	Turbidity/TSS	Chloride	pH	Ammonia	Bacteria (*E. coli*)
	550	**Sand Creek**	Headwaters to Sturgeon River	NA*	NA*	--	--	--	--	--	--
Bear River	513	**Bear River**	Headwaters to Sturgeon River	FS	FS	IF	FS	--	FS	FS	FS
	662	**Unnamed creek**	Unnamed creek to unnamed creek	FS	FS	--	--	--	--	--	NA
	663	**Bearskin River**	Unnamed creek to Bear River	FS	FS	--	--	--	--	--	NA
	664	**Bear River Creek**	Headwaters to Stony Brook	FS	FS	--	--	--	--	--	NA
	568	**Venning Creek**	T61 R23WS35, east line to Bear River	NA*	NA*	--	--	--	--	--	--

Subwatershed Name	AUID (Last 3 digits	Stream	Reach Description	Aquatic Life: Fish Index of Biotic Integrity	Aquatic Life: Macroinvertebrate Index of Biotic Integrity	Aquatic Life: Dissolved Oxygen	Aquatic Life: Turbidity/TSS	Aquatic Life: Chloride	Aquatic Life: pH	Aquatic Life: Ammonia	Aquatic Rec: Bacteria (*E. coli*)
	558	**Stony Brook**	T60 R22WS4, south line to Bear River Creek	NA*	NA*	--	--	--	--	--	--
Middle Little Fork River	505	**Little Fork River**	Sturgeon River to Willow River	FS	FS	IF	FS	--	FS	FS	FS
Middle Little Fork River Cont'd	506	**Little Fork River**	Willow River to Valley River	FS	FS	--	NS	--	FS	--	NA
	514	**Sturgeon River**	Bear River to Little Fork River	FS	FS	--	--	--	--	--	NA
	519	**Willow River**	Headwaters to Little Fork River	FS	FS	IF	IF	--	FS	FS	FS
	587	**Unnamed creek**	Unnamed creek to Willow River	FS	FS	--	--	--	--	--	NA

				Aquatic Life							Aquatic Rec
Subwatershed Name	AUID (Last 3 digits	Stream	Reach Description	Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic Integrity	Dissolved Oxygen	Turbidity/TSS	Chloride	pH	Ammonia	Bacteria (*E. coli*)
	668	**Unnamed creek**	Unnamed creek to Willow River	FS	FS	--	--	--	--	--	NA
	520	**Prairie Creek**	Headwaters to Little Fork River	FS	FS	--	--	--	--	--	NA
	512	**Valley River**	T62 R23WS4, north line to little Fork River	NA*	NA*	--	--	--	--	--	NA
	562	**Tributary to Valley River**	T63 R22WS28, south line to unnamed creek	NA*	NA*	--	--	--	--	--	NA
Lower Middle Fork River	508	**Little Fork River**	Prairie Creek to Nett Lake River	FS	FS	IF	NS	--	FS	FS	FS
Nett Lake	671	**Tributary to Nett Lake**	Unnamed creek to unnamed creek	FS	FS	--	--	--	--	--	NA

				Aquatic Life							Aquatic Rec
Subwatershed Name	**AUID (Last 3 digits**	**Stream**	**Reach Description**	**Fish Index of Biotic Integrity**	**Macroinvertebrate Index of Biotic Integrity**	**Dissolved Oxygen**	**Turbidity/TSS**	**Chloride**	**pH**	**Ammonia**	**Bacteria (*E. coli*)**
	673	**Nett Lake River**	Headwaters to unnamed creek	FS	FS	--	--	--	--	--	NA
	672	**Nett Lake River**	Unnamed creek to Little Fork River	FS	FS	IF	IF	--	FS	FS	FS
Beaver Brook	522	**Beaver Brook**	Headwaters to Little Fork River	FS	FS	IF	FS	--	FS	FS	FS
	669	**Unnamed creek**	Unnamed creek to Beaver Brook	FS	IF	--	--	--	--	--	NA
Lower Little Fork	510	**Little Fork River**	Cross River to Beaver Brook	FS	FS	IF	NS	FS	FS	FS	NA
	501	**Little Fork River**	Beaver Brook to Rainy River	FS	FS	FS	NS	FS	FS	FS	FS

				Aquatic Life							Aquatic Rec
Subwatershed Name	**AUID (Last 3 digits**	**Stream**	**Reach Description**	**Fish Index of Biotic Integrity**	**Macroinvertebrate Index of Biotic Integrity**	**Dissolved Oxygen**	**Turbidity/TSS**	**Chloride**	**pH**	**Ammonia**	**Bacteria (*E. coli*)**
	511	**Cross River**	Headwaters to Little Fork River	FS	FS	--	--	--	--	--	NA
	609	**Ester Brook**	Unnamed creek to Little Fork River	FS	FS	--	--	--	--	--	NA

FS = Fully Supporting: found to meet the water quality standard,
NS = Not Supporting: does not meet the water quality standard and therefore, is impaired,
IF = the data collected was insufficient to make a finding,
NA = not assessed
NA* = assessment deferred during 2010 assessments due to coldwater thermal regime and the lack of appropriate assessment tools for coldwater streams.
-- = no data collected for this parameter

Appendix B: Lake Assessment Status

Table 23: Assessment status of lakes in the Little Fork River Watershed

Subwatershed Name	Lake ID	Lake Name	Lake Surface Area (acres)	Aquatic Recreation
Upper Little Fork River	69-1029	Little Lost	18.6	NA
	69-0581	Lost	734.6	IF
South Branch Little Fork River	69-0701	Aerie	143.0	IF
	69-0731	Auto	95.2	FS
	69-0669	Big Rice	1,820.6	NA
	69-0739	Big Rosendahl	42.5	NA
	69-0737	Jammer	18.2	NA
	69-0734	James	17.2	NA
	69-0612	Little Rice	181.6	NA
	69-0732	Little Sand	86.4	IF
	69-0733	Minnow	10.0	NA
	69-0671	Pfeiffer	55.8	NA
	69-0736	Sand	751.1	IF
	69-0735	Wheel	10.3	NA
Bear & Dark River	69-0860	Balkan	27.8	NA
	69-0791	Beaver	13.4	NA
	69-0788	Camp A	15.8	NA
	69-0799	Clear	131.9	FS
	69-0790	Dark	221.7	FS
	69-0858	Deepwater	19.8	IF
	69-0793	Fourteen	384.7	NA
	69-0795	Gate	10.5	NA
	69-0801	Jutila	14.4	NA
	69-0796	Leander	244.2	NA
	69-0789	Lost Man	16.1	NA
	69-1007	McNiven	13.6	NA
	69-0798	Moose	61.9	NA
	69-0800	Mud	46.2	NA
	69-0794	Thirteen	76.2	IF
	69-0797	Watercress	26.3	NA
Sturgeon Lake	31-0058	Beatrice	112.5	FS
	69-0918	Clearwater	73.8	NA
	69-0906	Day	122.3	NA
	69-0912	Dewey	183.5	FS
	69-0924	Elk	12.0	NA

Subwatershed Name	Lake ID	Lake Name	Lake Surface Area (acres)	Aquatic Recreation
Sturgeon Lake (continued)	69-0913	Gansey	72.1	NA
	69-0923	Hobson	62.5	IF
	69-0911	Island	127.9	NA
	31-0059	Johnson	13.5	IF
	69-1290	Little Sturgeon	301.6	FS
	69-0859-01	Long (Main Basin)	188.7	FS
	69-0859-02	Long (North Basin)	49.8	IF
	69-0919	Loven	35.3	NA
	69-0914	McCormack	48.4	NA
	69-0939-02	Middle Sturgeon	129.1	NA
	31-1306	Olson	10.1	IF
	69-0932	Perch	339.9	FS
	69-0934	Pickerel	29.6	NA
	69-0922	Rat	70.9	NA
	69-0917	Rock	63.9	NA
	31-0060	Section Eleven	33.9	IF
	69-0925	Shannon	123.0	NA
	69-0910	Shoe Pack	36.6	NA
	69-0933	Side	368.4	FS
	31-0003	South Sturgeon	199.3	FS
	69-0877	Stingy	37.8	NA
	69-0920	Stuart	27.8	NA
	69-0939-01	Sturgeon	1,576.9	FS
	69-1025	Unnamed	11.3	NA
	69-0929	Unnamed	12.1	NA
	31-0061	Unnamed	12.6	IF
	69-1024	Unnamed	13.7	NA
	31-0063	Unnamed	14.8	NA
	69-0939-03	West Sturgeon	112.6	FS
Sturgeon River	69-0927	Bathtub	10.3	NA
	69-0926	Braun	11.9	NA
	69-0930	Elbow	24.3	NA
	69-0931	Luna	19.6	NA
	69-0928	Near Side	16.6	NA
Bear River	31-0295	Bass	20.0	IF
	31-0157	Bear	344.7	FS

Subwatershed Name	Lake ID	Lake Name	Lake Surface Area (acres)	Aquatic Recreation
Bear River (continued)	31-0286	Beaver	22.0	IF
	31-0285	Blind Pete	69.5	IF
	31-0167	Eve	16.3	NA
	31-0155	Horsehead	70.4	FS
	31-0291	Kelly	30.5	IF
	31-0299	Kelly	77.4	FS
	31-0194	Klingendiel	30.2	IF
	31-0156	Little Bear	126.3	FS
	31-0161	Little Drew	33.9	IF
	31-0162	Little Moose	123.2	IF
	31-0296	Long	80.1	IF
	31-0289	Lost	85.4	IF
	31-0302	May	62.4	NA
	31-0290	Napoleon	127.7	FS
	31-0301	Otter	109.5	FS
	31-0292	Owen	271.4	IF
	31-0166	Piel	11.8	NA
	31-0284	Raddison	200.5	FS
	31-0297	Rainbow	15.7	IF
	31-0319	Rat	52.7	NA
	31-0065	Spring	29.3	IF
	31-0158	Thistledew	324.2	IF
	31-0168	Tuber	35.9	IF
	31-1175	Unnamed	11.0	NA
	31-0163	Unnamed	11.4	IF
	31-0300	Unnamed	14.4	IF
	31-0165	Unnamed	16.8	NA
	31-0287	Unnamed	17.1	IF
	31-0310	Unnamed	18.5	IF
	31-0288	Unnamed	25.5	NA
	31-0322	Unnamed	30.3	IF
	31-0064	Unnamed (Fox)	25.5	IF
	31-0164	Unnamed (Seventeen)	21.8	IF
	31-0298	Walters	120.0	FS
	31-0071	Wamp	14.9	IF
	31-0320	Wilson	86.1	IF

Subwatershed Name	Lake ID	Lake Name	Lake Surface Area (acres)	Aquatic Recreation
Middle Little Fork River	31-0175	Button Box	80.0	IF
	31-0324	Candy	13.8	NA
	31-0171	Crum	18.1	IF
	31-0174	Herrigan	25.9	IF
	31-0330	Island	13.7	IF
	31-0170	Lost	24.7	IF
	31-0186	Perch	16.0	IF
	31-0184	Sun	12.8	IF
	31-0185	Unnamed	11.8	IF
	31-0325	Unnamed	39.1	NA
	31-0182	Unnamed (Blue Ridge)	14.0	NA
	31-0172	Unnamed (Herrigan)	10.4	NA
	31-0329	Unnamed(Little Horseshoe)	12.1	IF
Lower Middle Little Fork River	36-0005	Franklin	107.5	NA
	36-0007	Myrtle	165.5	NA
	36-0004	Pocquette	41.7	NA
Nett Lake	36-0001	Nett	7,269.0	NA

County Codes:

31 = Itasca County

36 = Koochiching

69 = St. Louis County

Aquatic Recreation Use Assessment Codes:

FS = Fully Supporting: found to meet the water quality standard,

NS = Not Supporting: does not meet the water quality standard and therefore, is impaired,

IF = the data collected was insufficient to make a finding,

NA = no monitoring data is available and therefore lake not assessed

Appendix C: WRAPS Meeting Notes

WRAPS Forestry Consensus Meeting

1:30-3:30pm, March 18, 2015, Littlefork, Minnesota

- Part of forestry business plan is land sales, but easements are not profitable due to tax limitations enacted during a change in legislation three years ago
- Minnesota Forestry Council Plans for North Central and Northeast
- Boise Cascade Corporation kept 800 acres – where and what is the land use?
- Log jams in many subwatersheds: Beaver, Sturgeon
- Focus on tributary head cuts
- Identified problems during the group discussion:
    - Bank stabilization from historical logging activities
    - Forest riparian buffers
    - Agricultural riparian buffers
    - Forest loss
    - Geology impacts to stream bank failures
    - Road culvert blow-outs
    - Feeder ditch and feeder creek erosion
    - Erosion at canoe carry-downs (inventory and prioritize)
    - Road slides (Buffers along roads near stream rivers, such as County 75 near Silverdale)
    - Conversion of forested land to developed land
    - Conservation easements along river to limit development (but have tax limitations)
    - Tributary head cuts not visible from Little Fork River mainstem (find willing landowner and make demonstration site – need other source for grant match)

WRAPS Public Open House

4:30pm-7:00pm, March 18, 2015, Littlefork, Minnesota

- What kind of willows work for live stakes?
- Beavers are a problem
- Boise sold land
- Use Boy Scouts or other sources of manpower (prisoner conservation corps) to stabilize erosion – access is limited to machines
- Remember that while we want to slow water down to settle out sediment, fisheries need water to speed up to scour and clean stream beds for spawning
- Locals want to know what our specific questions are. They can answer those. Where are the gullies? Where are the road slides?
- School Trust Lands (two sections of each township) are at risk for land use changes to increase profitability
- 14 mines proposed for Rainy River Basin
- Confederation Lake near Red Lake, ON (most productive Cu, Ni mine) in operation in the

- 1970's and 1980's still produces severe acid mine drainage
- Roman copper mines still produce acid – WOW
- Identified problems during the group discussion:
  - Inventory of erosion at canoe carry-downs
  - SE Koochiching County (Silverdale) – road slide into river along County 74/75
  - Forest fragmentation: selling of forested land and conversion to residential property
  - with clearings to river
  - Boise Forte Creek – perched culverts and head cuts
  - Beaver dams
  - Slow the water down
  - Utilize manpower to construct projects – invest people in watershed, can get to hard
  - to access sites
  - Conservation easements with landowners
  - County 22 shed
  - Drilling/mining issues?
  - School trust lands
  - Groundwater protection areas (aquifers)

WRAPS Forestry Consensus Meeting

1:30-3:30pm, March 19, 2015, Side Lake, Minnesota

- Goals for next Little Fork assessment cycle: refine HSPF model and marry with in the field geomorphic work
- Are there areas where the Little Fork does have a small floodplain? Could we stabilize some of those sloughing banks?
- Conductivity issues in Dark River and Dark Lake
- Recreational use of forest in Sturgeon and Dark Rivers: ATV traffic and trail erosion
- Ely USFS uses National Protocol for BMP monitoring
- USFS has existing culvert databases for forest owned roads that potentially includes information on other roads
- Nett Lake Army Corps of Engineers Remeander: just connecting a few oxbows, not a complete remeander of stream, not taking out dam just adding fish passage around dam
- DNR forestry at meeting from Hibbing office – Tom Splinter knows locations of roadslides
- Dark and Sturgeon Rivers contribute a lot of sediment to the Littlefork
- Sandy Verry completed a geomorph study of the Dark River in the 1980's. A lot of projects identified were tabled, interest has revitalized but still lack the proper political climate to implement.
- Valley River System
- Gardner Brook System
- Log jams: to remove or not to remove? Danger of taking out too much debris needed for habitat
- Headwater of Dark River flows through mine berm

WRAPS Public Open House

4:30pm-7:00pm, March 19, 2015 Side Lake, Minnesota

- Julie Lucas – Citizen Lake Monitor for "The Narrows" (Middle Sturgeon) and West Sturgeon
- Paul Oberstar – Landowner from SE Koochiching County
- Will? Bill? Bonte – Perch Lake Citizen Lake Monitor
- Septic straight pipes discharging to Little Fork upstream of the town of Littlefork
- We should quantify what size rainfall event correlates with which flow regimes
- Evidence of tannic acids staining boats in the Side Lake Area lakes
- Side Lake Area lake study funded by French township
- Little development on West Sturgeon, but all other lakes heavily developed
- West Sturgeon is stained very dark
- Consider pursuing a CWP grant for the Side Lake Area lakes?
- North St. Louis County SWCD is back online – office in Virginia
- Residents guess that 50% of shoreowners are seasonal
- Itasca County has point of sale septic check required
- South, Little or West Sturgeon have really high water table and could increase septic loads to lakes
- Water table at 6 feet in the Narrows
- Lake association sponsored certified independent septic inspector
- Homeowner education about no lawn waste dumping into lake
- Shoreline buffers
- Would a lake core show the period of logging disturbance in the late 1800's? Has this already been done?
- Problems identified during group discussion:
    - Destabilized stream banks
    - Clearing right to stream banks and lake shore
    - USFS: recreational/ATV impacts; culvert status; ownership
    - Further geomorphic studies on mainstem and tribs
    - Dark and Sturgeon Rivers sediment export (S. Verry 80's work in Dark)

Appendix D: LiDAR Terrain Analysis and BMP Siting

Introduction

(This section expands upon the summary in the report body.)

GIS analyses using LiDAR high resolution elevation data are invaluable tools for estimation of magnitudes and spatial distributions of hydrologic, hydraulic and erosional processes, especially when relevant observed data is lacking, as is the case with the Little Fork. Landscape erosion is an important stream sediment source in the Little Fork (i.e., sediment carried in runoff from forests, agricultural fields and grasslands to nearby streams); however, research indicates that the majority of the stream sediment comes from near-channel sources -- stream bank/bluff erosion and gully/ravine erosion (Anderson 2006, Anderson 2004–2008, Gran 2007) owing to the unique geological context and legacy of logging in the Little Fork River Watershed. Terrain analyses of varying types were conducted to help target local sediment source areas of both landscape and near-channel erosion for BMP implementation.

Approach

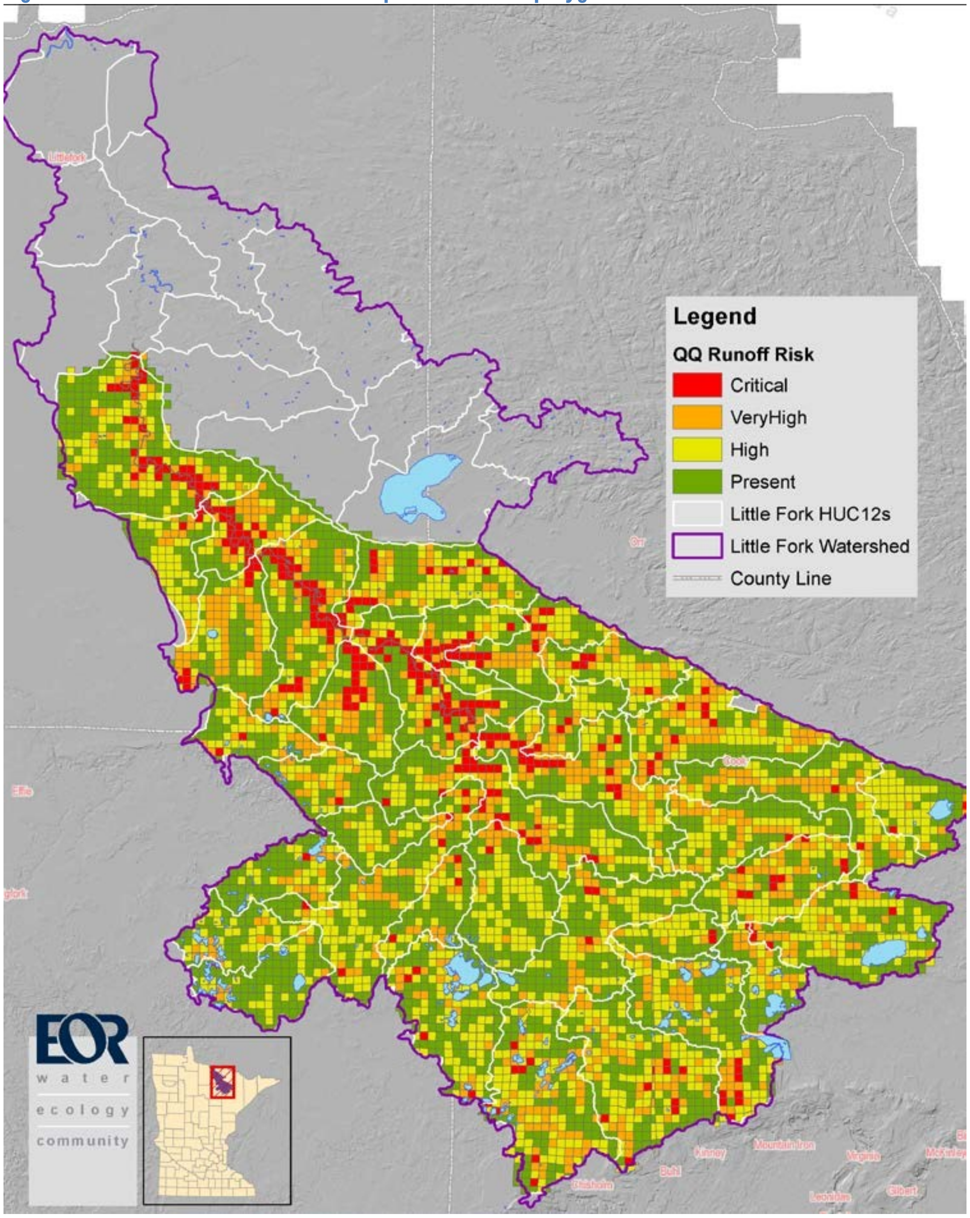
An area of focus was selected that encompassed the Little Fork Watershed upstream of the confluence with the Nett Lake River (36 HUC12 watersheds); this area was selected to emphasize the incised main channel reaches just upstream of the confluence, both in terms of near-channel source areas located within, but also the upstream landscape and channel areas that influence its erosional processes.

