

# North Fork Crow Watershed (07010204)

## Watershed Restoration and Protection Strategy Report

December 2014



## Table of Contents

|  |           |
|--|-----------|
| <i>Key Terms</i> .....   | 3         |
| <i>What is the WRAPS Report?</i> .....   | 4         |
| <b>1. Watershed Background &amp; Description</b> .....                                     | <b>5</b>  |
| <b>2. Watershed Conditions</b> .....   | <b>6</b>  |
| 2.1 <i>Condition Status</i> .....  | 7         |
| 2.2 <i>Water Quality Trends</i> .....  | 17        |
| 2.3 <i>Stressors and Sources</i> .....   | 17        |
| 2.4 <i>TMDL Summary</i> .....  | 27        |
| 2.5 <i>Protection Considerations</i> .....   | 32        |
| <b>3. Prioritizing and Implementing Restoration and Protection</b> .....                   | <b>34</b> |
| 3.1 <i>Targeting of Geographic Areas</i> .....   | 35        |
| 3.2 <i>Civic Engagement</i> .....  | 49        |
| 3.3 <i>Restoration &amp; Protection Strategies</i> .....                                   | 50        |
| <b>4. Monitoring Plan</b> .....  | <b>63</b> |
| <b>5. References and Further Information</b> .....   | <b>68</b> |
| <b>Appendix A: North Fork Crow Priority Shallow Lakes</b> .....                            | <b>69</b> |
| <b>Appendix B: DNR Watershed Conditions Report - North Fork Crow River Watershed</b> ..... | <b>70</b> |
| <b>Appendix C: North Fork Crow Lake Prioritization</b> .....                               | <b>99</b> |

The science and analysis described in this report began before the passage of the 2013 Clean Water Accountability Act. Thus, this report may not address all elements of the Clean Water Accountability Act. When this watershed is revisited (according to the 10-year cycle), the information will be updated according to the required elements of a Watershed Restoration and Protection Strategy (WRAPS) Report. This document is only the WRAPS report. It summarizes and references, but does not contain the Total Maximum Daily Load documents.

## 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 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 Mississippi River Basin is assigned a HUC-4 of 0701. The North Fork Crow River Watershed is assigned a HUC-8 of 07010204. There are 43 HUC -12 watersheds within the NFC HUC-8.

**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.

**Subwatershed:** Subwatersheds are referred to in the HSPF generated map discussion in this report. Subwatersheds are smaller than HUC-12s and were derived for use in the HSPF model based on available climatology data and land use. There are 134 subwatersheds within the NFC HUC-8.

**Total Maximum Daily Load (TMDL):** Calculations 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.

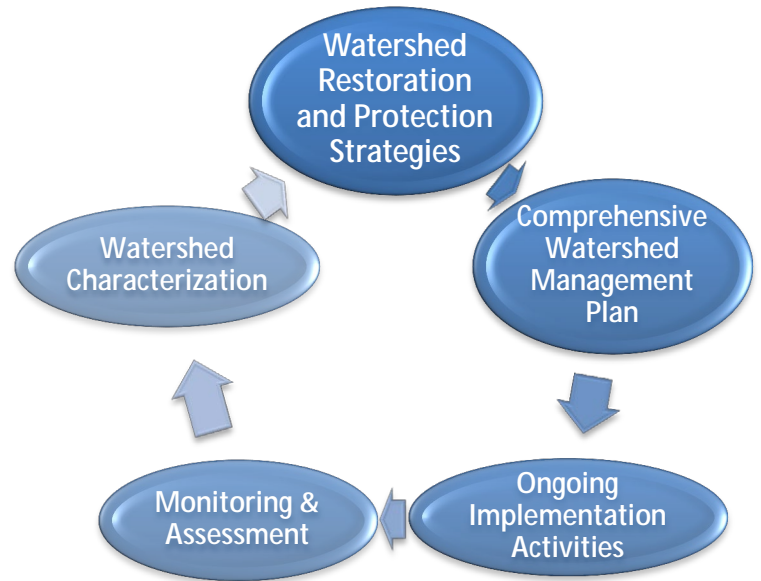
**Watershed Health Assessment Framework (WHAF):** A suite of watershed health index scores built on statewide GIS data have been calculated to represent many of the important ecological relationships for each of the 81 major watersheds.

# What is the WRAPS Report?

The State of Minnesota has adopted a “watershed approach” to address the state’s 81 “major” watersheds (denoted by 8-digit hydrologic unit code or HUC). This 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.