Within this area of focus, the watershed was split up into quarter-sections ("QS"; roughly 160 acre, 2640 feet on a side) for landscape sediment source assessment and ranking. This QS analysis served to constrain the BMP analysis to critical landscape areas thought to contribute the most flow and sediment to the channel network. Each QS was analyzed according to the following procedure:

1. LiDAR was used to generate three-meter rasters of slope and distance ("cost-distance") to the nearest perennial stream.
2. NLCD 2011 land use change data were analyzed to pinpoint 30-meter cells where land use changed from forest to scrub, barren or herbaceous/grassland from 2006 to 2011; this served as a proxy for recent forest harvesting (but unfortunately does not include such activities 2012 to present).
3. County-soil survey information (using 30-meter digital SSURGO soils data) was analyzed to delineate soils with low vs. high runoff potential (using hydrologic soil group ratings: "A", "B", "C", "D", "A/D", "B/D", "C/D").

These four GIS raster layers were intersected using raster algebra and zonal statistics to produce a representative, weighted QS "Runoff Risk" with qualitative ratings of Critical, Very High, High or Present. Figure 3 depicts the watershed area of focus and QS runoff risk ratings.

Figure 4: Littlefork area of focus with quarter section polygons and calculated runoff risk



A GIS terrain analysis framework for targeting sediment source areas and potential BMP sites was developed by Jason Ulrich (EOR) by adapting the Agricultural Conservation Planning Framework (ACPF; version 1 Beta, 2015) developed by Mark Tomer and others at the USDA-ARS (Ames, Iowa) to forested landscapes in northern Minnesota. The ACPF is a LiDAR-based analysis framework that determines source areas on the landscape, and targets potential parcel-scale sites for a set of specific agricultural BMPs such as water and sediment control basins (WASCOBs), restored/constructed wetlands, riparian buffers and grassed waterways. Local scale BMPs are sited taking into account criteria identified by NRCS to meet Environmental Quality Incentives Programs (EQIP) specifications (e.g., appropriate contributing drainage area to BMP, location of dominant landscape flow paths, depressional basin depths and volumes, etc.). However, as WASCOBs and restored/constructed wetlands are less appropriate for the Little Fork's largely non-agricultural landscape, only the ACPF riparian buffer and grassed waterway tools were judged to pertain and, therefore, were the primary BMPs sited using the analysis.

The adapted ACPF was run by EOR for 36 HUC-12 watersheds in the Little Fork River Watershed (see maps in Appendix E). Of the 1000's of buffer and grassed waterway BMP features initially sited by the analysis, the number was reduced to a more manageable amount by considering only the most critical sites. Critical BMP features were determined by requiring: (1) intersection with a QS rated Critical for runoff risk, and (2) intersection with the perennial stream channel. This insures the potential BMPs intercepted areas with the highest potential runoff and sediment, and exported them directly to the stream channel. See Appendix E for a HUC-12 breakdown of all targeted BMP features.

Results

A grassed waterway (as adapted for this analysis) is a bit of a misnomer. Grassed waterway outputs are, in fact, maps of landscape flow paths and their intersections with the nearest perennial stream (i.e., places where runoff/sediment empty into a stream channel and presumably find their way to reaches downstream). These flow paths may be channelized, gullying areas, or may be simply areas where non-channelized (i.e., non-gully) flow is present. As such, these flow paths were used for two BMP purposes: (1) To pinpoint riparian areas where buffers should be implemented or current buffers widened, and (2) To pinpoint flow paths that are likely gully/ravine features where, in addition to a riparian buffer, some sort of stabilization (grassed waterway, grade stabilization, check dam, etc.) is necessary.

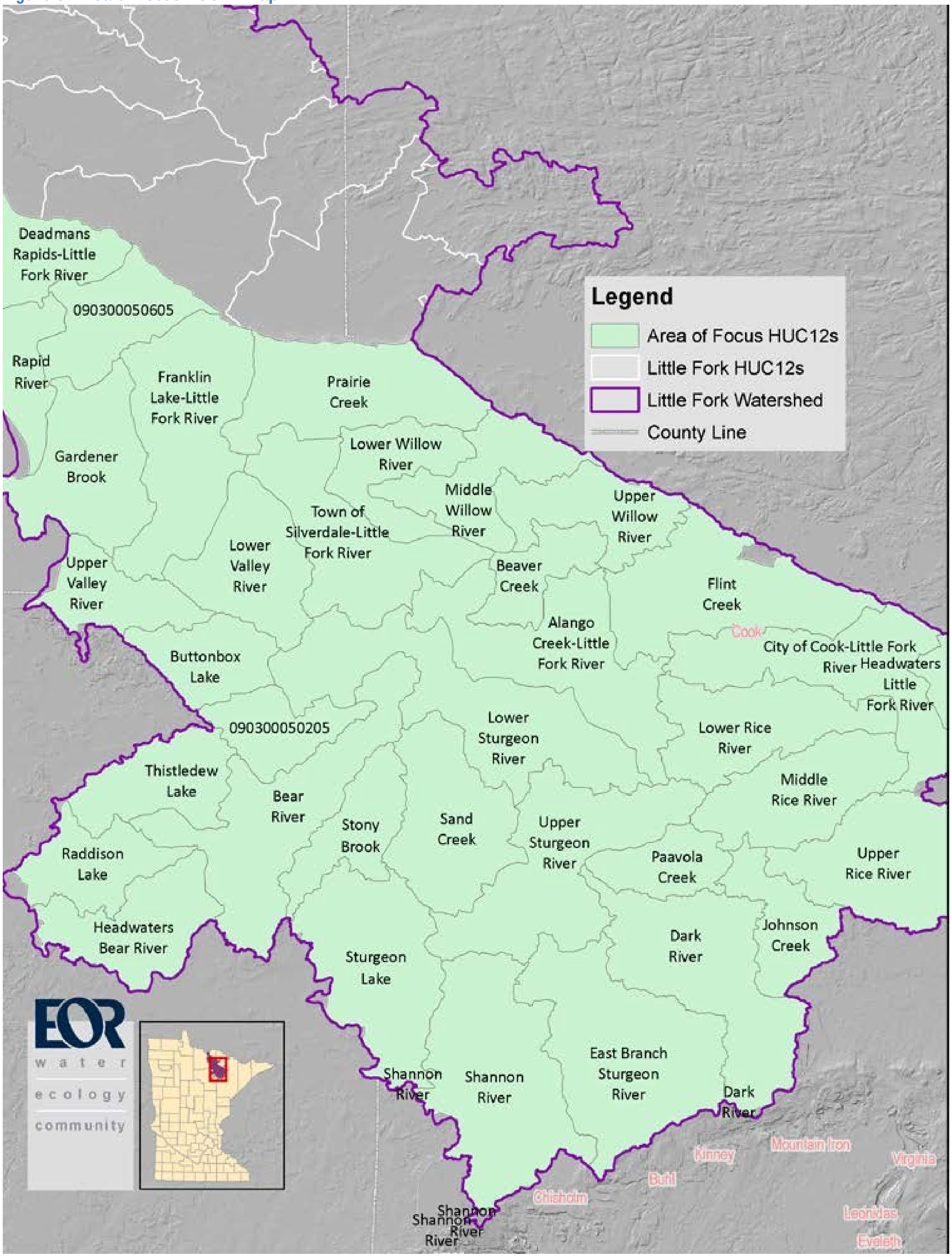
As mentioned above, potential locations of riparian buffers and grassed waterways were constrained such that the most critical areas were targeted for maximum practicality and cost-effectiveness. Analyses resulted in approximately 1,100 targeted features across the 36 HUC-12s. Overall, the incised area of the Little Fork mainstem (Gran's Reaches III and IV) provided the most "critical" opportunities for BMP implementation as siting analyses were heavily influenced by high slopes present there. Results of the analyses were intended to provide a basis for discussion on BMP planning and implementation within these watersheds. Detailed HUC-12 maps are presented in Appendix E.

GIS Terrain Analysis Tool Output

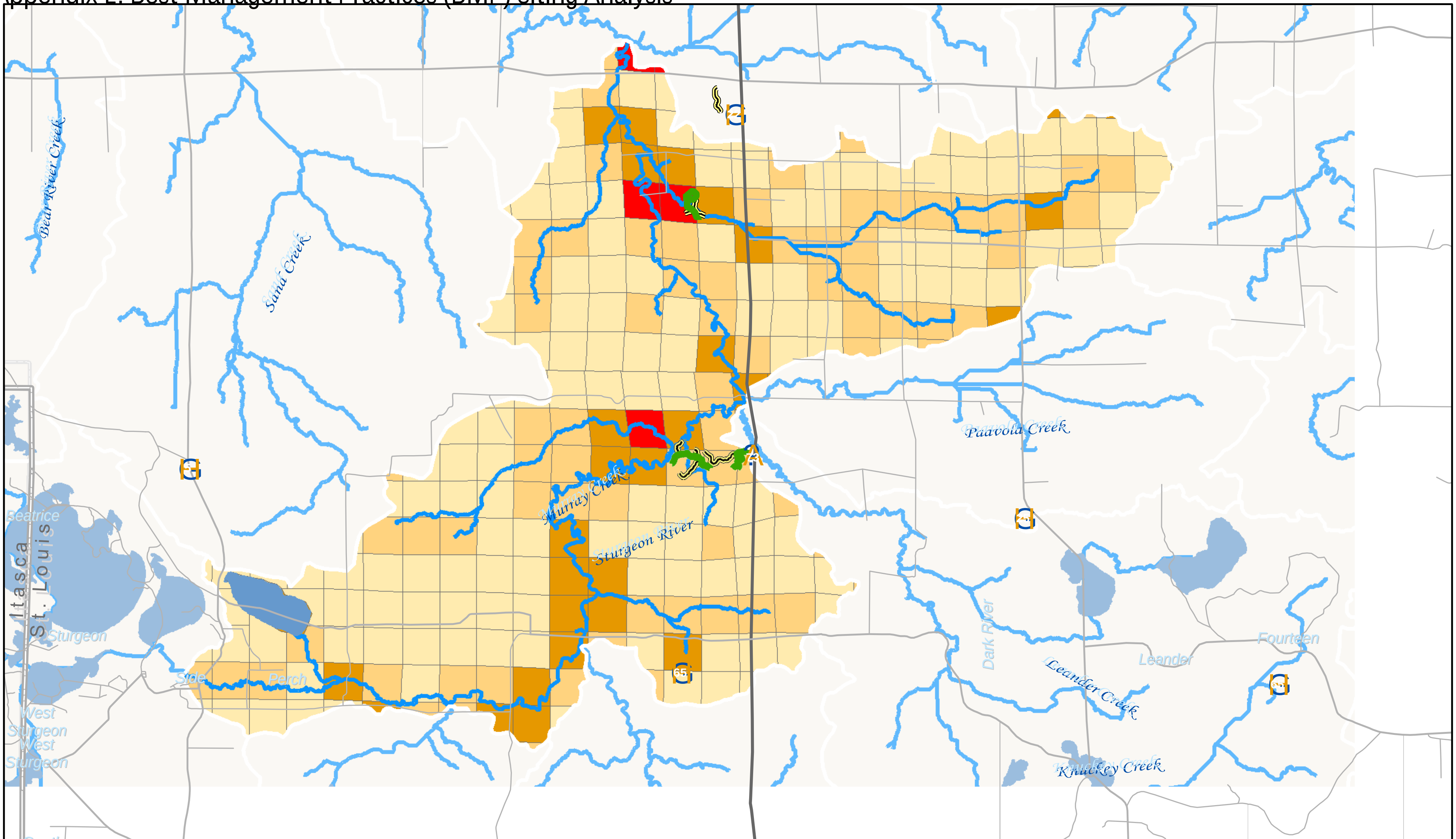
The output from the GIS Terrain Analysis Tool is provided for the following individual HUC-12s in the accompanying Appendix E. (See accompanying Figure 4 below for HUC-12 map):

HUC-12 ID	HUC 12 Name
090300050307	Sand Creek
090300050403	Lower Willow River
090300050503	Lower Valley River
090300050601	Town of Silverdale-Little Fork River
090300050603	Franklin Lake-Little Fork River
090300050604	Gardener Brook
090300050606	Rapid River
090300050204	Stony Brook
090300050206	Bear River
090300050301	Sturgeon Lake
090300050302	Shannon River
090300050303	East Branch Sturgeon River
090300050304	Dark River
090300050101	Headwaters Little Fork River
090300050104	Johnson Creek
090300050108	Beaver Creek
090300050306	Upper Sturgeon River
090300050308	Lower Sturgeon River
090300050401	Upper Willow River
090300050402	Middle Willow River
090300050501	Upper Valley River
090300050502	Button Box Lake
090300050602	Prairie Creek
090300050605	090300050605
090300050607	Deadmans Rapids-Little Fork River
090300050109	Alango Creek-Little Fork River
090300050201	Headwaters Bear River
090300050202	Raddison Lake
090300050203	Thistledew Lake
090300050205	090300050205
090300050305	Paavola Creek
090300050102	City of Cook-Little Fork River
090300050103	Upper Rice River
090300050105	Middle Rice River
090300050106	Lower Rice River
090300050107	Flint Creek

Figure 5: Area of Focus HUC12 Map



Date: 10/1/2015 Time: 4:17:20 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



water
ecology
community

Legend

Potential Riparian Buffers (Critical)
Potential Grassed Waterways (Critical)
Flow Network

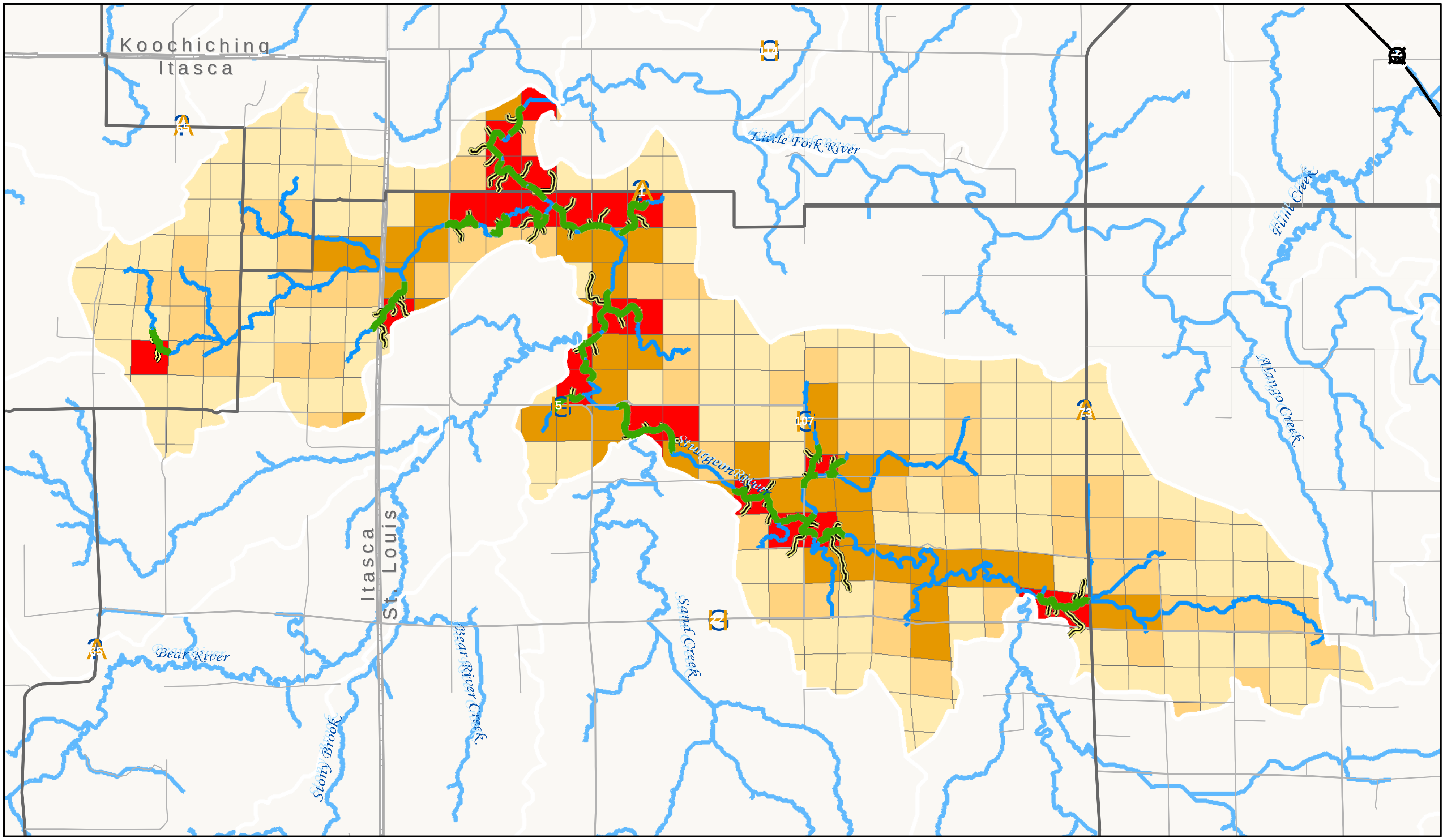
Quarter-section Runoff Risk

Critical
VeryHigh
High
Present

Little Fork WRAPS
BMP Siting Analysis
Upper Sturgeon River

Miles
0 2

Date: 10/1/2015 Time: 4:17:27 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



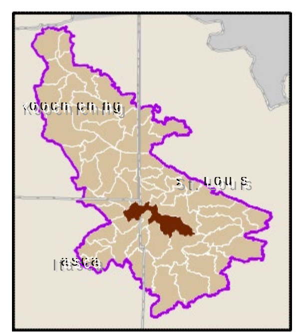
Little Fork WRAPS
BMP Siting Analysis
Lower Sturgeon River

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

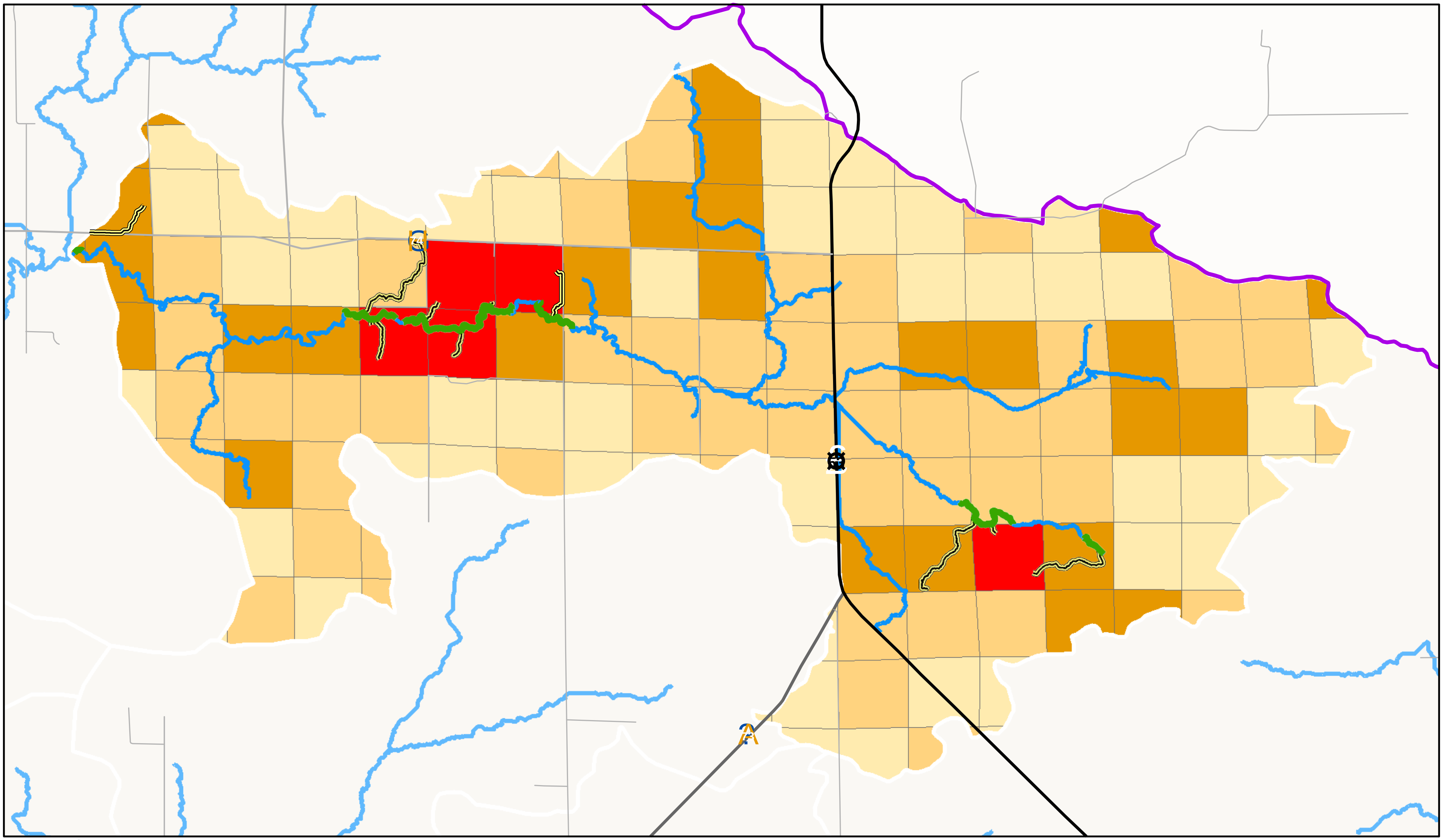
- Critical
- VeryHigh
- High
- Present



Miles
0 2 4

water
ecology
community

Date: 10/1/2015 Time: 4:17:31 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

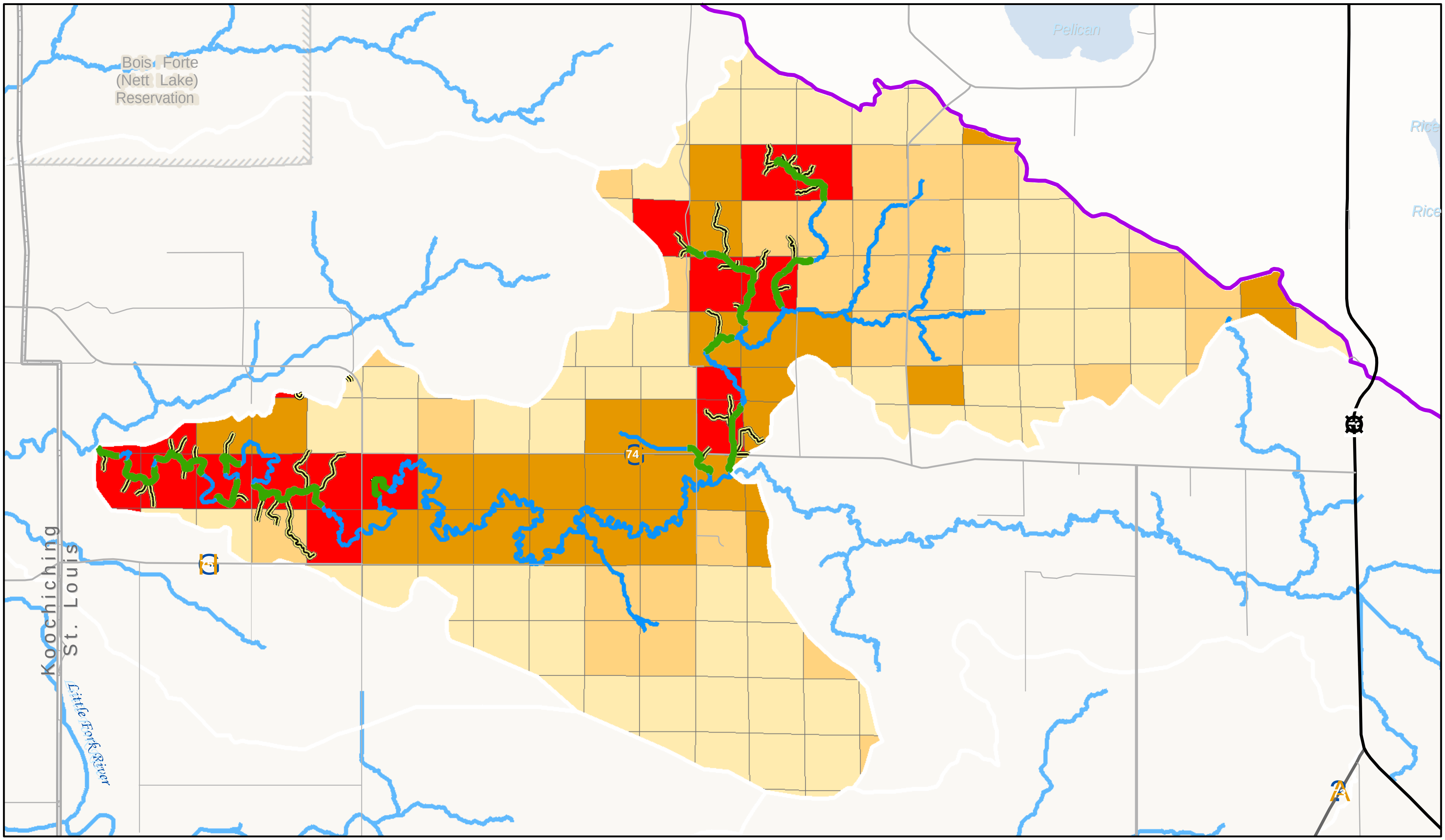
Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Upper Willow River

Miles
0 2

Date: 10/1/2015 Time: 4:17:36 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

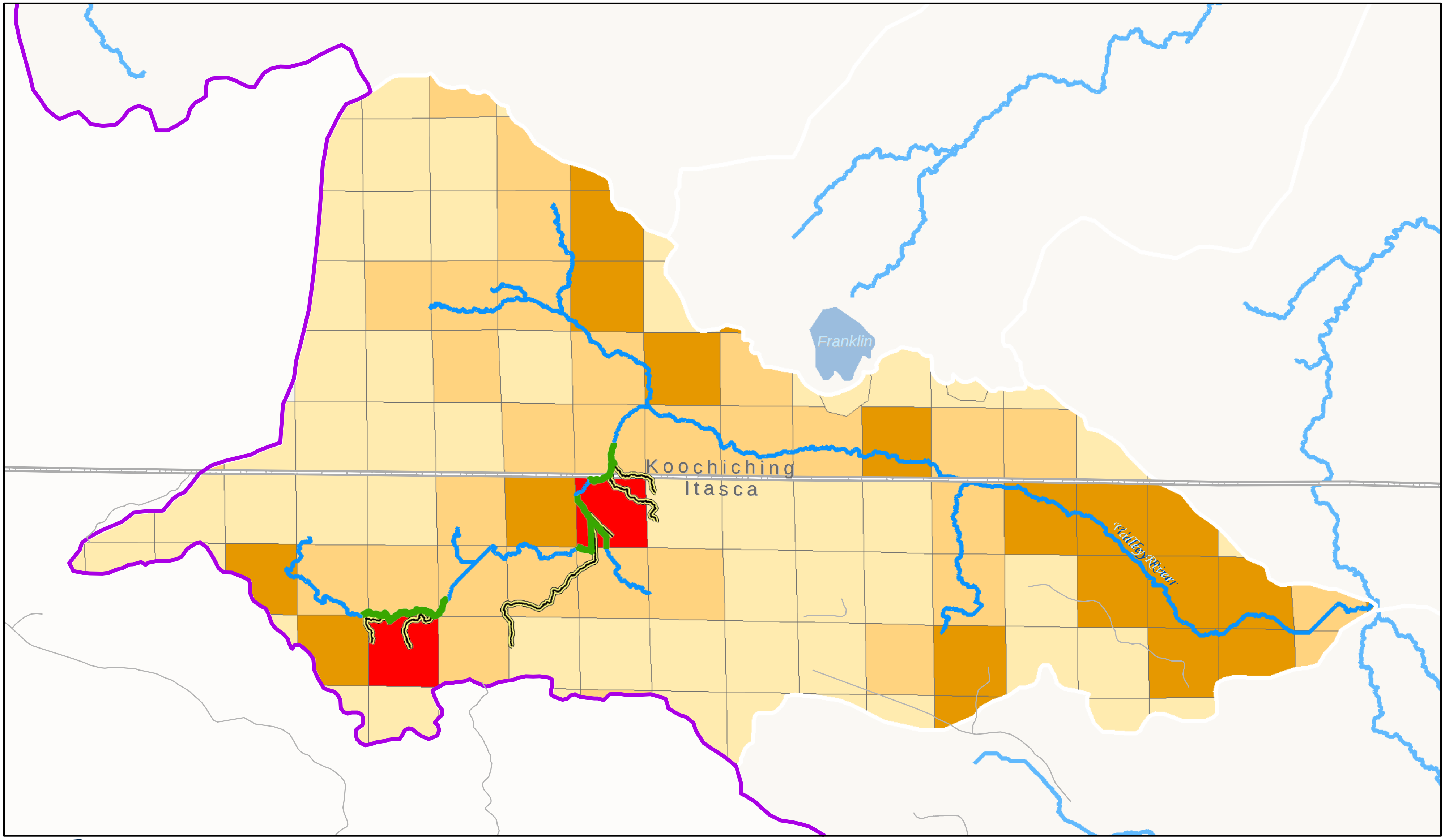
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Middle Willow River

Miles
0 2



Little Fork WRAPS

BMP Siting Analysis

Upper Valley River

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

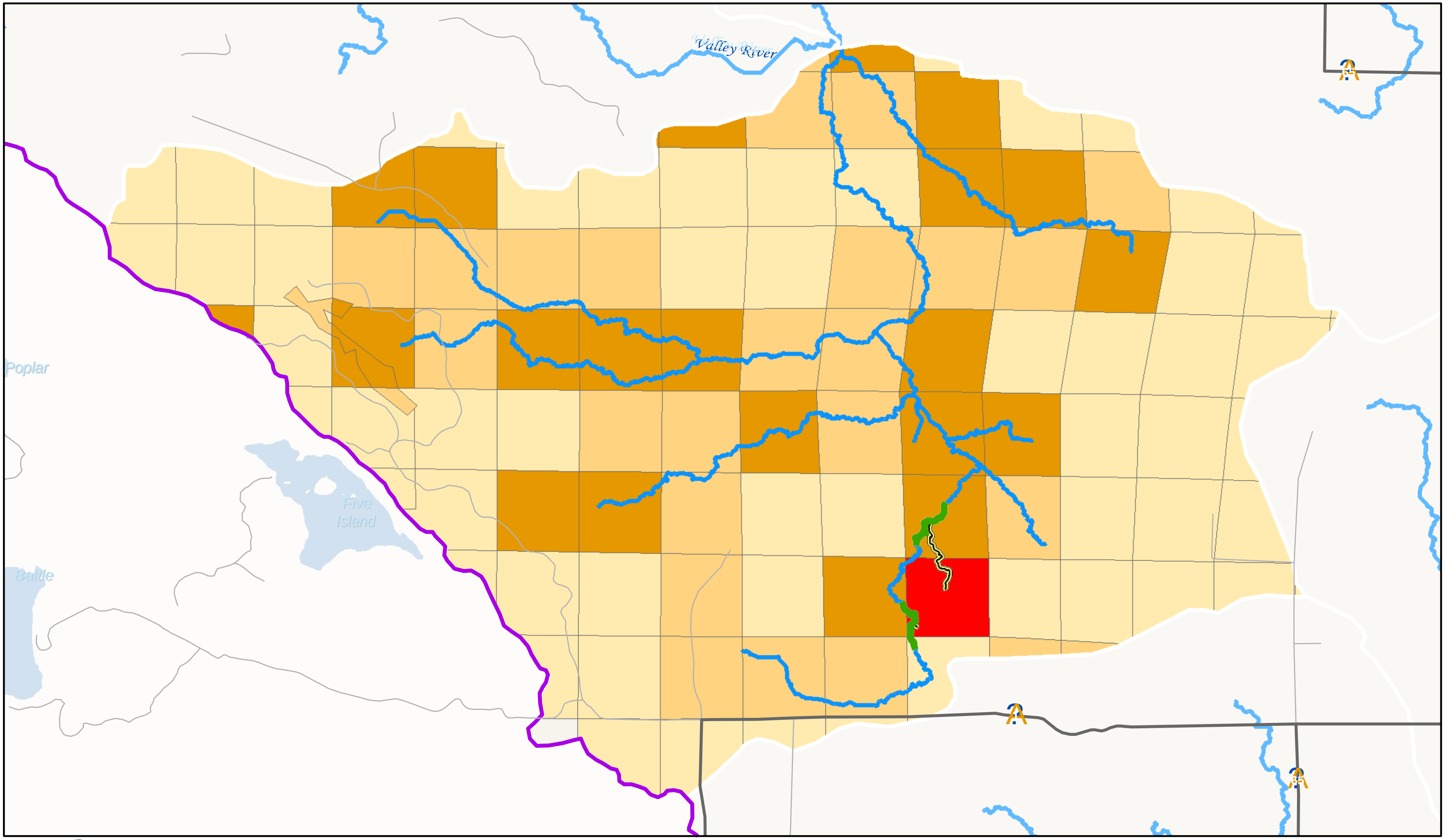
Miles

0 2

EOR water ecology community

Date: 10/1/2015 Time: 4:17:40 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd

Date: 10/1/2015 Time: 4:17:44 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



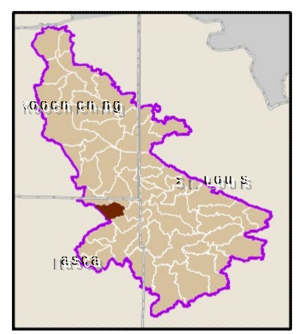
EOR
water
ecology
community

Legend

Potential Riparian Buffers (Critical)
Potential Grassed Waterways (Critical)
Flow Network

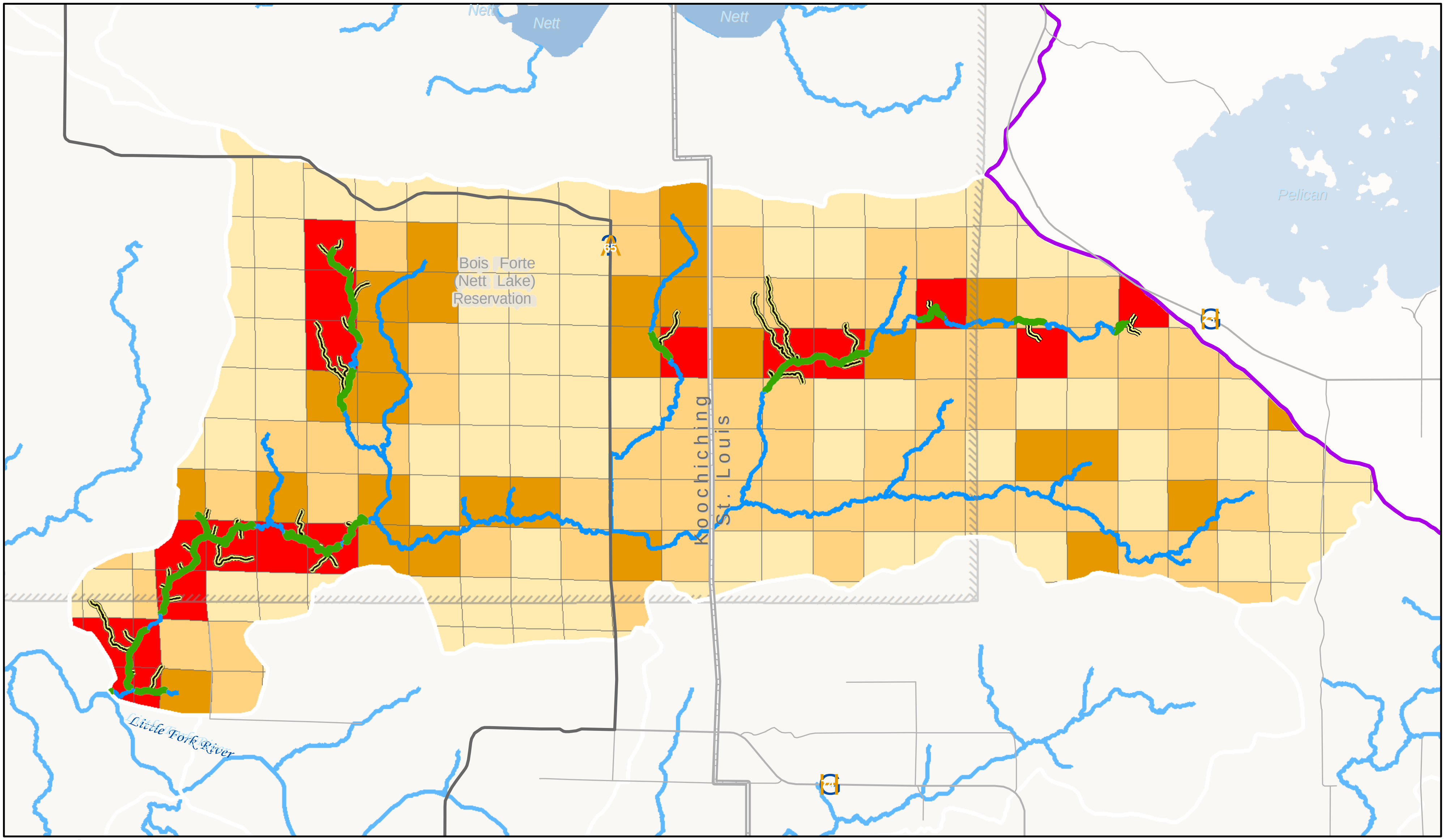
Quarter-section Runoff Risk

Critical
VeryHigh
High
Present



Little Fork WRAPS
BMP Siting Analysis
Buttonbox Lake

Date: 10/1/2015 Time: 4:17:48 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

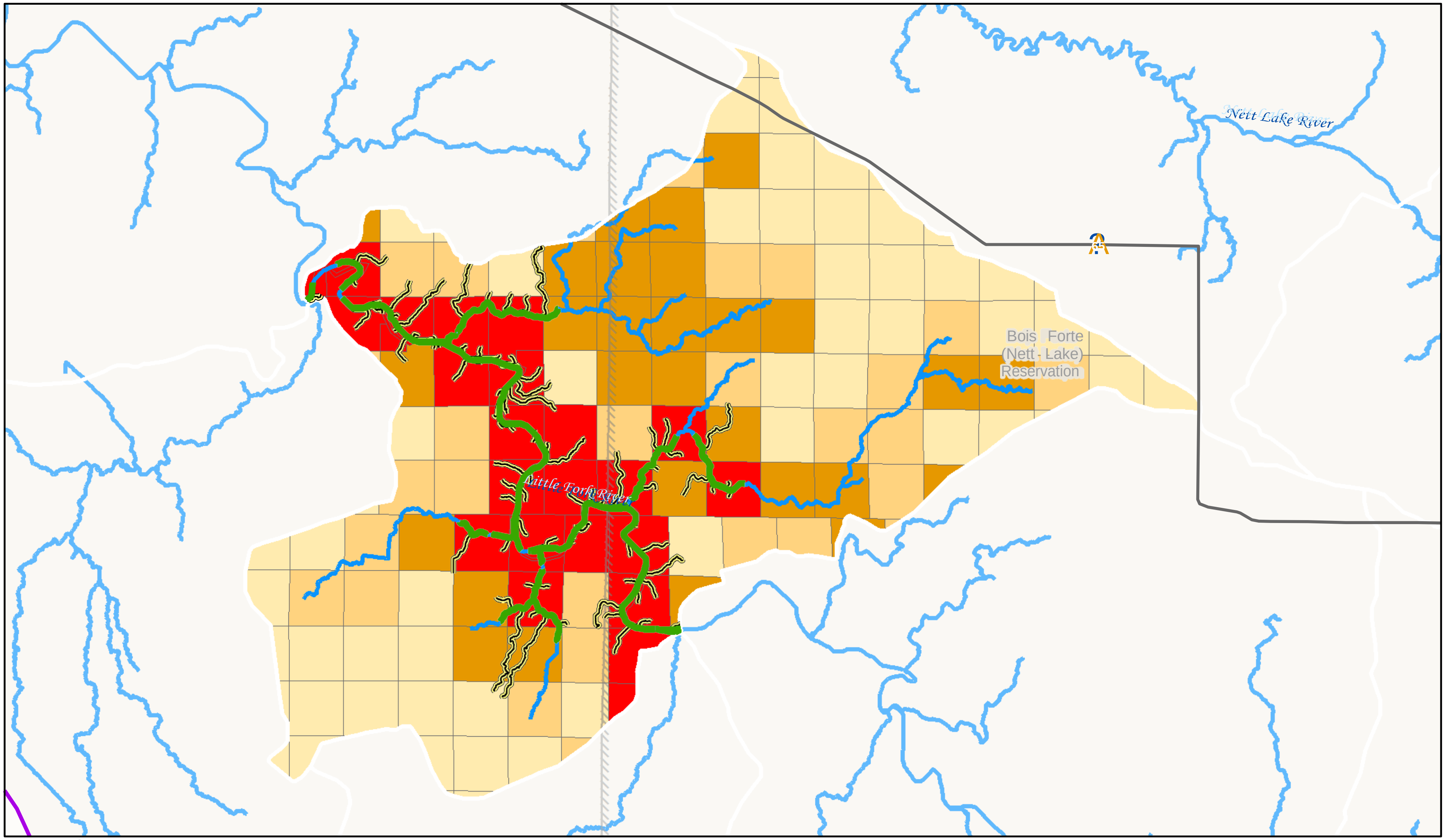
Potential Riparian Buffers (Critical)
Potential Grassed Waterways (Critical)
Flow Network

Quarter-section Runoff Risk

Critical
VeryHigh
High
Present

Little Fork WRAPS
BMP Siting Analysis
Prairie Creek

Miles
0 2



EOR water ecology community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

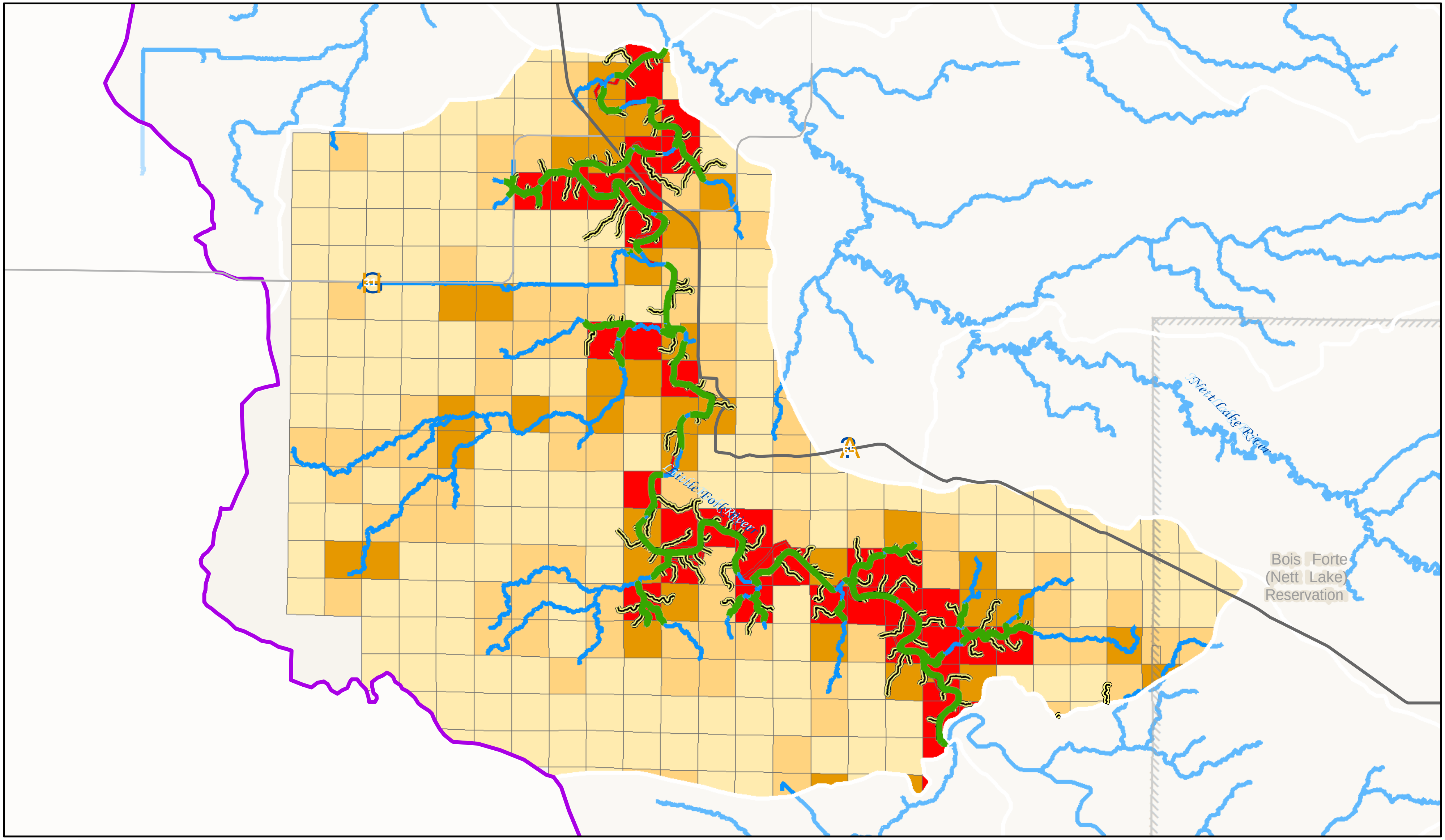
Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
090300050605