As part of the watershed approach, waters not meeting state standards are still listed as impaired and Total Maximum Daily Load (TMDL) studies are performed, as they have been in the past, but in addition the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health. A key aspect of this effort

is to develop and utilize watershed-scale models and other tools to help state agencies, local governments and other watershed stakeholders determine how to best proceed with restoring and protecting lakes and streams. This report summarizes past assessment, diagnostic and TMDL work and outlines ways to prioritize actions and strategies for continued implementation.



|                 |  |
|-----------------|--|
| <p>Purpose</p>  | <ul style="list-style-type: none"> <li>• Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning</li> <li>• Summarize Watershed Approach work done to date including the following reports:               <ul style="list-style-type: none"> <li>• North Fork Crow Watershed Monitoring and Assessment Report</li> <li>• Assessment of Selected Lakes within the North Fork Crow River Watershed</li> <li>• North Fork Crow Watershed HSPF Modeling</li> <li>• North Fork Crow Lakes Eutrophication Modeling</li> <li>• North Fork Crow and Lower Crow: Bacteria, Turbidity, and Low DO TMDL</li> <li>• North Fork Crow River, Rice Lake: Excess Nutrients</li> <li>• North Fork Crow River, Emma and Ann lakes: Excess Nutrients</li> <li>• Diamond Lake: Excess Nutrients</li> </ul> </li> </ul> |
| <p>Scope</p>    | <ul style="list-style-type: none"> <li>• Impacts to aquatic recreation and impacts to aquatic life in streams</li> <li>• Impacts to aquatic recreation in lakes</li> </ul>   |
| <p>Audience</p> | <ul style="list-style-type: none"> <li>• Local working groups (local county, city and township governments, SWCDs, watershed management groups, etc.)</li> <li>• State agencies (MPCA, DNR, BWSR, etc.)</li> <li>• Federal agencies (NRCS, USFWS, etc.)</li> </ul>   |

## 1. Watershed Background & Description

The North Fork Crow (NFC) River watershed is located in the Upper Mississippi River Basin and covers eight counties, which include Wright, Meeker, Kandiyohi, Stearns, Pope, Hennepin, McLeod, and Carver. The watershed is approximately 1,485 square miles, or 950,000 acres and is predominantly in the North Central Hardwood Forests ecoregion with a very small portion crossing into the Western Corn Belt Plains ecoregion. As the main stem of the NFC River passes through the central and eastern regions of the watershed, land use is dominated by crop and pasture land. There are 31 municipalities located completely or partially within the boundaries of the NFC

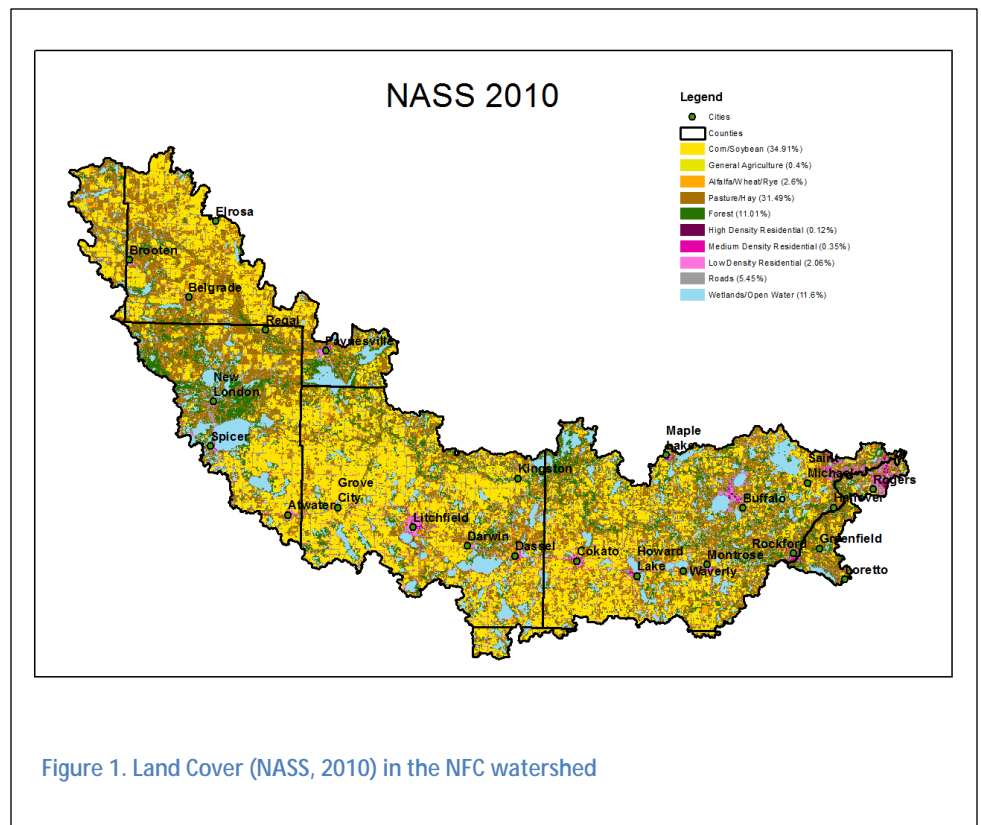


Figure 1. Land Cover (NASS, 2010) in the NFC watershed

Watershed (Figure 1). The NFC flows from its western headwaters to its confluence with the South Fork Crow near Rockford, Minnesota, after which it joins the Mississippi near Dayton, Minnesota. Additional background information and description of the NFC watershed can be found in the resources listed below.

### Additional North Fork Crow Watershed Resources

USDA Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the NFC River Watershed: [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_022499.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_022499.pdf)

Past MPCA studies including assessment, TMDLs, and implementation in the NFC River Watershed can be found at: <http://www.pca.state.mn.us/jsridda>

Minnesota Department of Natural Resources (DNR) Watershed Assessment Mapbook for the NFC Watershed: [http://files.dnr.state.mn.us/natural\\_resources/water/watersheds/tool/watersheds/wsm18.pdf](http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/wsm18.pdf)

## 2. Watershed Conditions

There are 679 lakes and 233 stream segments referred to as Assessment Unit IDs (AUIDs) in the watershed, although not all were assessed due to insufficient data, limited resource waters status, or predominantly channelized stream reaches. Of the lakes and streams mentioned previously, 90 lakes and 74 streams have been assessed (Tables 1 and 2). Although there are many streams and lakes that have been assigned AUIDs or DNR lake numbers, they may not have been assessed since they are too small (lakes under four hectares) or they are limited resource waters (ditches or heavily channelized streams).

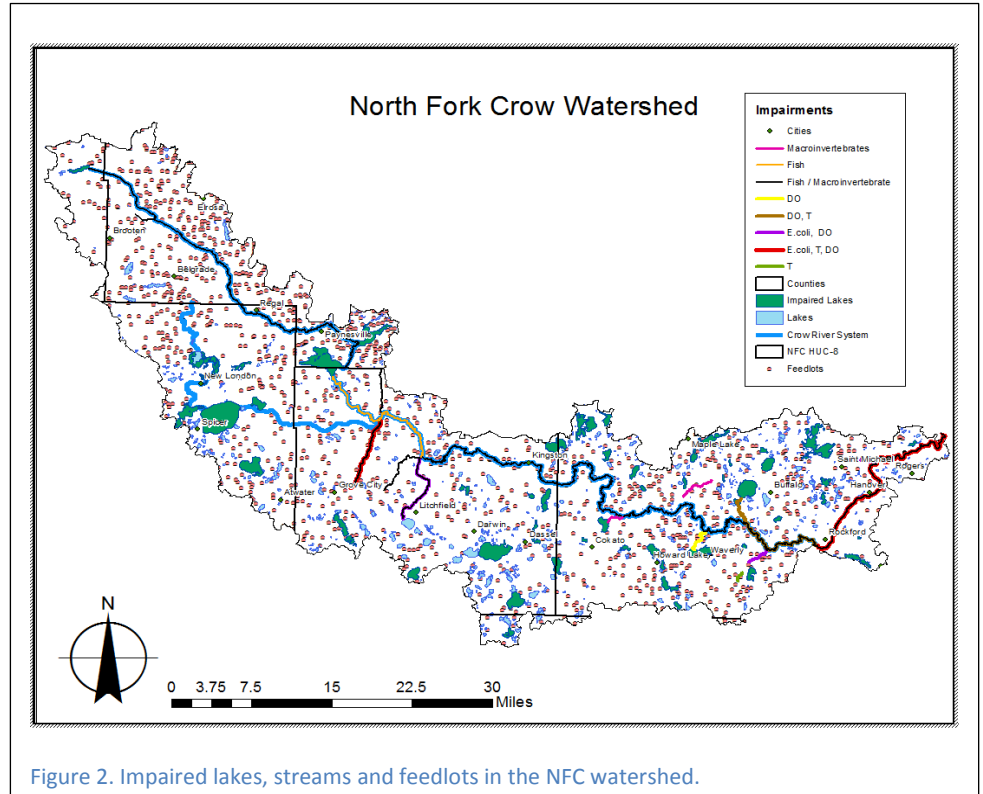


Figure 2. Impaired lakes, streams and feedlots in the NFC watershed.