Miles
0 2

Little Fork WRAPS
BMP Siting Analysis
Deadmans Rapids-Little Fork River

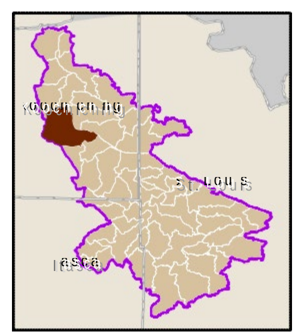


Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

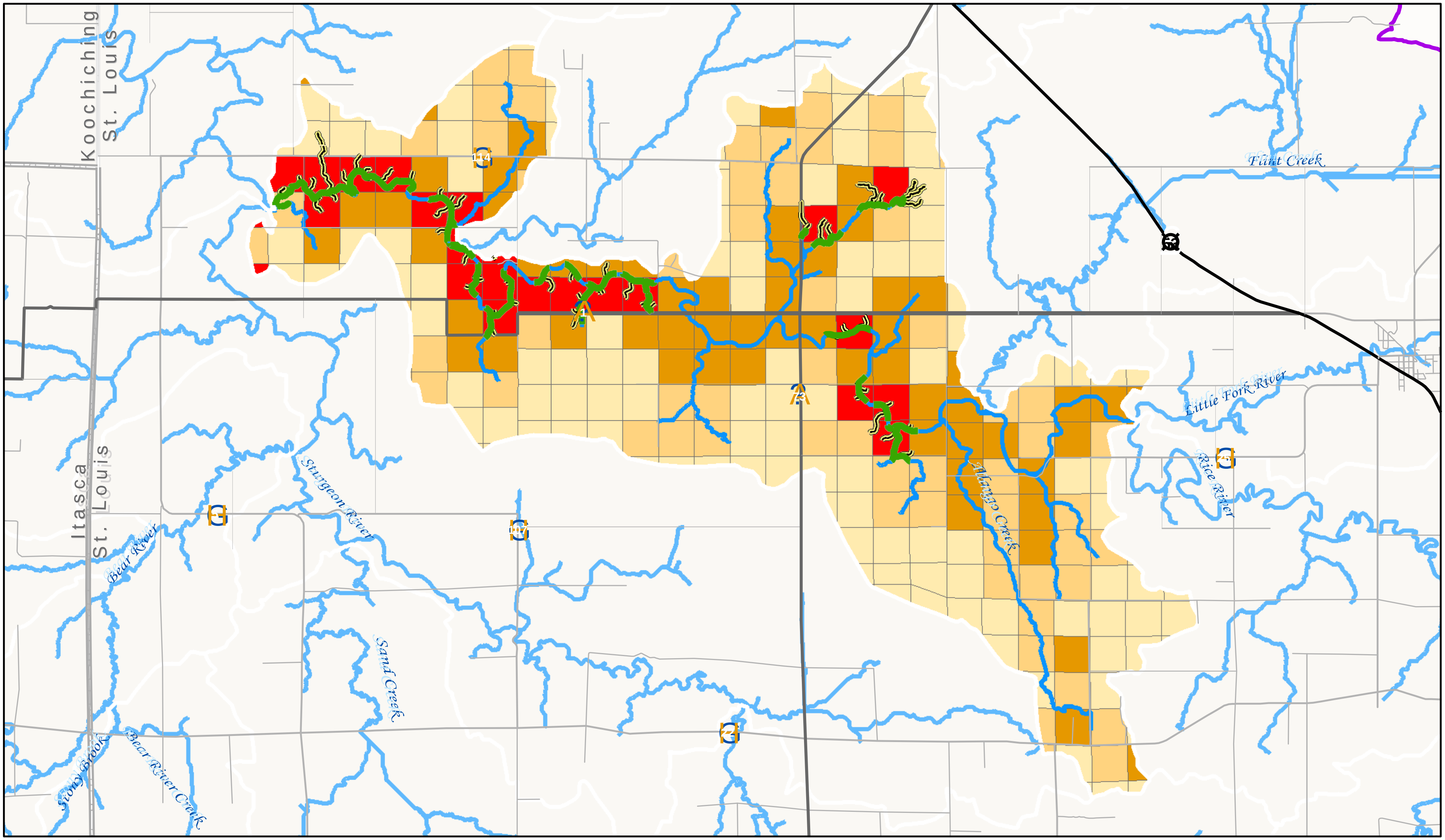


Miles
0 2

water
ecology
community

Date: 10/1/2015 Time: 4:17:56 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd

Date: 10/1/2015 Time: 4:18:00 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Little Fork WRAPS

BMP Siting Analysis

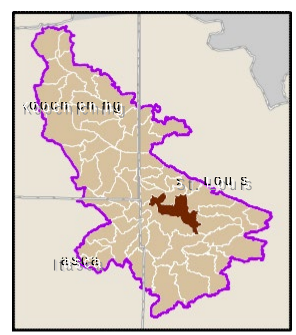
Alango Creek-Little Fork River

Legend

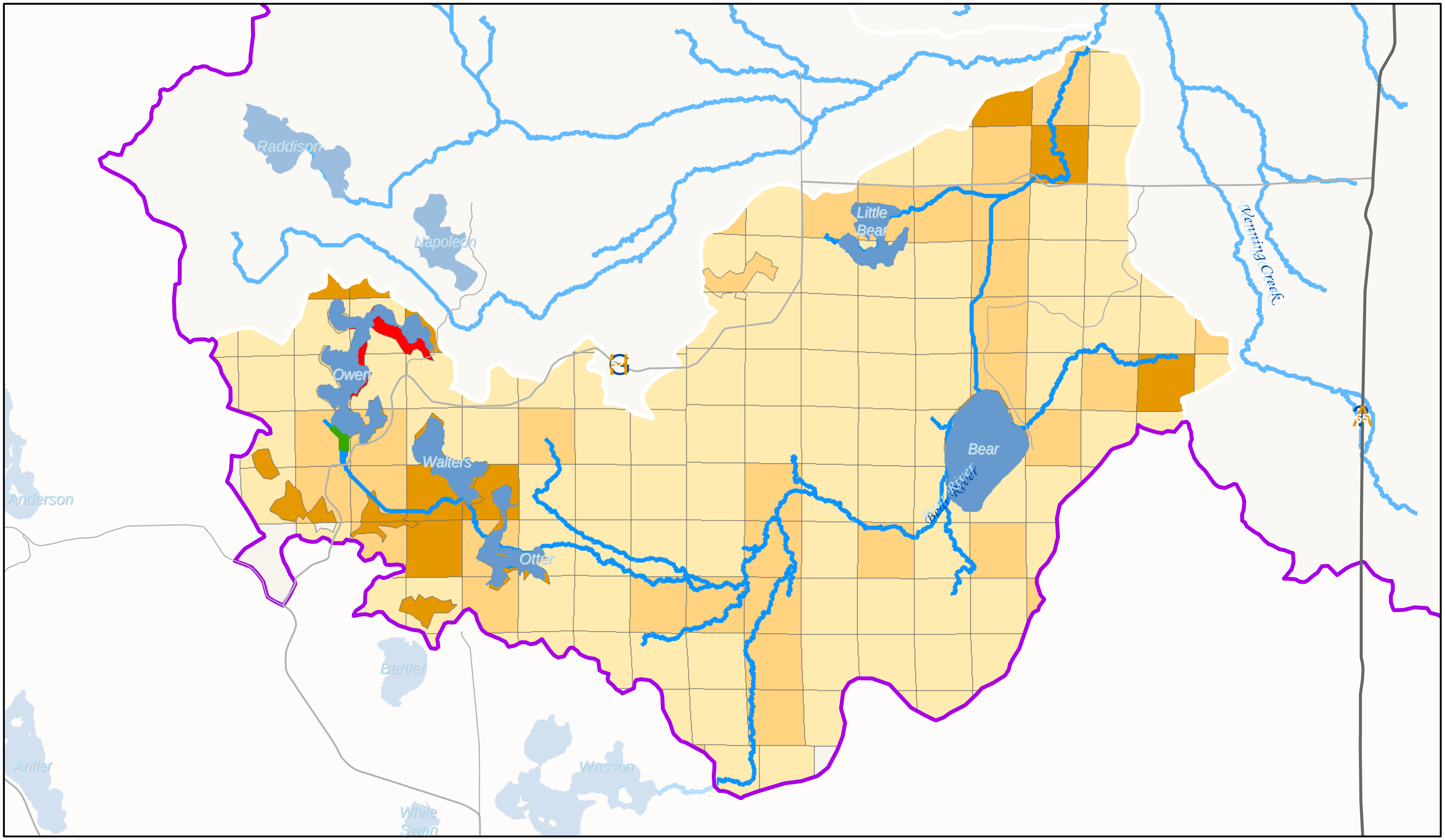
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present



Miles
0 2 4



Date: 10/1/2015 Time: 4:18:04 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd

water ecology community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

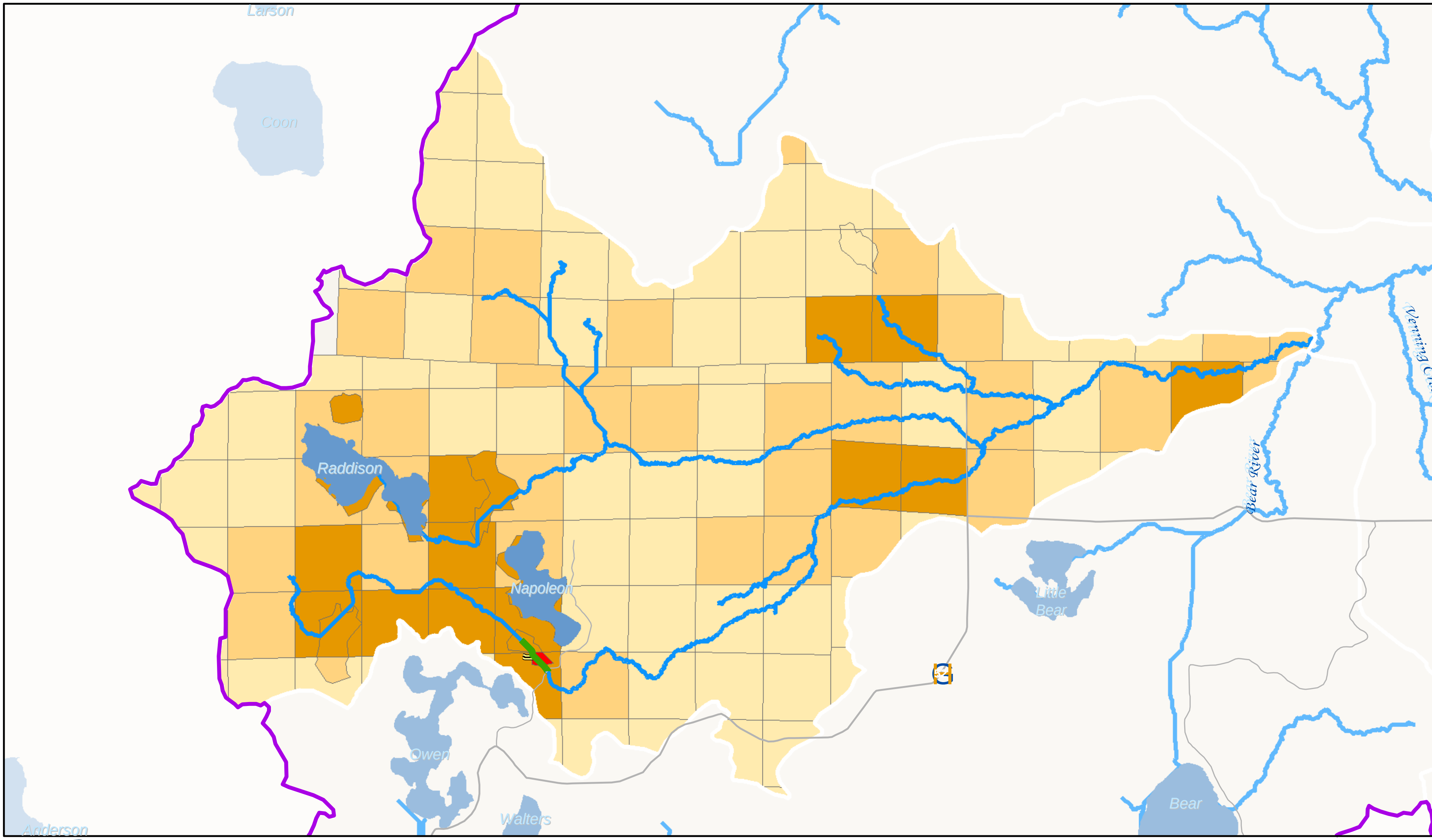
Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Headwaters Bear River

Miles
0 2

Date: 10/1/2015 Time: 4:18:08 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

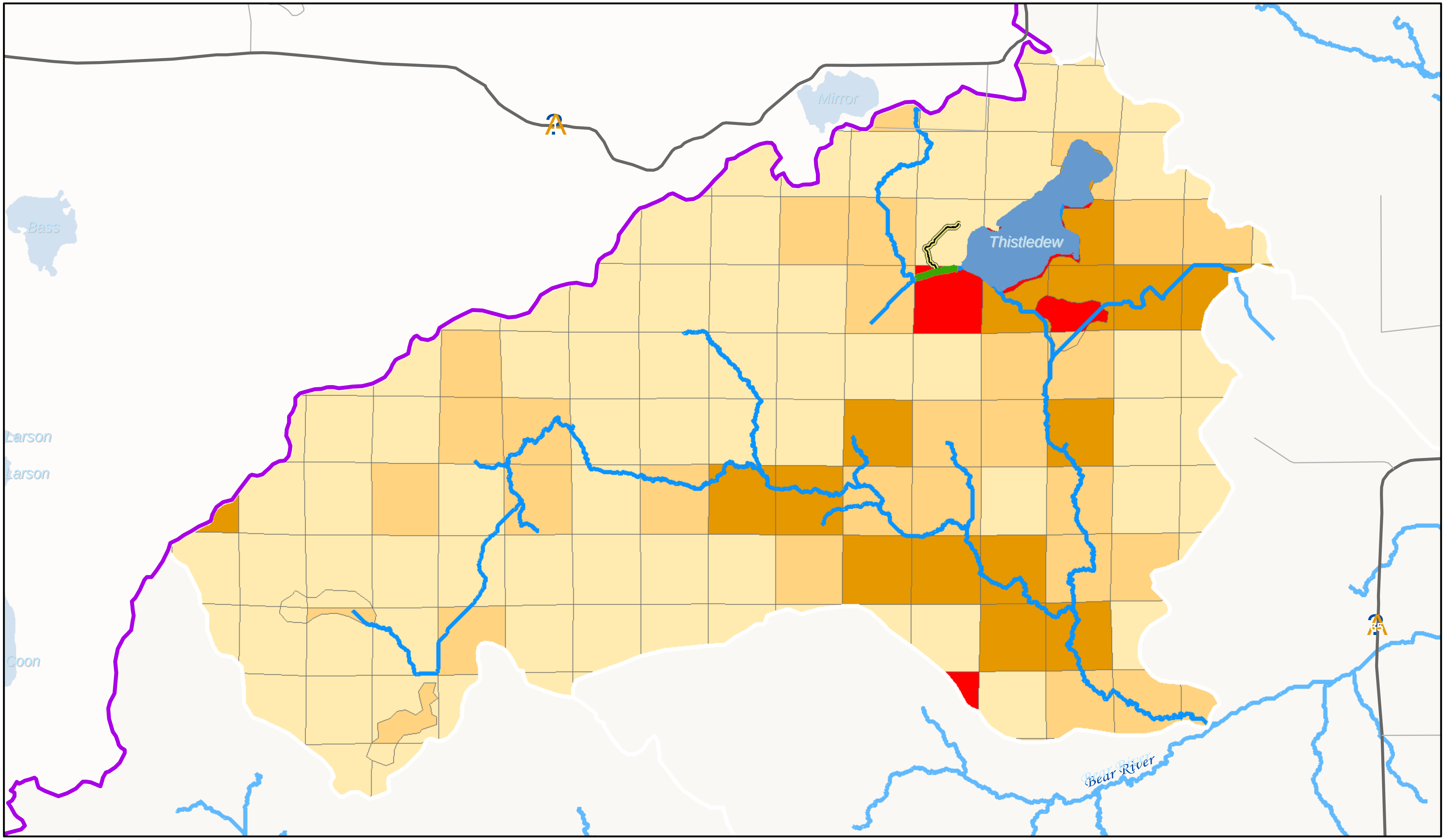
Potential Riparian Buffers (Critical)
Potential Grassed Waterways (Critical)
Flow Network

Quarter-section Runoff Risk
Critical
VeryHigh
High
Present

Little Fork WRAPS
BMP Siting Analysis
Raddison Lake

Miles
0 2

Date: 10/1/2015 Time: 4:18:13 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

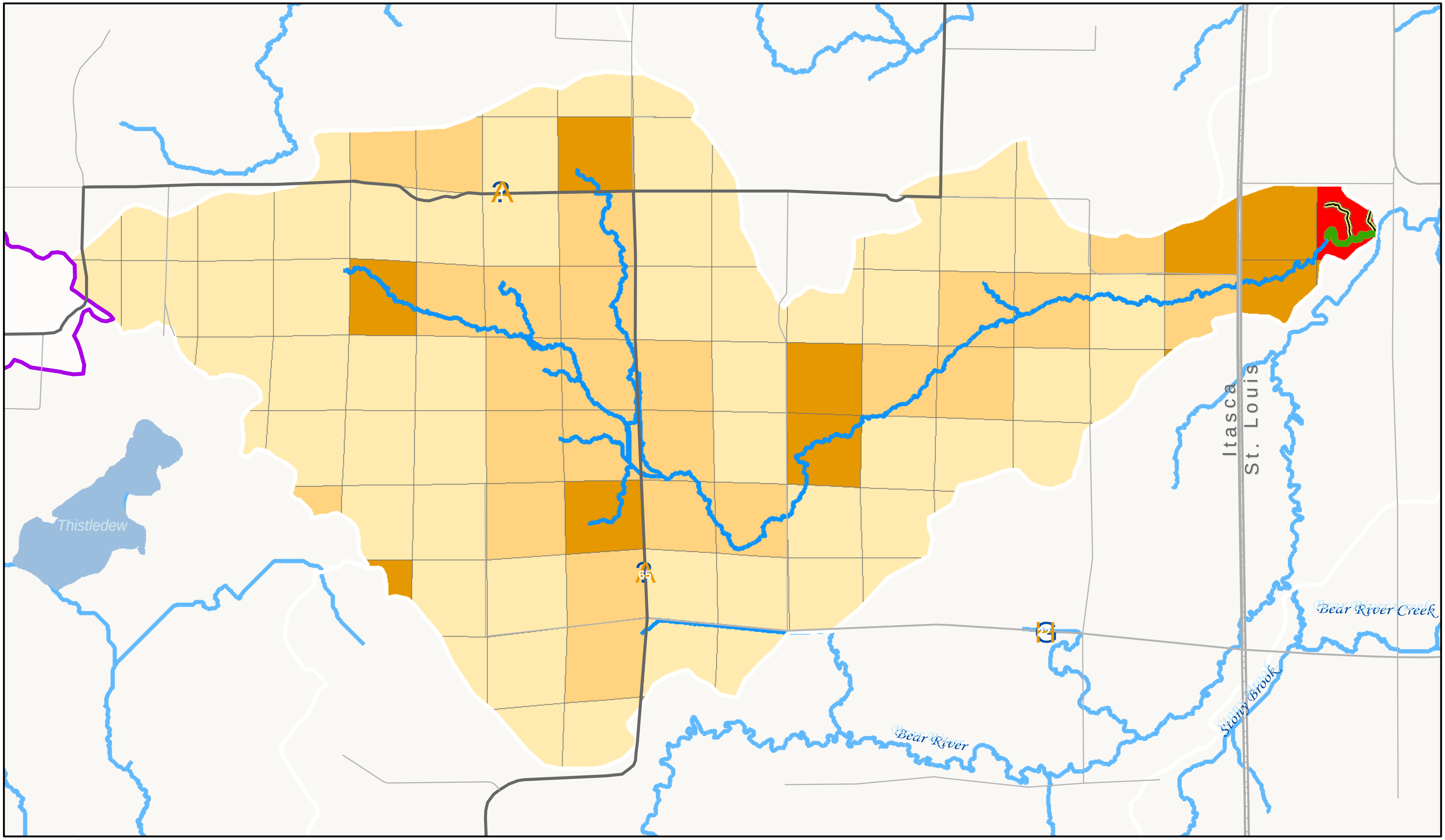
Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Thistledew Lake

Miles
0 2

Date: 10/1/2015 Time: 4:18:17 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

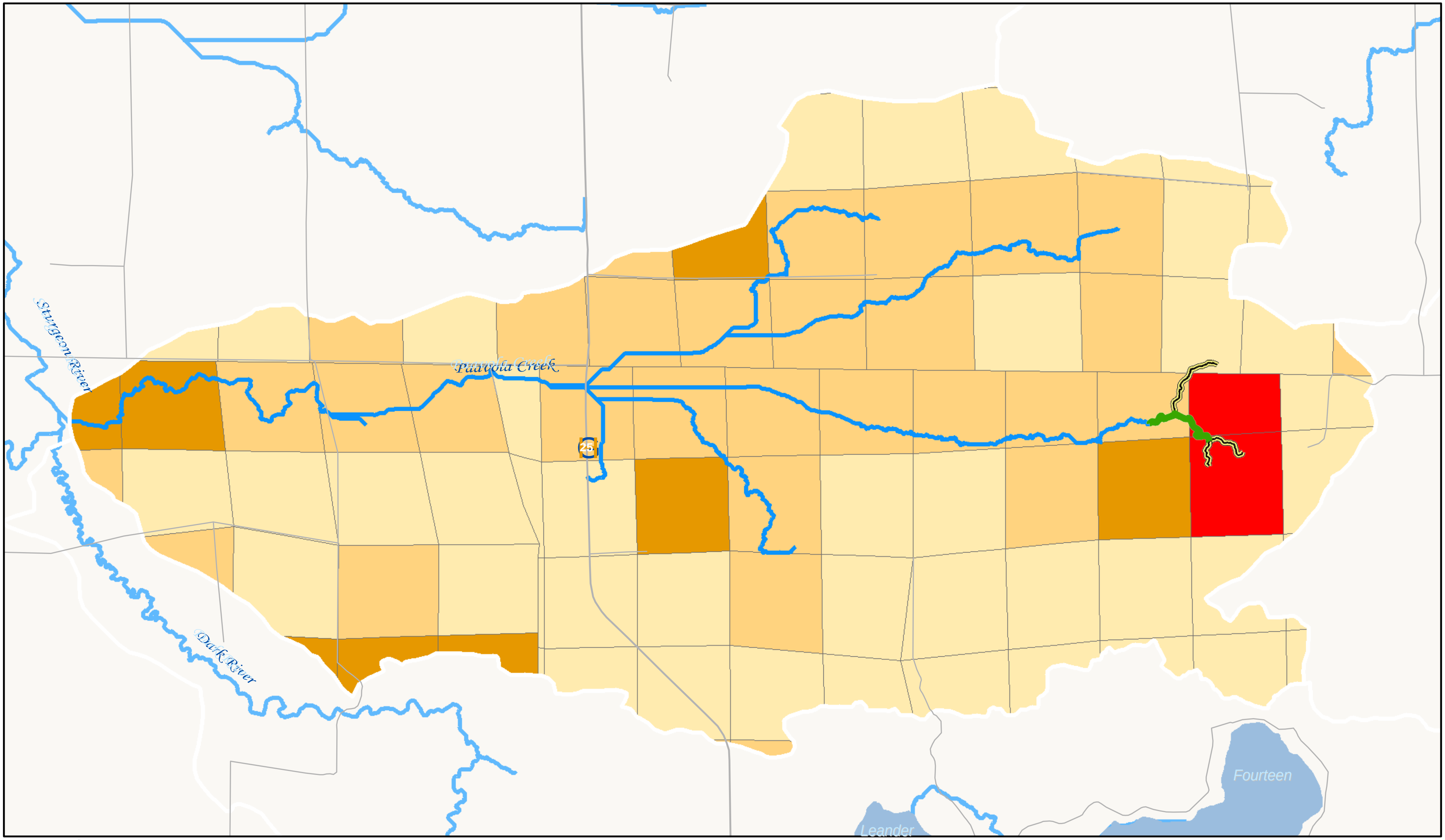
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
090300050205

Date: 10/1/2015 Time: 4:18:20 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



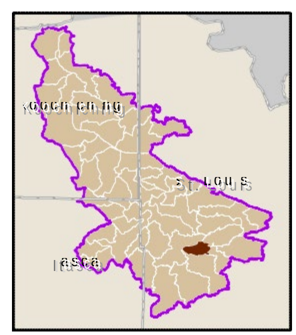
EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

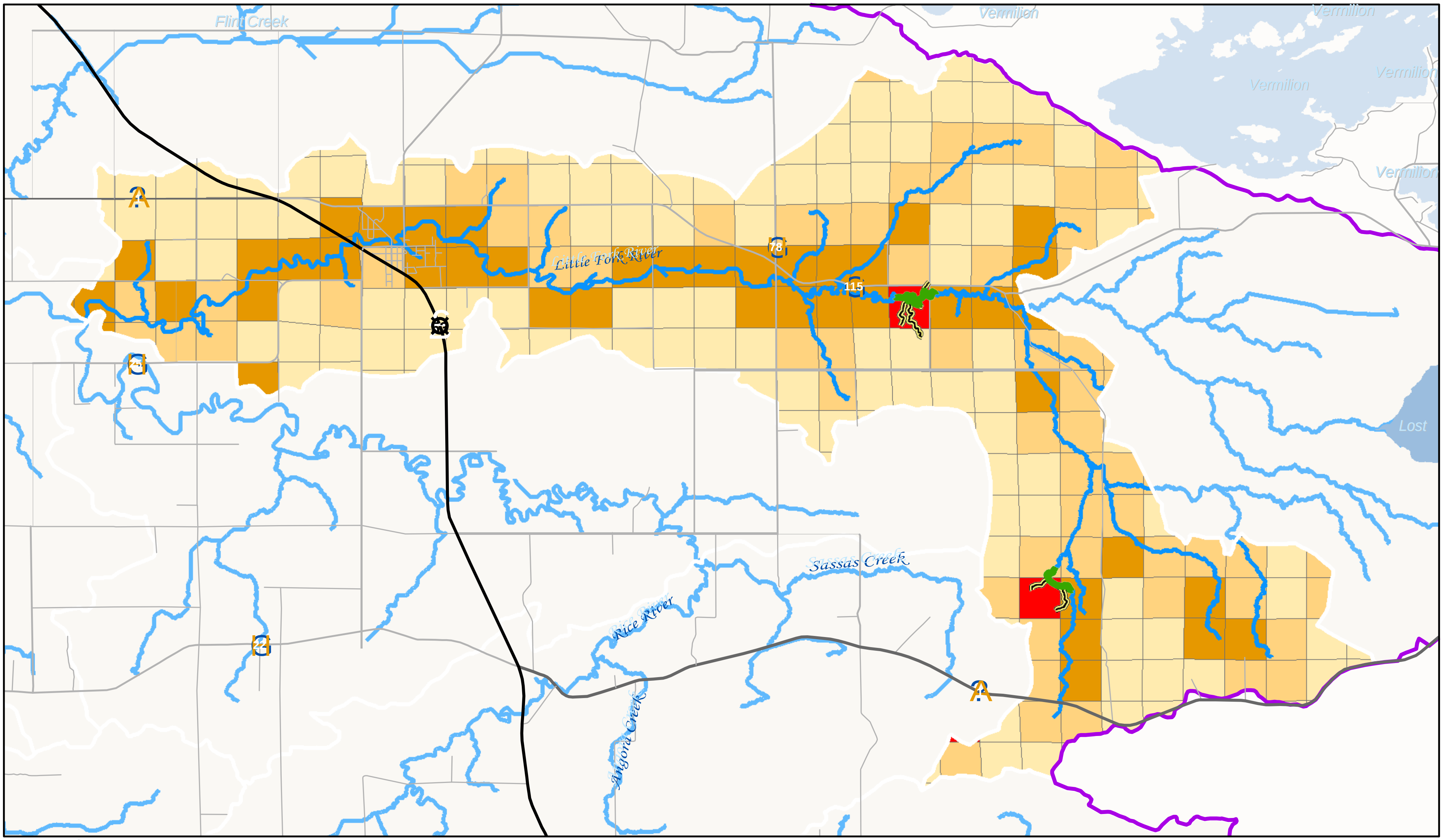
Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present



Little Fork WRAPS
BMP Siting Analysis
Paavola Creek

Date: 10/1/2015 Time: 4:18:24 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



water
ecology
community

Little Fork WRAPS
BMP Siting Analysis
City of Cook-Little Fork River

Legend

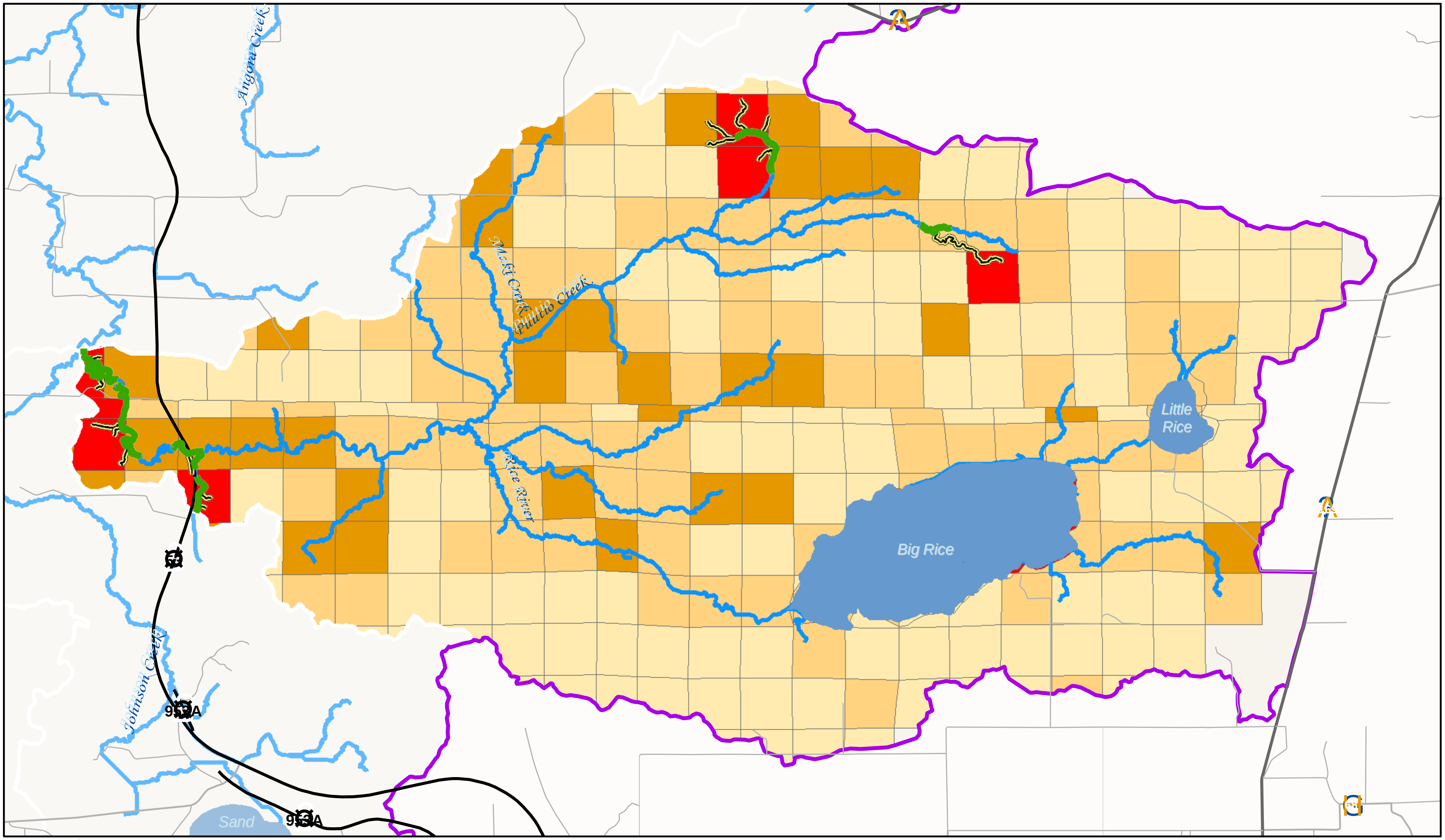
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Miles
0 2

Date: 10/1/2015 Time: 4:18:29 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



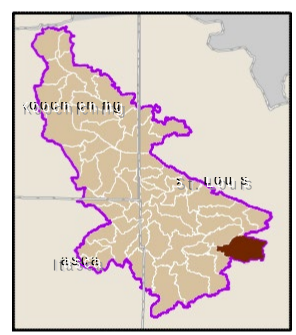
EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

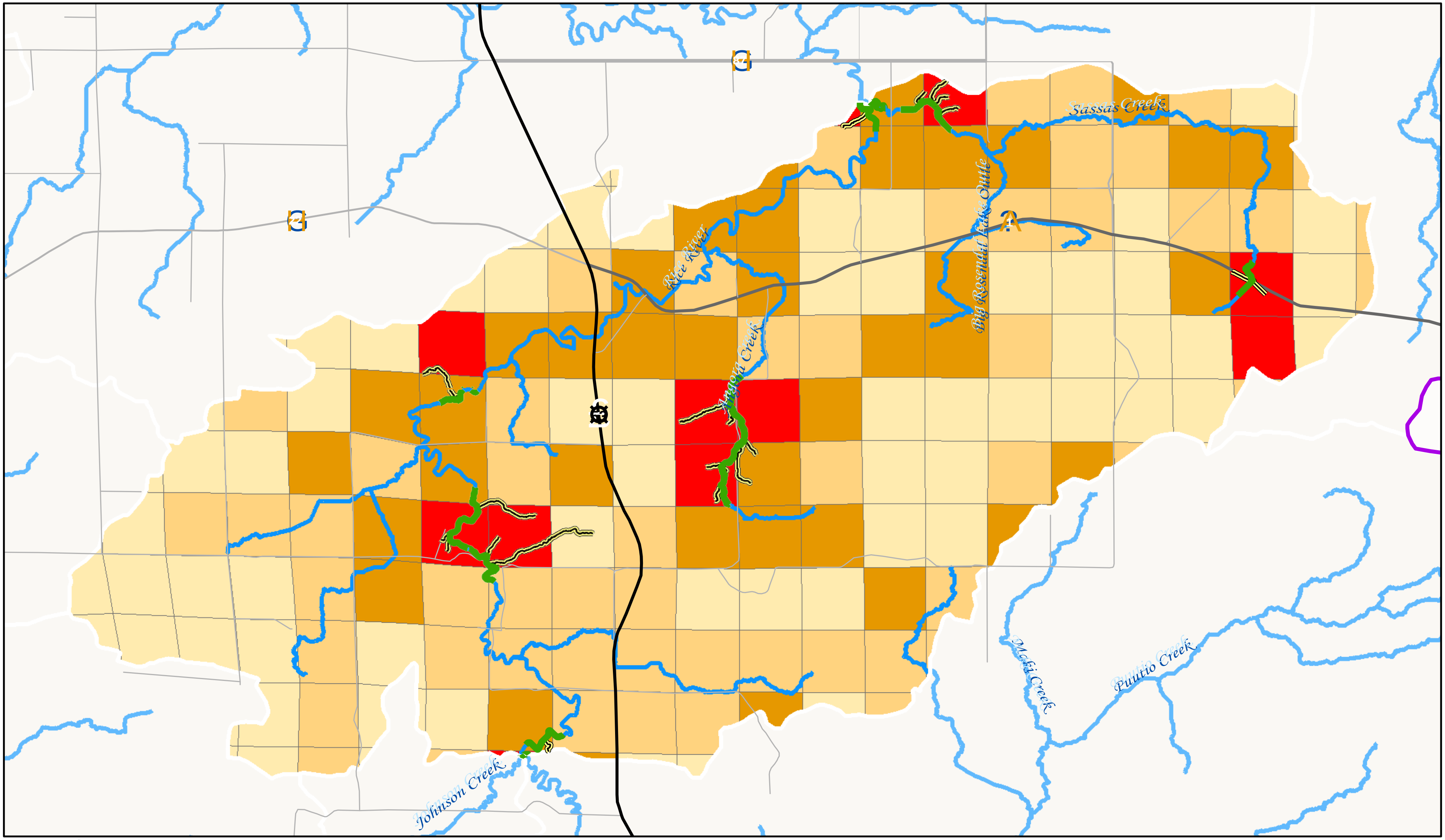
- Critical
- VeryHigh
- High
- Present



Little Fork WRAPS
BMP Siting Analysis
Upper Rice River

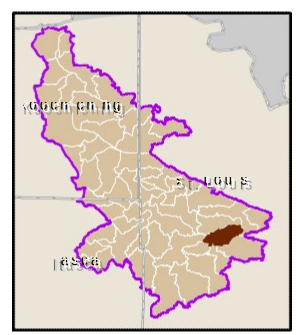
Miles
0 2

Date: 10/1/2015 Time: 4:18:34 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



water
ecology
community

Little Fork WRAPS
BMP Siting Analysis
Middle Rice River



Legend

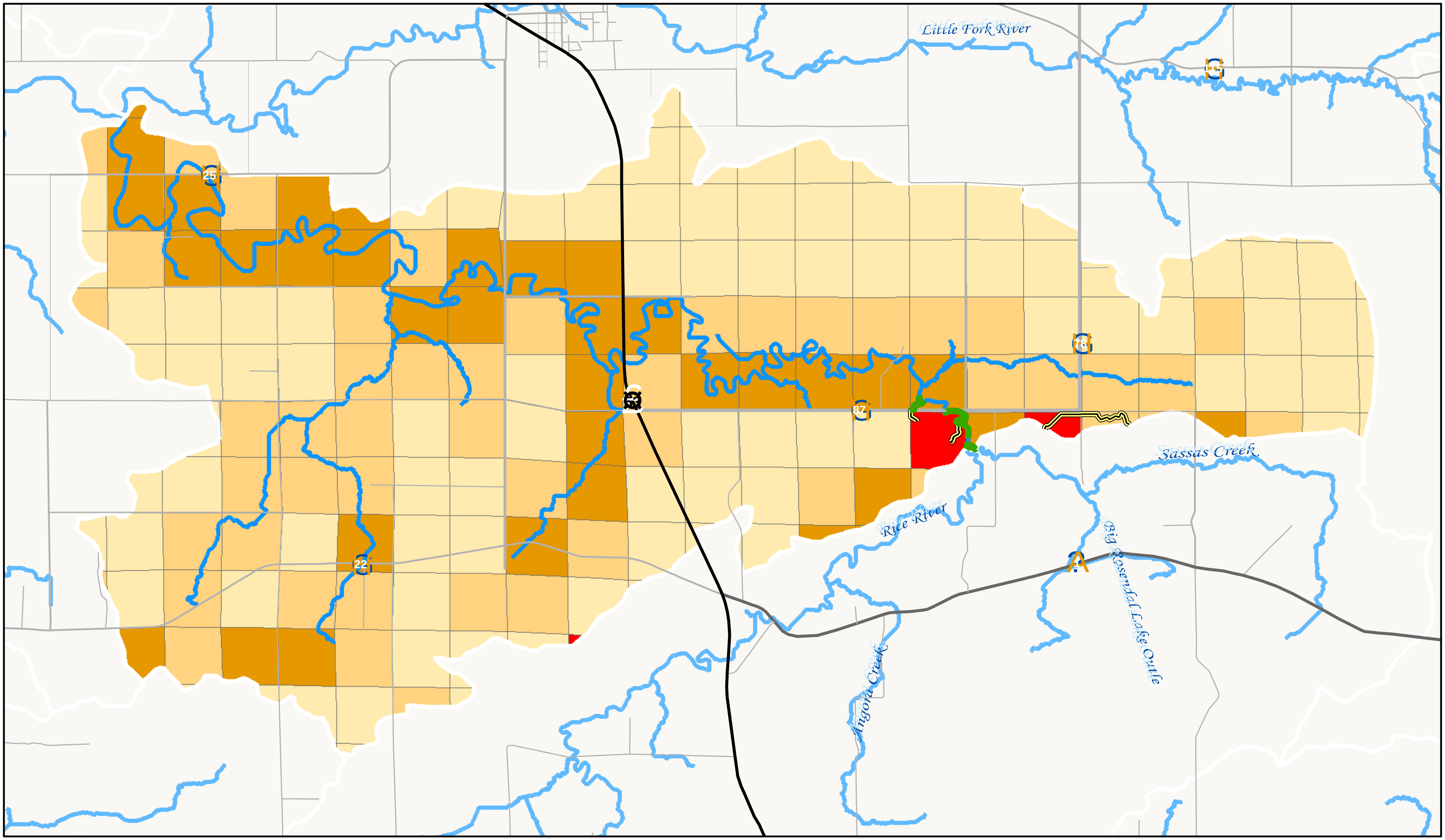
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Miles
0 2

Date: 10/1/2015 Time: 4:18:38 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



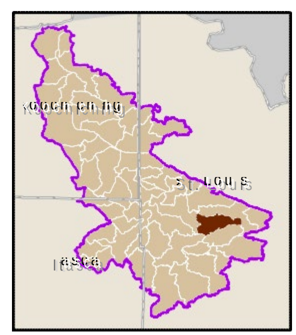
EOR
water
ecology
community

Legend

Potential Riparian Buffers (Critical)
Potential Grassed Waterways (Critical)
Flow Network