In 2007 when this project began, the primary focus of the Minnesota Pollution Control Agency (MPCA) lake monitoring was lakes  $\geq 500$  acres (large lakes) in size since these represent 72% of the total lake area within Minnesota and generally provide the greatest aquatic recreational opportunity to Minnesota's citizens. The MPCA also supported monitoring of at least 25% of lakes between 100-499 acres (small lakes). Lakes also had to be accessible; therefore, many of the lakes that were assessed in this first 10 cycle meet one of these basic size criteria and have a public access.

Since this project began as a demonstration and precursor of the watershed approach, all available lake data collected in a 10 year period ending in 2009 was used to assess selected lakes in the NFC watershed. Many of the assessed lakes had sufficient data points to assess water quality but in other cases, not enough data (minimum of five years) was available to detect clear water quality trends. (See *Assessment Report of Selected Lakes within the North Fork Crow River Watershed*)

Even when pooling MPCA, local and citizen resources, it was not possible to monitor and assess all 679 lakes in the NFC watershed in this first 10 year cycle. Agencies and local government units will coordinate with stakeholders to develop a monitoring program for the unassessed lakes. Collecting sufficient data points to fully assess the lakes that currently are classified as "IF" (Table 1) will be a priority for monitoring in the next cycle, which begins in 2017. Lakes that have active lake associations, high scores from the DNR's Watershed Health Assessment Framework Tool (WHAF), are designated by DNR as wild rice or priority shallow lakes, or unimpaired lakes that have a discernable downward trend will be targeted for assessment in the 2017 cycle.

Stream monitoring strategies utilized the nested watershed design that allows aggregation of watersheds from a coarse to a fine scale. Streams are broken into segments by HUCs to define separate waterbodies within a watershed. Minor subwatersheds are sampled near their outlets along with the major watershed outlet to provide a complete assessment of water quality. This monitoring approach, which was adopted by the MPCA in order to assess waters of the state via a 10-year cycle, provides a holistic and more fully integrated assessment of rivers and streams without monitoring every stream reach in the 8 digit HUC.

It is also important to note that only natural stream segments were assessed. Biological criteria has not been developed yet for channelized streams and ditches in Minnesota, therefore, assessment of fish and macroinvertebrate community data for aquatic life use support is not yet possible for channelized streams in Minnesota. Currently, the MPCA is deferring any new impairments on channelized reaches until new aquatic life use standards have been developed as part of the tiered aquatic life use (TALU) framework. For additional information on TALU see: <http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/tiered-aquatic-life-use-talu-framework.html>

The NFC watershed lake and stream water quality conditions are typical of waters located in areas dominated by agricultural land uses. Although the watershed generally has water quality issues driven by land use, the general trend in lake water quality decreases from upstream to downstream (west to east) throughout the watershed. Further description of the condition of streams and lakes in the NFC watershed, including associated pollutant sources, are detailed in the following sections of this report.

The *North Fork Crow River Monitoring and Assessment Report* and the *Assessment of Selected Lakes within the North Fork Crow River Watershed (Pope, Stearns, Kandiyohi, Meeker, McLeod, Wright, and Hennepin Counties)* contain more detailed information on the lake and stream assessments that were completed for the NFC watershed project. These reports can be found at:

<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/north-fork-crow-river.html>

The *DNR Watershed Conditions Report – North Fork Crow River Watershed* contains more detailed information on watershed health index scores that represent important ecological relationships in the NFC watershed. More information can be found at:

<http://www.dnr.state.mn.us/whaf/index.html>

## 2.1 Condition Status

The purpose of this section is to summarize the impairment status of the lakes and streams assessed within the NFC watershed. The streams summarized in Table 1 have been assessed for aquatic life parameters including dissolved oxygen (DO), index of biotic integrity (IBI), and turbidity; in addition, aquatic recreation parameters include bacteria (fecal coliform or *E. coli*) were also used to assess streams. Lakes in Table 2 have been evaluated for aquatic recreation, which are assessed using total phosphorus (nutrient) criteria. Some of the waterbodies in the NFC watershed are impaired by mercury; however, this report does not cover toxic pollutants. For more information on mercury impairments see the statewide mercury TMDL at: <http://www.pca.state.mn.us/wfhy9efl>.