Quarter-section Runoff Risk

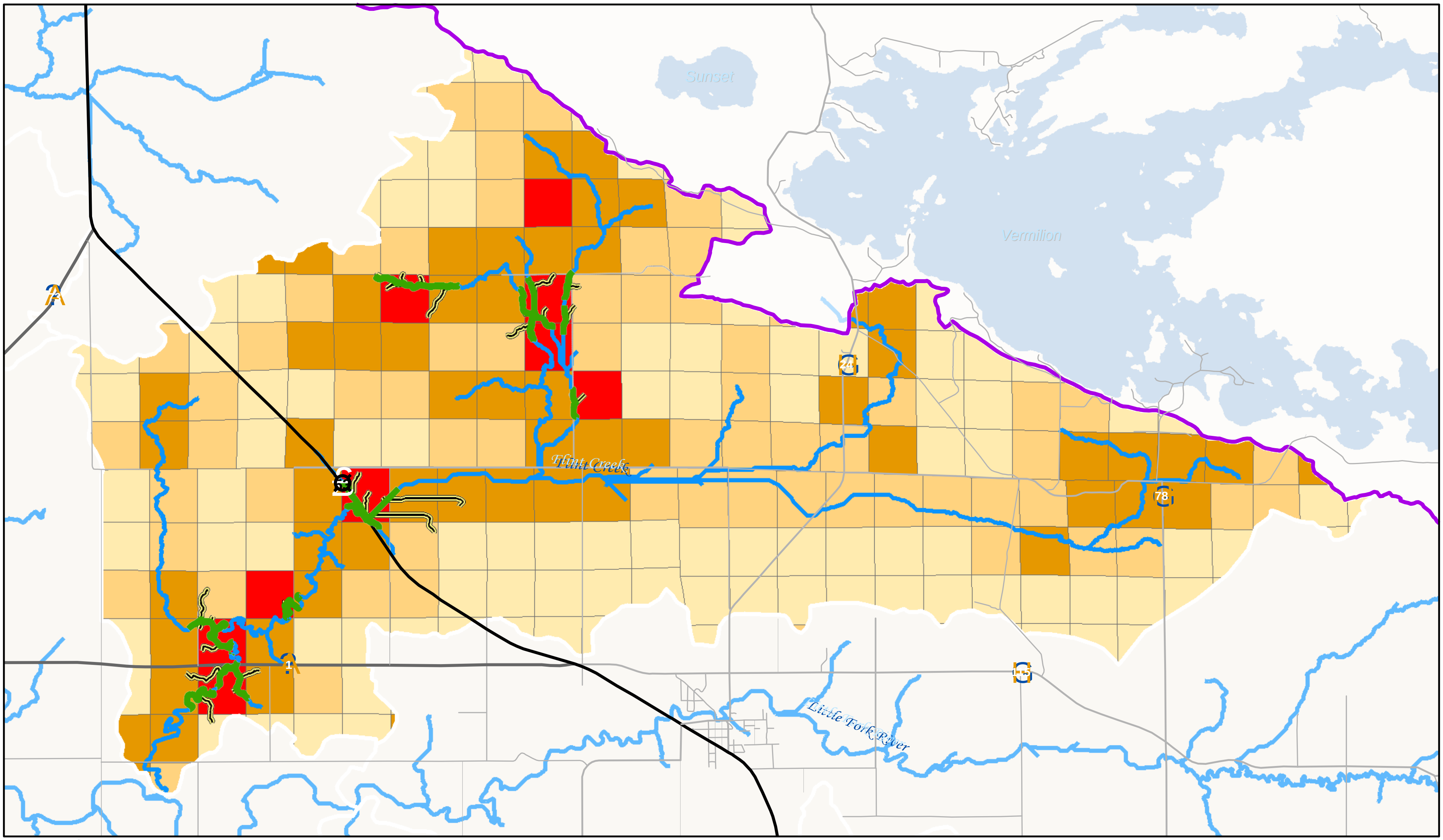
Critical
VeryHigh
High
Present



Little Fork WRAPS
BMP Siting Analysis
Lower Rice River

Miles
0 2

Date: 10/1/2015 Time: 4:18:43 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_L_revised.mxd



EOR
water
ecology
community

Legend

Potential Riparian Buffers (Critical)
Potential Grassed Waterways (Critical)
Flow Network

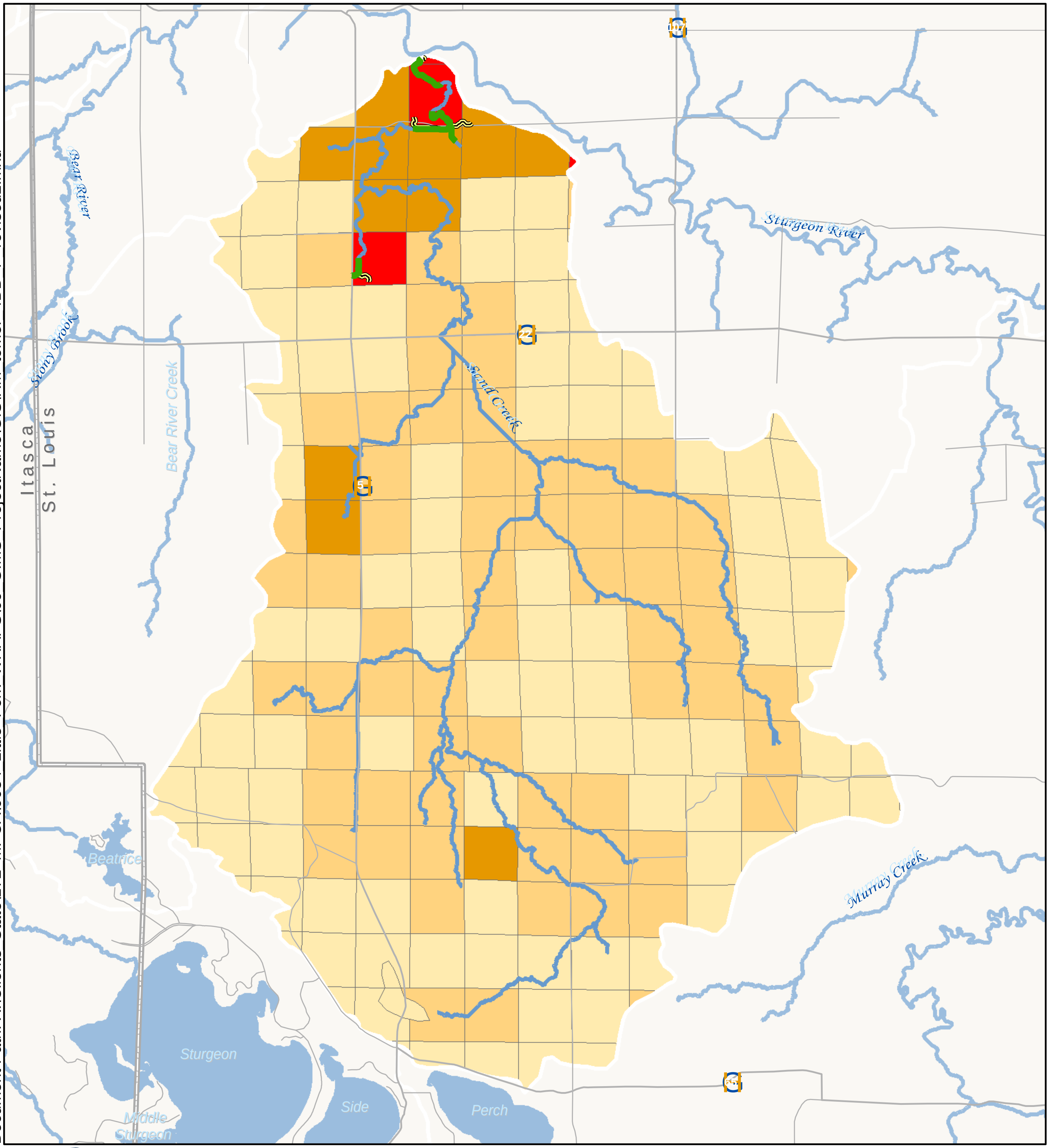
Quarter-section Runoff Risk

Critical
VeryHigh
High
Present

Little Fork WRAPS
BMP Siting Analysis
Flint Creek

Miles
0 2

Date: 10/1/2015 Time: 4:15:32 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



Little Fork WRAPS
BMP Siting Analysis
Sand Creek

EOR
water
ecology
community

Legend

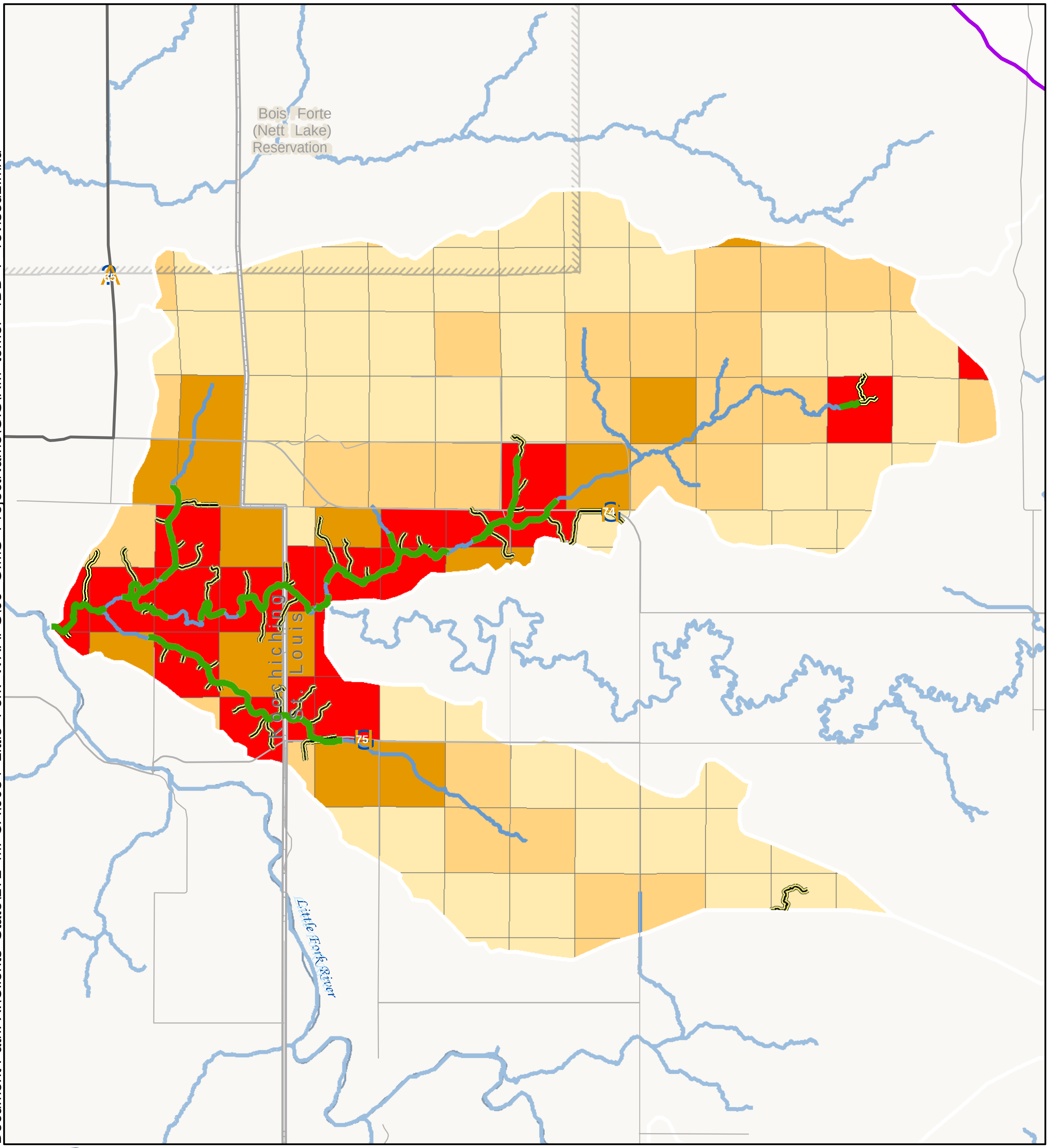
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Miles
0 2

Date: 10/1/2015 Time: 4:15:37 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_P_revised2.mxd



Little Fork WRAPS

BMP Siting Analysis

Lower Willow River

EOR water ecology community

Legend

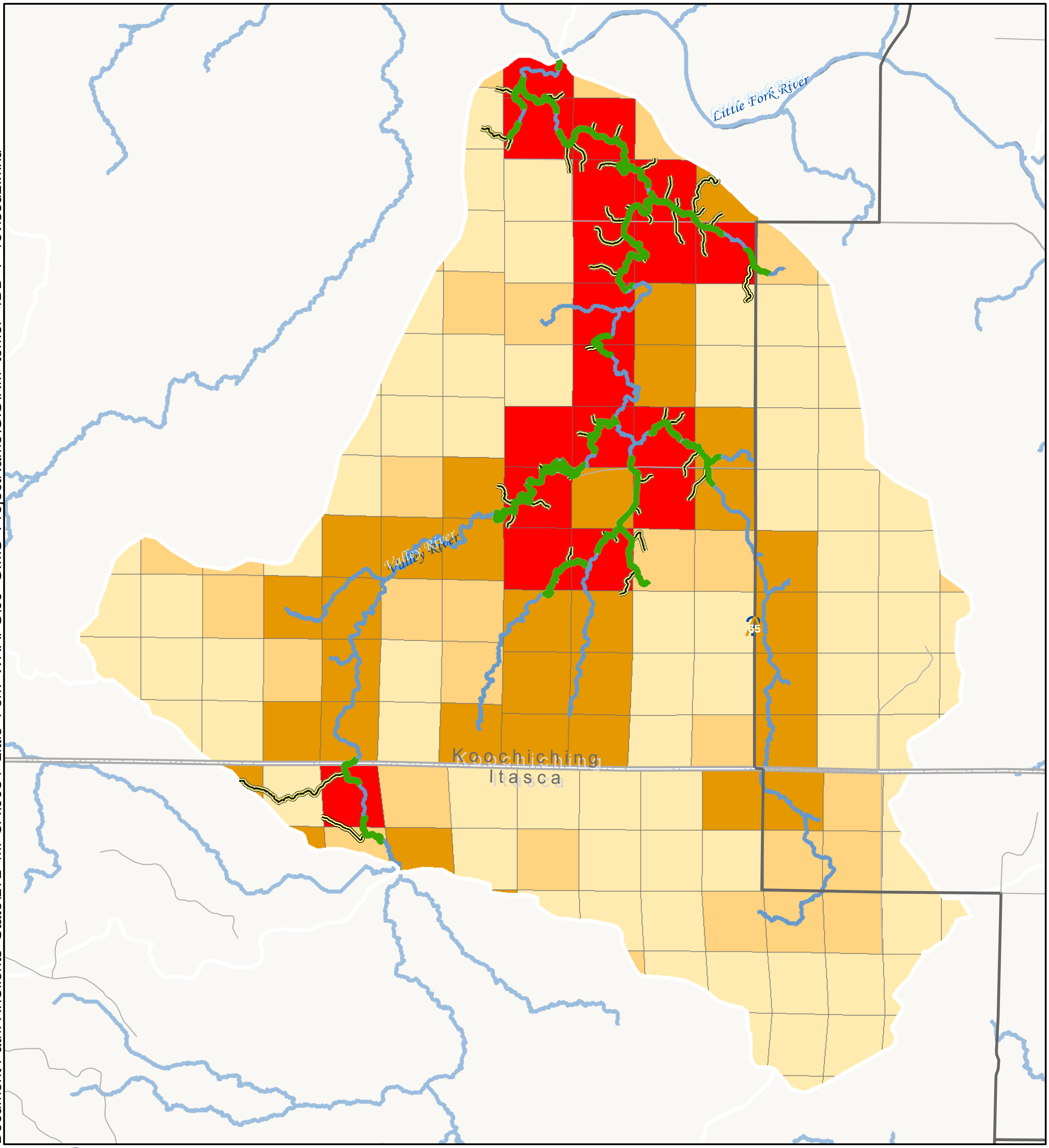
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Miles

0 2



Date: 10/1/2015 Time: 4:15:41 PM Author: ejensen

Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd

EOR

water

ecology

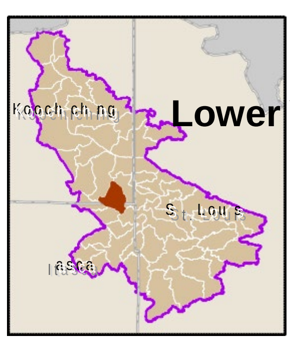
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present



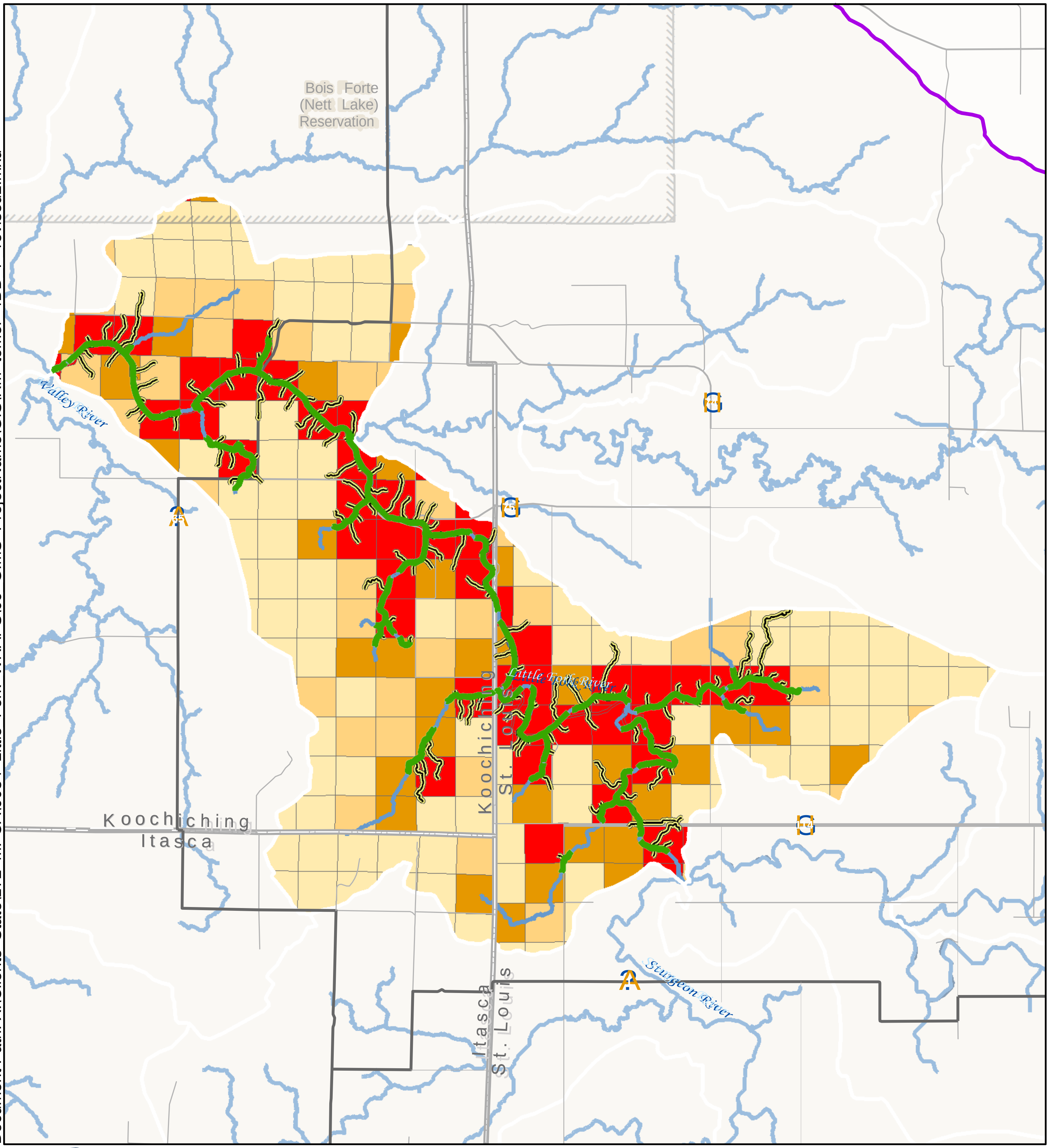
Little Fork WRAPS

BMP Siting Analysis

Lower Valley River

Miles

0 2



Date: 10/1/2015 Time: 4:15:46 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd

EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS

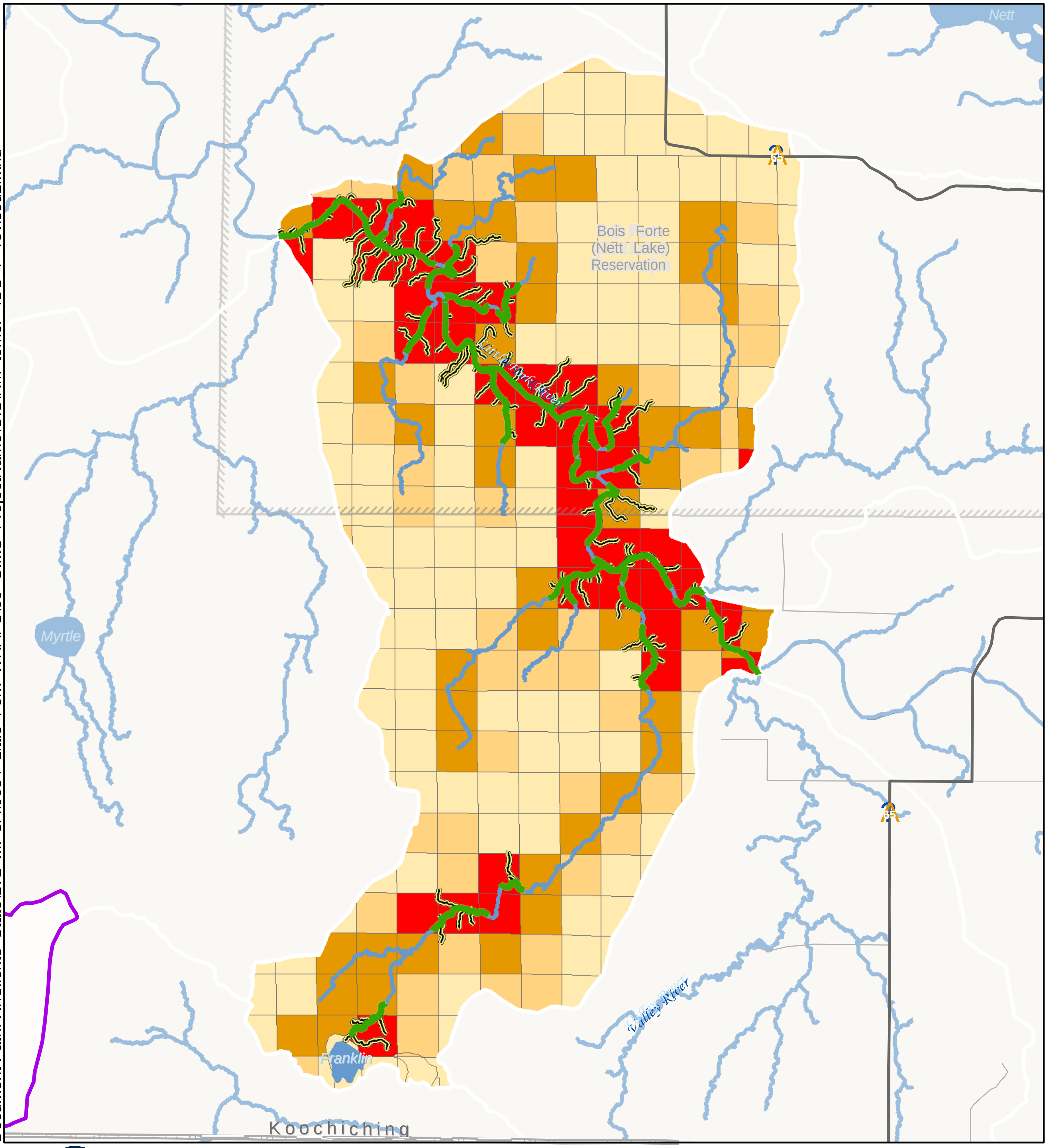
BMP Siting Analysis

Town of Silverdale-Little Fork River

Miles
0 2

Date: 10/1/2015 Time: 4:15:51 PM Author: ejensen

Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

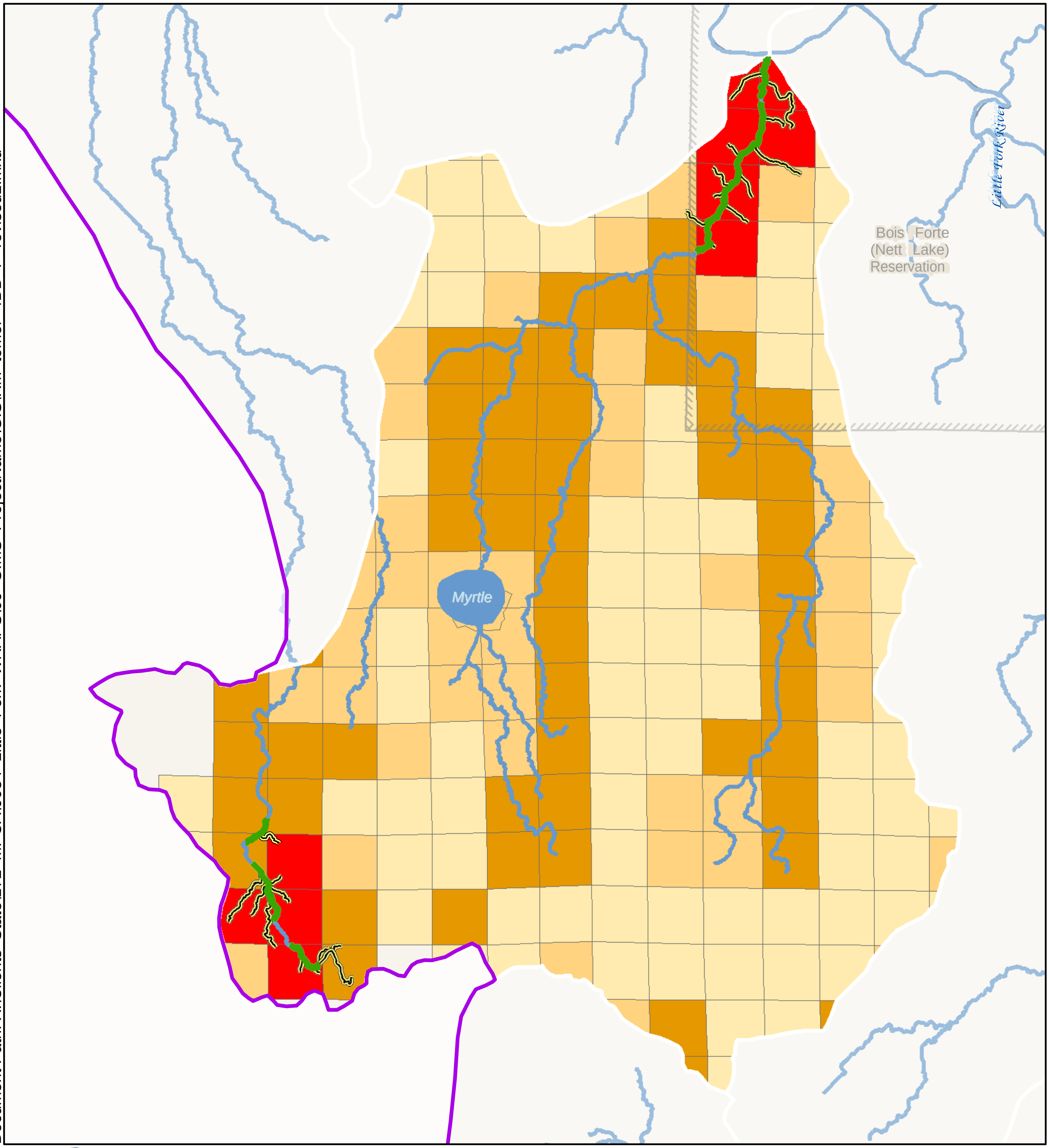
Little Fork WRAPS

BMP Siting Analysis

Franklin Lake-Little Fork River

Miles

0 2



Little Fork WRAPS
BMP Siting Analysis
Gardener Brook

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

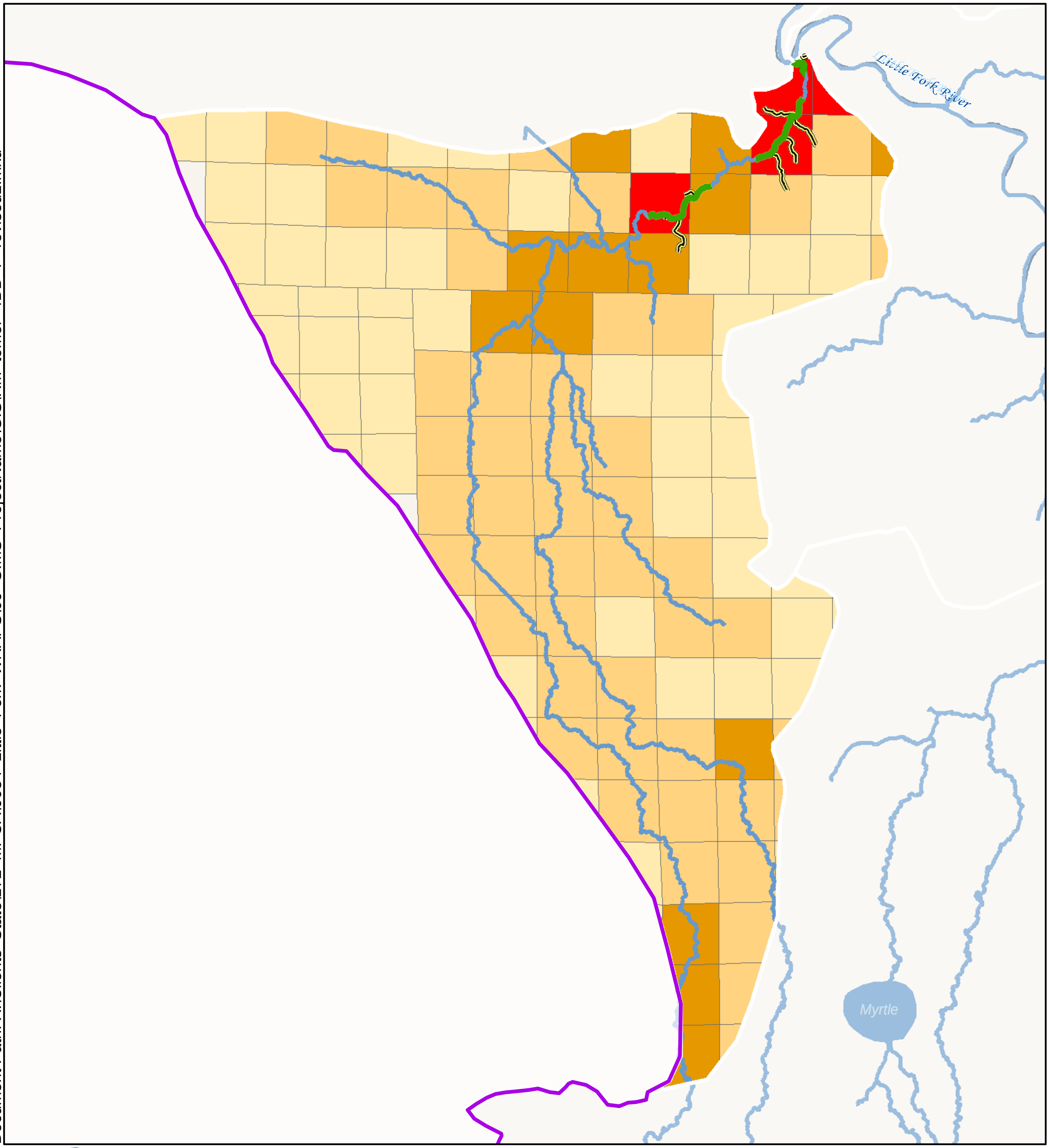
Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Miles
0 2

water
ecology
community

Date: 10/1/2015 Time: 4:15:55 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



Date: 10/1/2015 Time: 4:15:59 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_P_revised2.mxd

EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

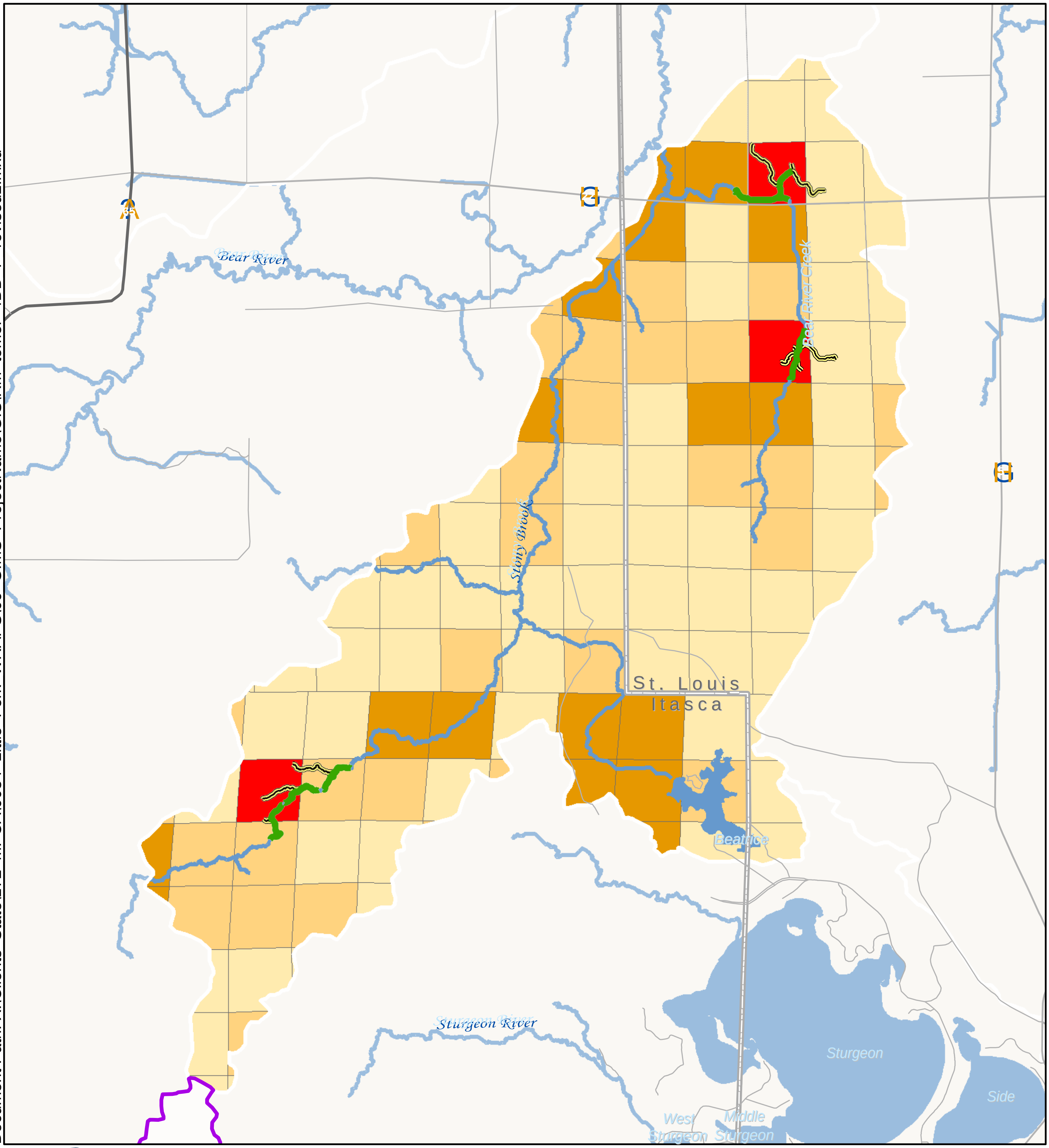
Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Rapid River

Miles
0 2

Date: 10/1/2015 Time: 4:16:04 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

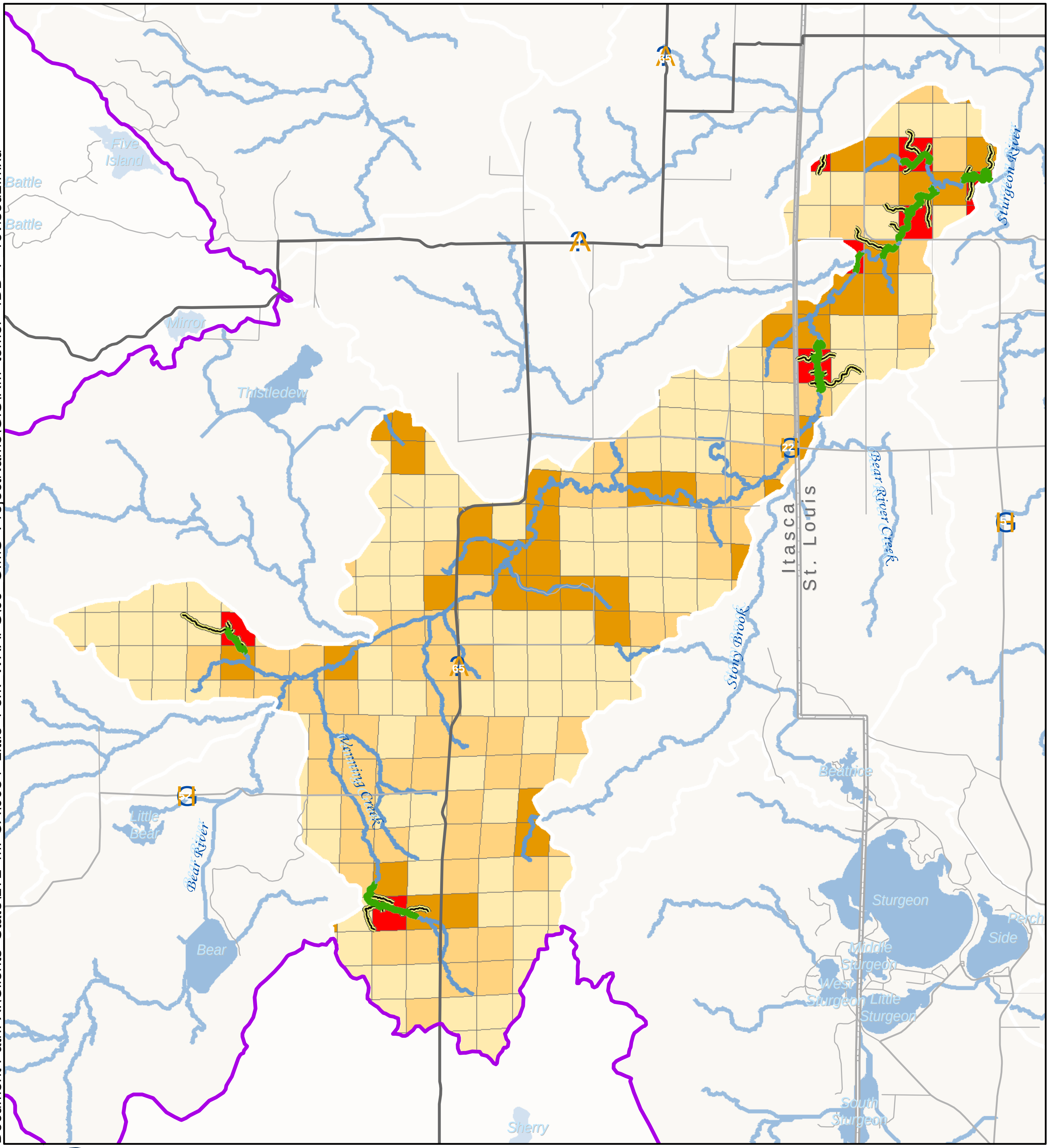
Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Stony Brook

Miles
0 2

Date: 10/1/2015 Time: 4:16:09 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_P_revised2.mxd



EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

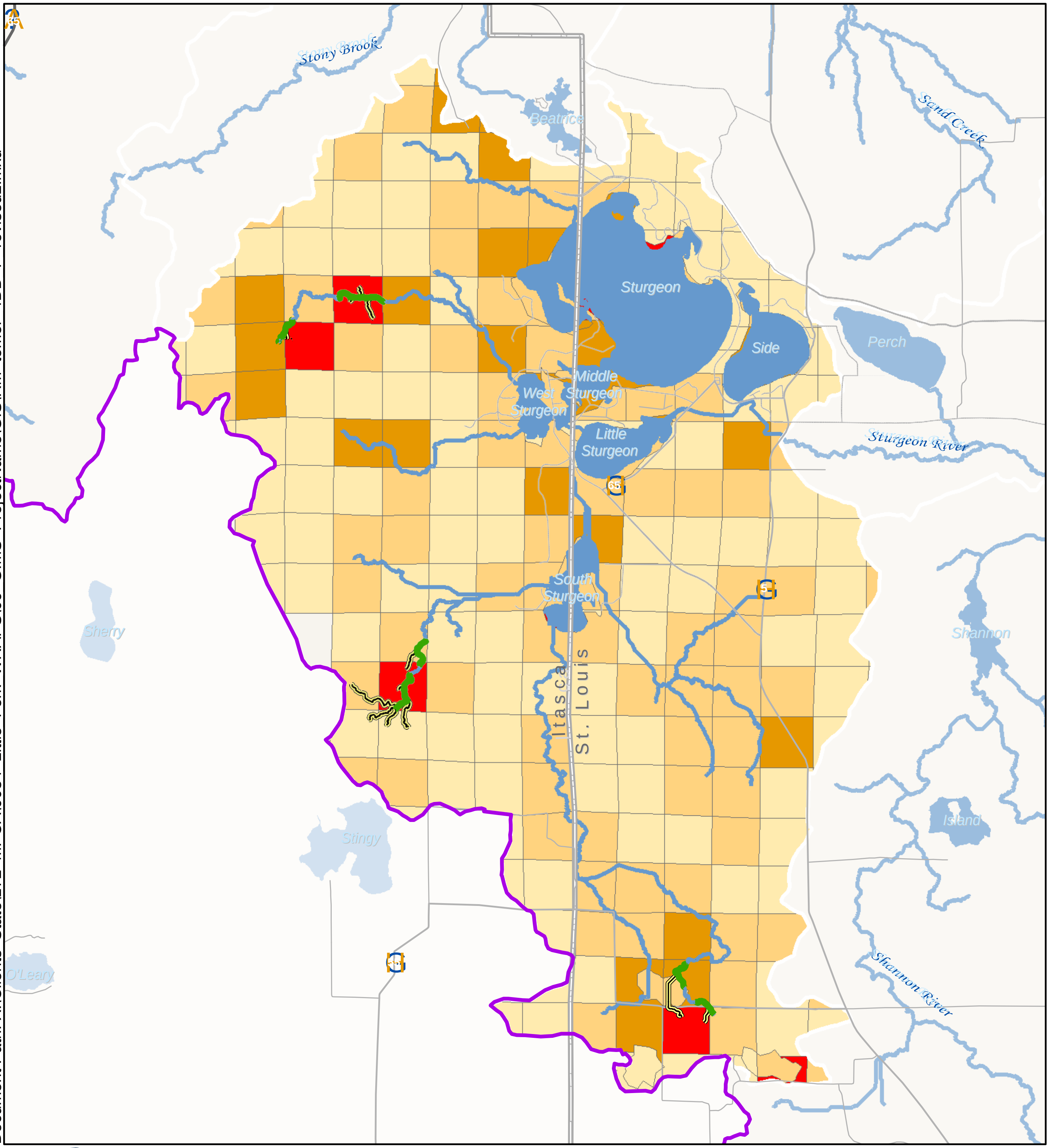
Little Fork WRAPS

BMP Siting Analysis

Bear River

Miles
0 2 4

Date: 10/1/2015 Time: 4:16:14 PM Author: ejensen
Document Path: X:\Clients_State\172_MPCA\0084_Little_Fork_WRAPS\09_GIMS_ProjectName\GIS\RM_tomer_4DD_P_revised2.mxd



EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

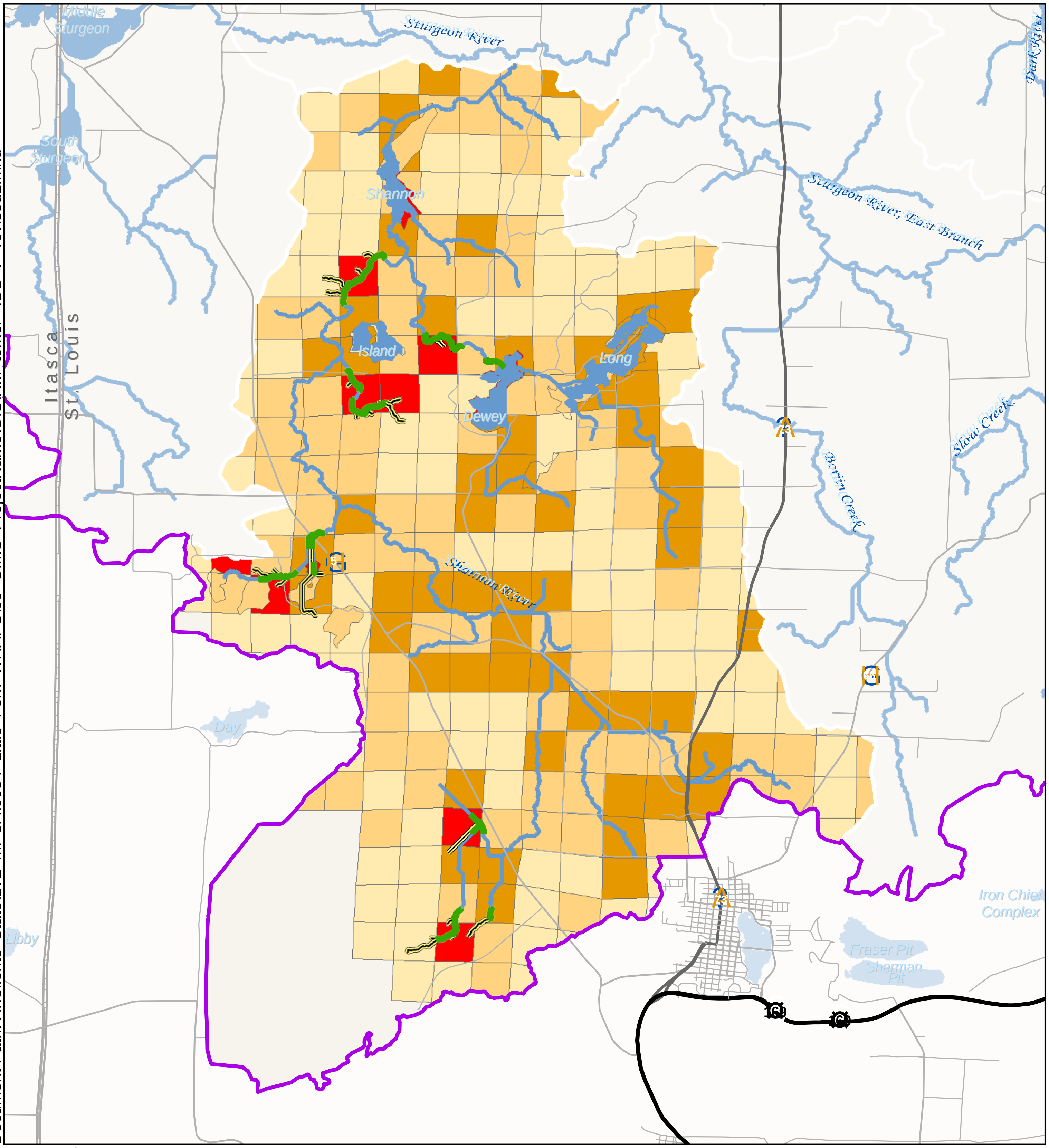
Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Sturgeon Lake