In general, water quality declines from upstream to downstream or from west to east. Most of the nutrient lake impairments, with a few exceptions, are located in the eastern half of the watershed while stream impairments are located throughout the watershed. Many of the impairments in the NFC watershed are typical of a predominantly

agricultural watershed. As a result, lake eutrophication caused by excess nutrient runoff is a typical stressor for lake water quality, whereas stream channel modification and overland runoff are a primary stressor resulting in *E. coli*, turbidity, and dissolved oxygen violations (Wenck, 2012; Wenck, 2013).

## **Streams**

Of the 233 reaches assigned AUIDs, 74 have been assessed for aquatic life or aquatic recreation. The parameters, as mentioned previously, used to assess aquatic life are IBI, DO, and turbidity, while the parameter used to assess aquatic recreation is bacteria (*E. coli* and fecal coliform). The 74 AUIDs assessed using the aforementioned criteria are summarized in Table 1, which is organized by HUC-10 watershed, listed from west to east. Of the 74 that have been assessed, four fully support aquatic life and one fully supports aquatic recreation, while 20 are impaired for aquatic life and 16 are impaired for aquatic recreation.

TMDLs were completed for stream reaches on the 2010 303(d) impaired waters list. Additional impairments were identified and added to subsequent 303(d) lists as assessments were completed through the NFC watershed process. Due to timing of the watershed process, budgeting and contracting constraints, the additional new stream impairments are deferred until the 2017 cycle.



Table 1. Assessment status of stream reaches in the NFC Watershed, presented (mostly) from upstream to downstream.

|  | AUID<br>(Last 3<br>digits) | Stream                         | Reach Description                           | Aquatic Life                   |   |                  |               | Aq<br>Rec |
|--|----------------------------|--------------------------------|---|--------------------------------|---|------------------|---------------|-----------|
|  |                            |                                |   | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Turbidity/TSS | Bacteria  |
| Lake Koronis - North Fork Crow<br>(0701020401) | 531                        | Skunk River                    | Headwaters to NFC River                     | NA                             | NA  | IF               |               |           |
|  | 576                        | County Ditch 5                 | Unnamed Cr to N Fk Crow R                   | IF                             | IF  |                  | Sup           | NA        |
|  | 579                        | Sedan Brook                    | CD 36 to N Fk Crow R                        | Imp                            |   | Imp              | Sup           | NA        |
|  | 580                        | County Ditch 7                 | Unnamed Ditch to N Fk Crow R                | NA                             |   | IF               | Sup           | NA        |
|  | 581                        | County Ditch 7                 | Unnamed Ditch to N Fk Crow R                | NA                             | NA  | IF               | Sup           | NA        |
|  | 582                        | Judicial Ditch 1               | Unnamed Ditch to Grove Lk                   |                                |   | Imp              | Sup           | NA        |
|  | 583                        | Judicial Ditch 1               | Lincoln Lk to Unnamed ditch                 |                                |   | Imp              | Sup           | NA        |
|  | 584                        | Judicial Ditch 1               | Unnamed Ditch to N Fk Crow R                | NA                             |   | Imp              | Sup           | NA        |
|  | 685                        | Crow River, North Fork         | Headwaters (Grove Lk-61-0023-00) to Rice Lk | Imp                            |   | Imp              | Sup           | NA        |
|  | 687                        | Crow River, North Fork         | Rice Lk to Lk Koronis                       | NA                             | Imp   | Imp              | Sup           | Sup       |
|  | 553                        | Unnamed Creek (County Ditch 4) | Unnamed Cr to Lk Koronis                    | NA                             | NA  | IF               | Sup           |           |
|  | 578                        | County Ditch 32                | Unnamed Ditch to N Fk Crow R                | NA                             |   | Imp              | Sup           |           |
| 504  | Crow River, North Fork     | Lk Koronis to M Fk Crow R      | Imp   | Imp                            | IF  | Sup              |               |           |
| Middle Fork Crow River<br>(0701020402)         | 536                        | County Ditch 37                | Unnamed Cr to M Fk Crow R                   | NA                             | NA  |                  | Sup           | NA        |
|  | 537                        | Crow River, Middle Fork        | Headwaters to Mud Lk                        | Sup                            | Sup   |                  | Sup           | NA        |

Imp= Impaired for impacts to aquatic recreation, Sup= Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

Table 1, continued. Assessment status of stream reaches in the NFC Watershed, presented (mostly) from upstream to downstream.

| HUC-10 Subwatershed                                 | AUID<br>(Last 3<br>digits) | Stream                       | Reach Description                             | Aquatic Life                   |   |                  |               | Aq<br>Rec |
|---|----------------------------|------------------------------|---|--------------------------------|---|------------------|---------------|-----------|
|   |                            |                              |   | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Turbidity/TSS | Bacteria  |
| Middle Fork Crow River<br>Continued<br>(0701020402) | 539                        | Crow River, Middle Fork      | Mud Lk to Nest Lk                             | NA                             | NA  | Imp              | Sup           | IF        |
|   | 577                        | County Ditch B6              | Unnamed Cr to N Fk Crow R                     | Sup                            | Sup   |                  | Sup           | NA        |
|   | 722                        | Unnamed Creek                | Headwaters (Unnamed Lk 34-0046) to Diamond Lk |                                |   | IF               | IF            | NA        |
|   | 723                        | Unnamed Creek                | Hubbard Lk to Diamond Lk                      |                                |   | IF               | IF            | NA        |
|   | 724                        | Unnamed Creek (Alvig Slough) | Unnamed Lk (34-0113) to Green Lk              |                                |   | IF               | IF            | NA        |
|   | 651                        | Unnamed Creek                | Long Lake to M Fk Crow R                      | IF                             | IF  |                  |               | NA        |
|   | 511                        | Crow River, Middle Fork      | Green Lk to N Fk Crow R                       | NA                             | NA  | IF               | Sup           | Imp       |
|   | 541                        | Crow River, Middle Fork      | Nest Lk to Green Lk                           |                                |   |                  | Sup           | NA        |
|   | 569                        | County Ditch 26              | Unnamed ditch to Lk Calhoun                   | IF                             | IF  |                  | Imp           | NA        |
|   | 589                        | Unnamed Creek                | Unnamed Cr to Diamond Lk                      | IF                             | IF  |                  |               | NA        |
|   | 672                        | Unnamed Creek                | Headwaters to Wheeler Lk                      | IF                             | IF  |                  |               | NA        |
| Jewetts Creek-North Fork Crow River<br>(0701020403) | 514                        | Grove Creek                  | Unnamed Cr to N fk Crow R                     | Imp                            | Imp   | Imp              | Imp           | Imp       |
|   | 643                        | County Ditch 26              | Unnamed Lk to Long Lake                       | NA                             |   |                  | Imp           |           |

Imp= Impaired for impacts to aquatic recreation, Sup= Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

Table 1, Continue. Assessment status of stream reaches in the NFC Watershed, presented (mostly) from upstream to downstream.

|  |     |                              |   | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Turbidity/TSS | Bacteria |
|--|-----|------------------------------|---|--------------------------------|---|------------------|---------------|----------|
| Jewetts Creek-North Fork Crow River<br>continued<br>(0701020403) | 552 | Unnamed Creek (Battle Creek) | T120 R31W S32, south line to Jewetts Cr     | Imp                            | Imp   |                  |               |          |
|  | 585 | Jewetts Creek                | Headwaters (Lk Ripley 47-0134-00) to NFC R  | Imp                            | Imp   | Imp              | Sup           | Imp      |
|  | 506 | Crow River, North Fork       | Jewetts Cr to Washington Cr                 | Imp                            | Imp   | IF               | Sup           | IF       |
|  | 507 | Crow River, North Fork       | M Fk Crow R to Jewetts Cr                   | Imp                            | Sup   | IF               | Sup           | Imp      |
|  | 572 | Stag Brook                   | Headwaters (Unnamed lk 73-0153-00) to NFC R | Imp                            | Imp   |                  |               |          |
| Washington Creek<br>(0701020404)                                 | 518 | Washington Creek (CD 9)      | Washington Lk to N Fk Crow R                | NA                             | NA  | Imp              | Sup           | Imp      |
|  | 547 | County Ditch 36              | Powers Lk outlet to Washington Cr           | NA                             | NA  |                  | Sup           |          |
|  | 728 | Unnamed Creek                | Headwaters to Lk Minnebelle                 |                                |   |                  |               |          |
|  | 623 | Unnamed Creek                | Dunns Lk to CD 36                           |                                |   |                  |               |          |
|  | 616 | Unnamed Creek (CD 35)        | Unnamed Cr to Richardson Lk                 |                                |   |                  |               |          |
|  | 615 | Unnamed Creek (CD 35)        | Headwaters to Unnamed Cr                    |                                |   |                  |               |          |
|  | 669 | Lake Minnie Belle Outlet     | Lk Minnie Belle to T118 R31W S12, east line |                                |   | IF               | Sup           | Imp      |