Miles
0 2

Date: 10/1/2015   Time: 4:16:20 PM   Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



EOR water ecology community

Legend

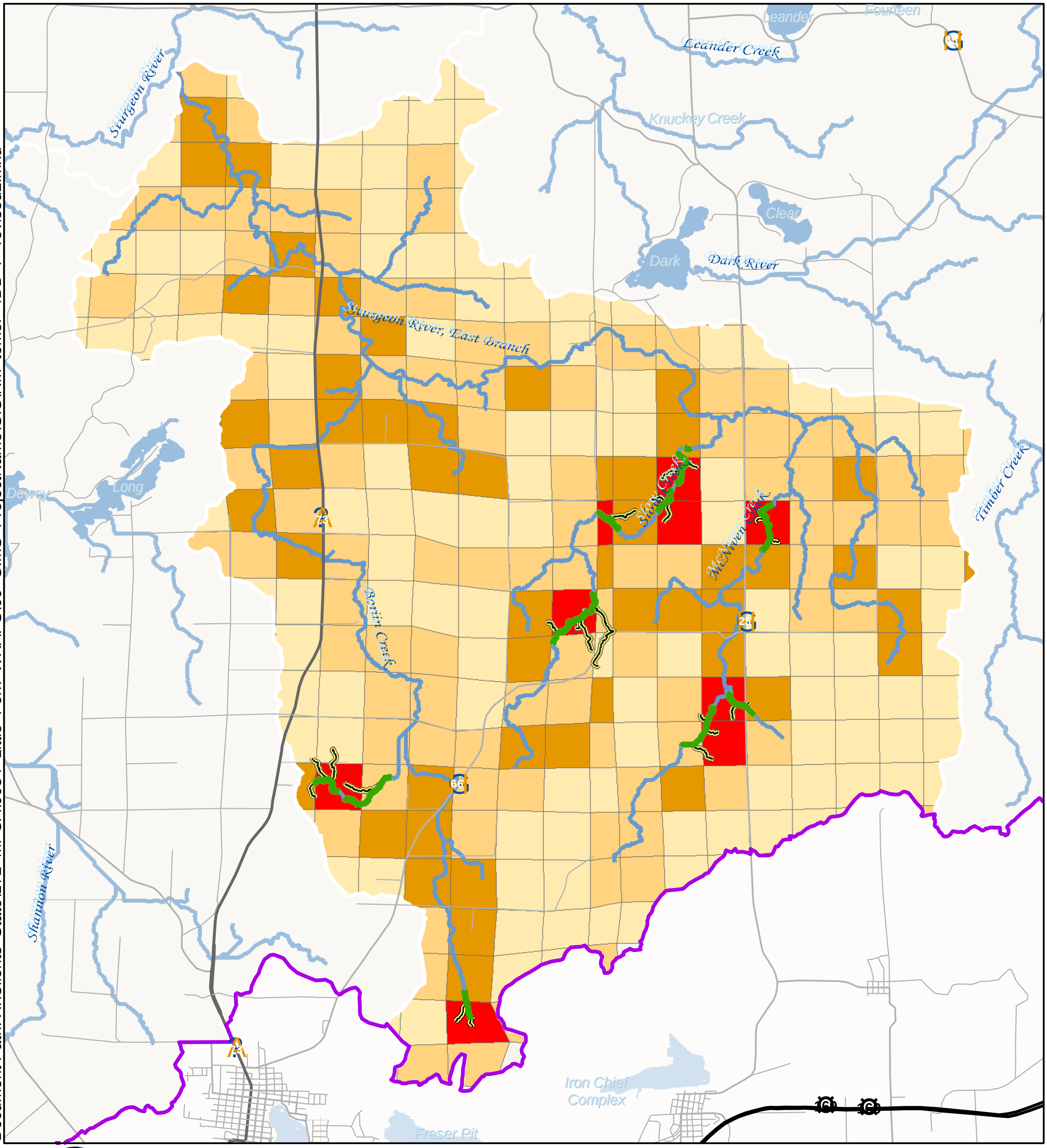
- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Shannon River

Miles
0 2



Date: 10/1/2015 Time: 4:16:25 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd

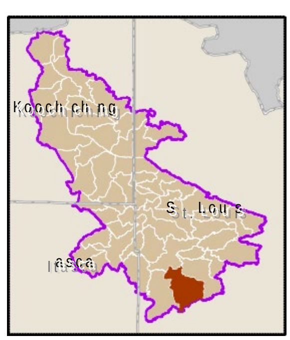
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

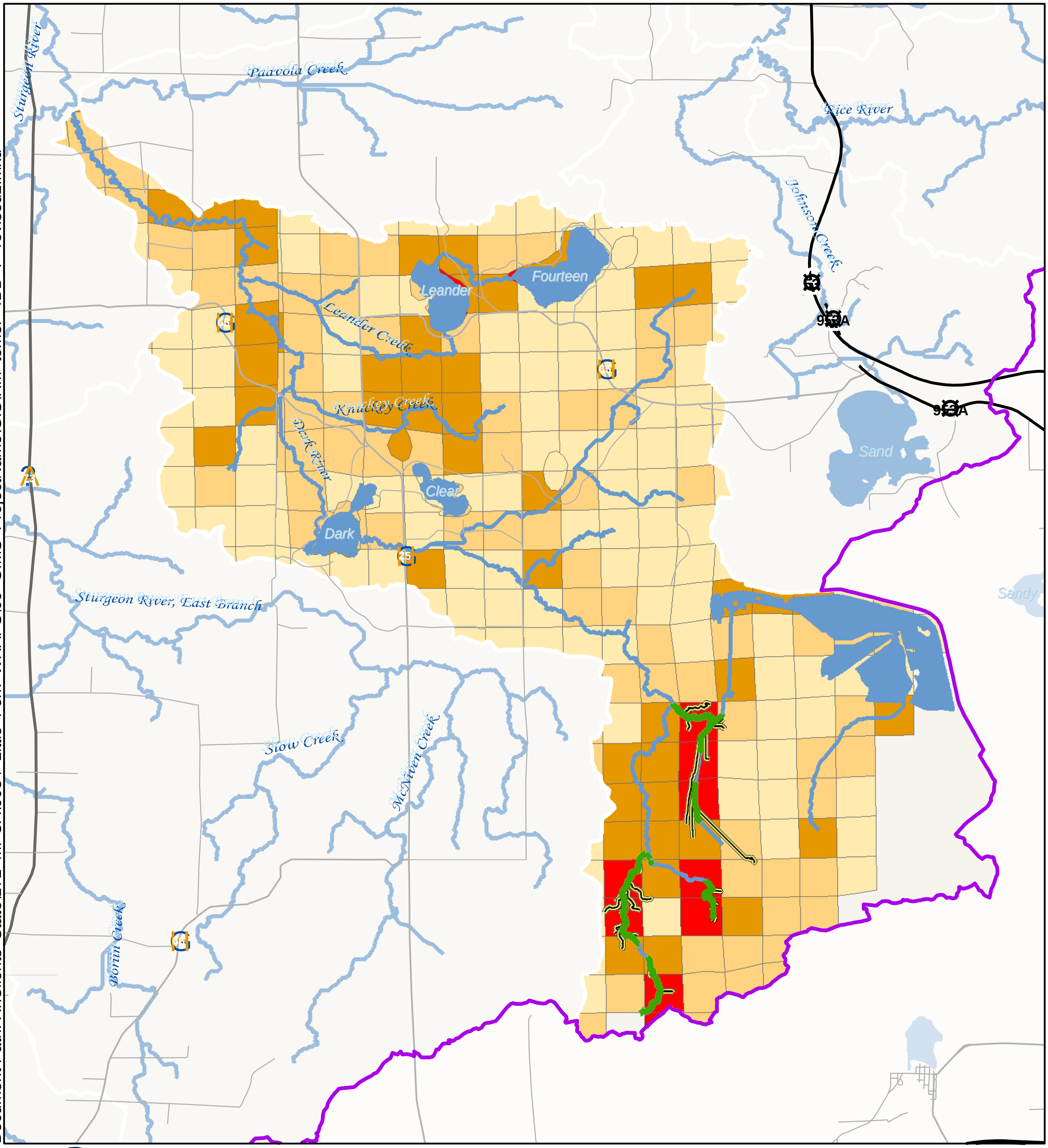


Little Fork WRAPS

BMP Siting Analysis

East Branch Sturgeon River

Miles
0 2



Date: 10/1/2015 Time: 4:16:32 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd

EOR water ecology community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

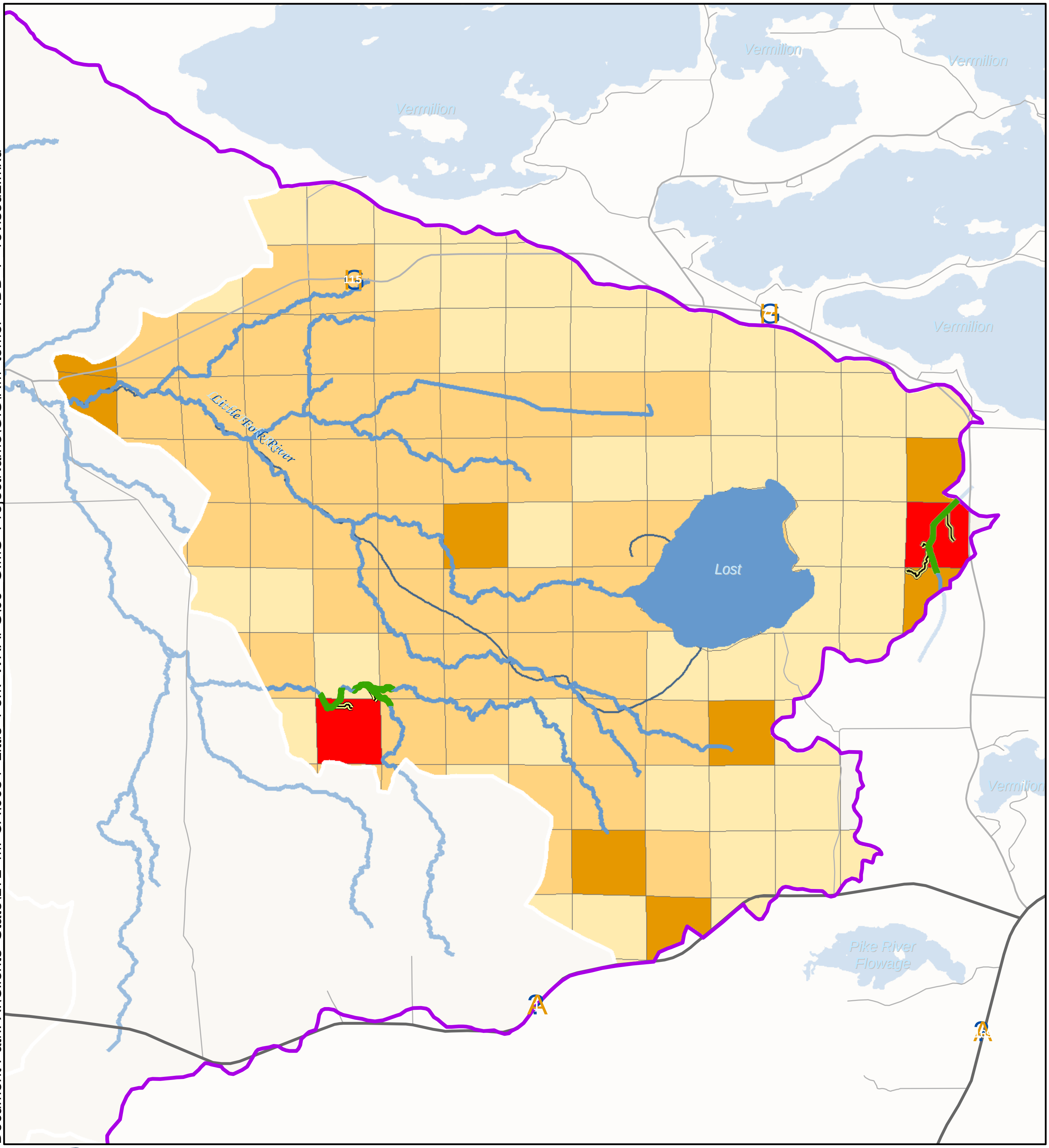
Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Dark River

Miles
0 2

Date: 10/1/2015 Time: 4:16:37 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



EOR
water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

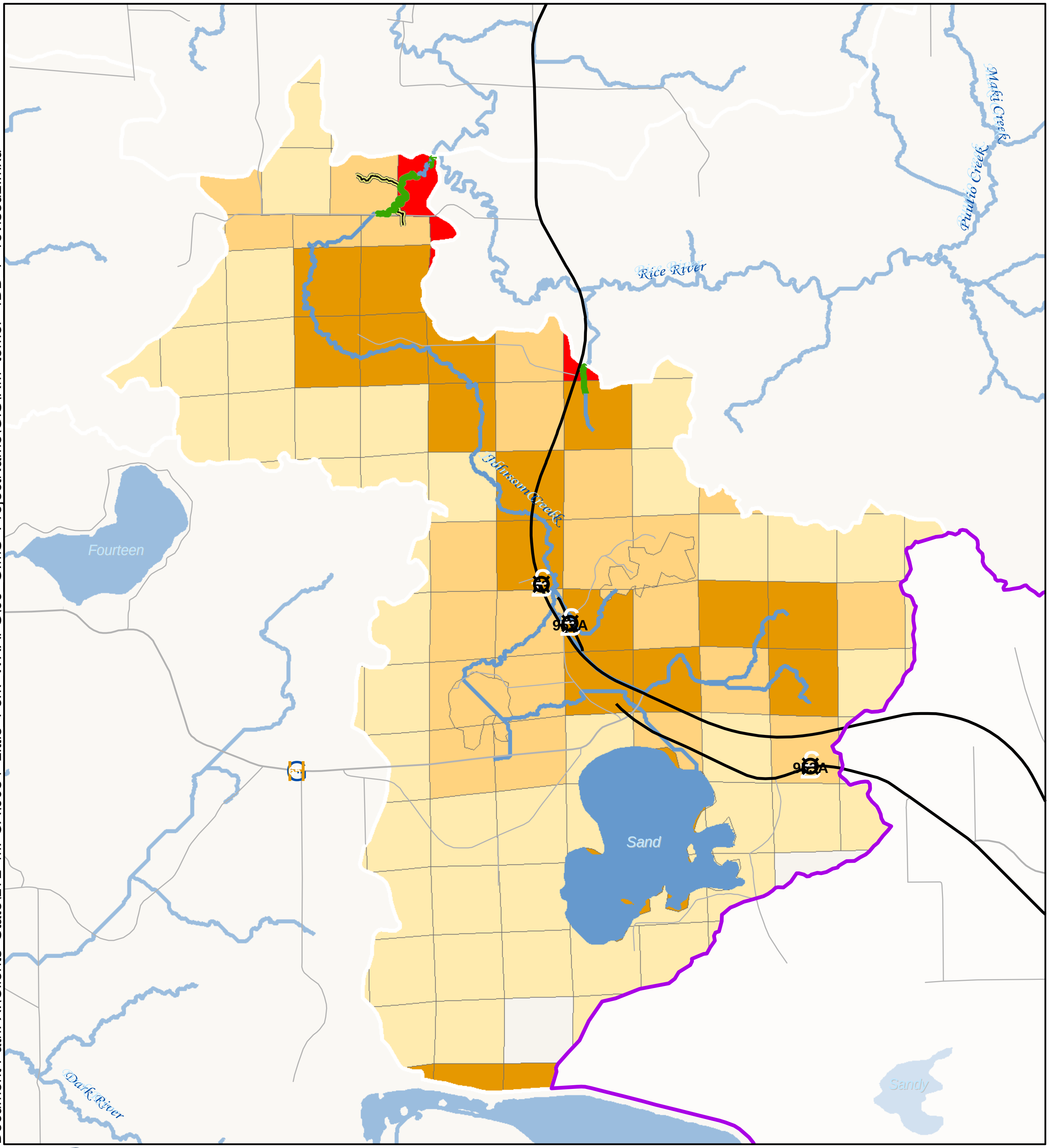
- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS

BMP Siting Analysis

Headwaters Little Fork River

Miles
0 2



water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

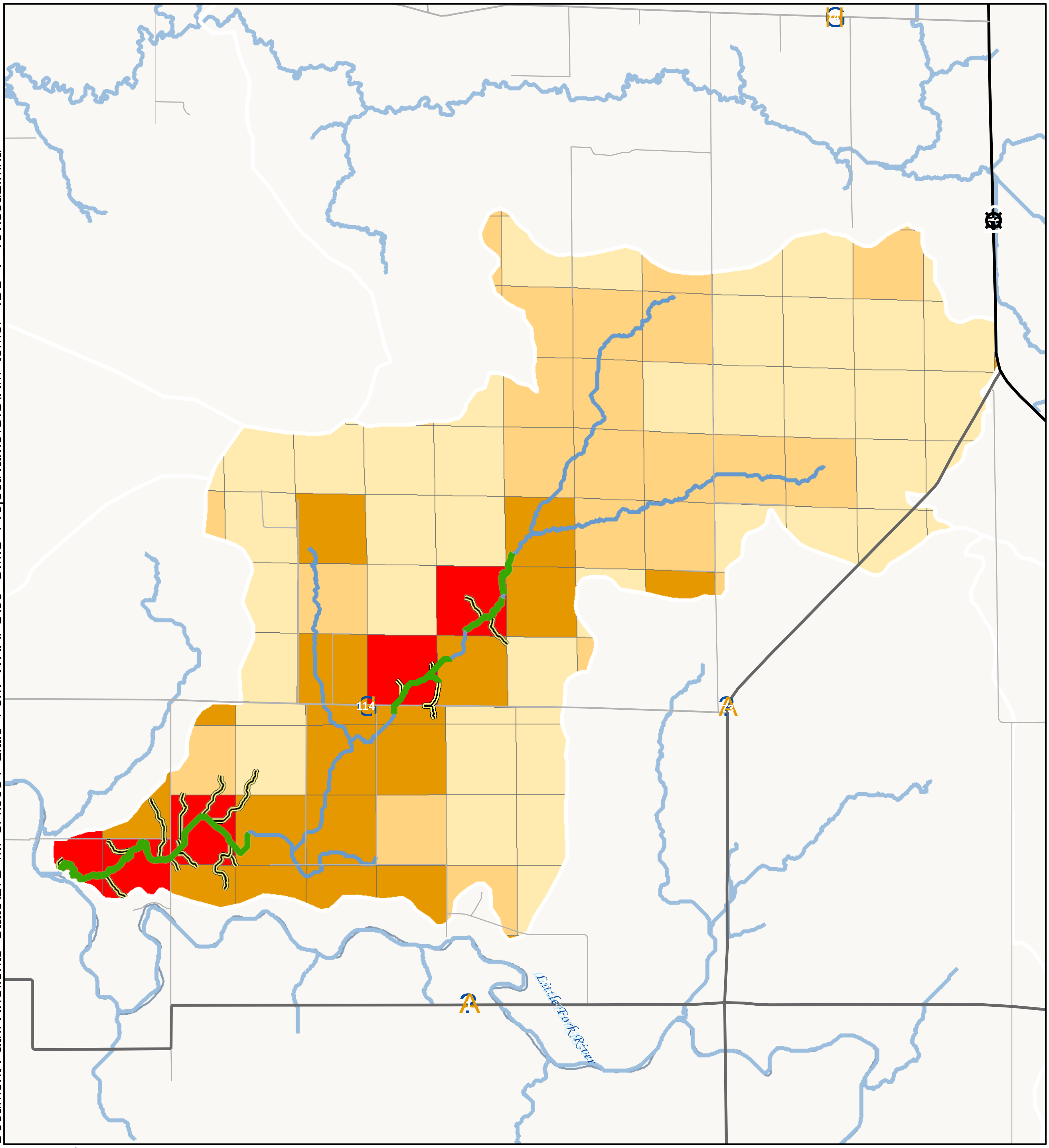
Little Fork WRAPS

BMP Siting Analysis

Johnson Creek

Miles
0 2

Date: 10/1/2015 Time: 4:16:49 PM Author: ejensen
Document Path: X:\Clients State\172 MPCA\0084 Little Fork WRAPS\09 GIMS ProjectName\GIS\RM tomer 4DD P revised2.mxd



water
ecology
community

Legend

- Potential Riparian Buffers (Critical)
- Potential Grassed Waterways (Critical)
- Flow Network

Quarter-Section Runoff Risk

- Critical
- VeryHigh
- High
- Present

Little Fork WRAPS
BMP Siting Analysis
Beaver Creek

Miles
2