Imp= Impaired for impacts to aquatic recreation, Sup= Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

Table 1, continued. Assessment status of stream reaches in the NFC Watershed, presented (mostly) from upstream to downstream.

| HUC-10 Subwatershed                   | AUID<br>(Last 3<br>digits) | Stream                            | Reach Description                           | Aquatic Life                   |   |                  |               | Aq<br>Rec |
|---------------------------------------|----------------------------|-----------------------------------|---|--------------------------------|---|------------------|---------------|-----------|
|                                       |                            |                                   |   | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Turbidity/TSS | Bacteria  |
| Big Swan Lake<br>(0701020405)         | 546                        | Unnamed Creek (Big Swan Outlet)   | Big Swan Lk to N Fk Crow R                  |                                |   | IF               | Sup           | IF        |
|                                       | 557                        | Silver Creek                      | Unnamed Cr to Collinwood Lk                 | NA                             |   |                  | Sup           |           |
|                                       | 604                        | Collinwood Creek                  | Unnamed Cr (Unnamed Lk 47-0031) to Big Swan | NA                             |   | Imp              | Imp           | Imp       |
|                                       | 720                        | Unnamed Creek                     | Maple Lk to Collinwood Lk                   |                                |   |                  | IF            |           |
| North Fork Crow River<br>(0701020406) | 682                        | Sucker Creek                      | Cokato Lk to N Fk Crow R                    | Sup                            | Imp   | Imp              | Imp           | Imp       |
|                                       | 684                        | Sucker Creek                      | Headwaters to Cokato                        | NA                             | NA  | IF               |               | IF        |
|                                       | 559                        | County Ditch 10                   | Unnamed Ditch to Grass Lake                 |                                |   |                  | Imp           |           |
|                                       | 560                        | County Ditch 10                   | Grass Lake to Unnamed Ditch                 |                                |   |                  | Sup           |           |
|                                       | 561                        | Unnamed Ditch                     | Headwaters to CD 10                         |                                |   |                  | Imp           |           |
|                                       | 563                        | County Ditch 10                   | Unnamed Ditch to Unnamed ditch              | NA                             | NA  |                  | Sup           |           |
|                                       | 564                        | County Ditch 10                   | Unnamed Ditch to Lk Ann                     |                                |   |                  | Sup           |           |
|                                       | 565                        | Unnamed Creek                     | Lk Emma to Twelvemile Cr                    |                                |   |                  | Sup           |           |
|                                       | 595                        | Unnamed Creek                     | Headwaters to Howard Lk                     |                                |   |                  | Sup           |           |
|                                       | 596                        | Unnamed Creek                     | Headwaters to Howard Lk                     |                                |   |                  | Sup           |           |
|                                       | 634                        | Unnamed Creek                     | Waverly Lk to Little Waverly Lk             |                                |   |                  | Sup           | Imp       |
|                                       | 648                        | Unnamed Creek                     | Headwaters to Waverly Lk                    |                                |   |                  | Imp           |           |
|                                       | 679                        | Dutch Lake to Little Waverly Lake | Dutch Lk to Little Waverly Lk               |                                |   |                  | Sup           |           |

Imp= Impaired for impacts to aquatic recreation, Sup= Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

Table 1, continued. Assessment status of stream reaches in the NFC Watershed, presented (mostly) from upstream to downstream.

| HUC-10 Subwatershed                                | AUID<br>(Last 3<br>digits) | Stream                         | Reach Description                       | Aquatic Life                   |   |                  |               | Aq<br>Rec |
|--|----------------------------|--------------------------------|---|--------------------------------|---|------------------|---------------|-----------|
|  |                            |                                |   | Fish Index of Biotic Integrity | Macroinvertebrate Index of Biotic Integrity | Dissolved Oxygen | Turbidity/TSS | Bacteria  |
| North Fork Crow River<br>continued<br>(0701020406) | 515                        | Mill Creek                     | Buffalo Lk to N Fk Crow R               |                                |   | Imp              | Imp           | Imp       |
|  | 524                        | Mill Creek                     | Ramsey Lk to Buffalo Lk                 | Sup                            | Sup   |                  |               |           |
|  | 681                        | Little Waverly Lk to NFC River | Little Waverly Lk to N Fk Crow R        |                                |   |                  | IF            |           |
|  | 667                        | Unnamed Creek                  | Woodland WMA wetland to N Fk Crow R     | NA                             |   |                  | Sup           |           |
|  | 668                        | Unnamed Creek                  | Unnamed Cr to Woodland WMA Wetland      |                                |   | Imp              | Sup           | Imp       |
|  | 503                        | Crow River, North Fork         | Mill Cr. To S Fk Crow R                 | Imp                            | Imp   | Imp              | Imp           | Imp       |
|  | 509                        | Eagle Creek                    | Unnamed Cr to N Fk Crow R               | NA                             |   |                  |               |           |
|  | 555                        | Crow River                     | North Fork Crow River                   | Imp                            | Imp   |                  |               |           |
|  | 556                        | Crow River, North Fork         | Meeker/Wright County line to Mill Creek | Imp                            | Imp   | IF               | Imp           | Imp       |
|  | 725                        | Crow River, North Fork         | Unnamed Creek: Wetland to French Lake   | IF                             | IF  |                  |               | IF        |
|  | 543                        | Unnamed Creek                  | Headwaters to Unnamed Cr                |                                | Imp   |                  |               |           |
|  | 592                        | French Creek                   | French Lk to N Fk Crow R                | NA                             |   |                  | Sup           |           |
|  | 656                        | Unnamed Creek                  | Headwaters to Unnamed Creek             | NA                             |   |                  |               |           |
| Crow River<br>(0701020407)                         | 625                        | Unnamed Creek                  | Headwaters to Lk Sarah                  |                                |   |                  | Sup           |           |
|  | 628                        | Sarah Creek                    | Lk Sarah to Crow R                      | NA                             |   |                  | Imp           |           |
|  | 627                        | Unnamed Creek                  | Headwaters to Lk Sarah                  |                                |   |                  | IF            |           |
|  | 542                        | Unnamed Creek (Regal Creek)    | Unnamed Creek to Crow R                 |                                |   | Imp              | Sup           | Imp       |
|  | 502                        | Crow River                     | S Fk Crow to Mississippi R              | Imp                            | Imp   | Imp              | Imp           | Imp       |

Imp= Impaired for impacts to aquatic recreation, Sup = Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

## Lakes

All 90 lakes assessed in the NFC watershed are classified as class 2B waters for which aquatic life and recreation are the protected beneficial uses (Table 2). The Minnesota standard for all class 2 waters states “...there shall be no material increase in undesirable slime growths or aquatic plants including algae.” In order to evaluate whether a lake is in an impaired condition the MPCA developed “numeric translators” for the narrative standard for purposes of determining which lakes should be included in the section 303(d) list as being impaired for nutrients. Aquatic life impairments are determined using nutrient criteria parameters that include total phosphorus (TP), Secchi depth measurements, and chlorophyll-*a*.

Of the 90 lakes assessed, 46% are impaired for aquatic recreation, 33% are fully supporting aquatic recreation, and 21% have insufficient data to make an assessment. TMDLs were completed for all nutrient impaired NFC lakes on the draft 2012 303(d) impaired waters list.

Table 2. Assessment status of lakes in the NFC Watershed.

| HUC-10 Subwatershed                             | Lake ID    | Lake                                | Aquatic Recreation |
|---|------------|-------------------------------------|--------------------|
| Lake Koronis-North Fork Crow River (0701020401) | 61-0023-00 | Grove                               | Sup                |
|   | 73-0200-02 | Koronis (Main Basin)                | IF                 |
|   | 73-0200-01 | Koronis (Mud Lake)                  | Sup                |
|   | 73-0144-00 | Pirz                                | Sup                |
|   | 73-0196-00 | Rice                                | Imp                |
| Middle Fork Crow River (0701020402)             | 34-0044-00 | Diamond                             | Imp                |
|   | 34-0049-00 | Schultz                             | IF                 |
|   | 34-0062-00 | Calhoun                             | Sup                |
|   | 34-0066-00 | Long                                | Sup                |
|   | 34-0079-00 | Green                               | Sup                |
|   | 34-0119-00 | Elkhorn                             | Sup                |
|   | 34-0141-00 | Woodcock                            | IF                 |
|   | 34-0142-00 | George                              | Sup                |
|   | 34-0154-00 | Nest                                | Imp                |
|   | 34-0158-01 | Monongalia (Main Basin)             | Sup                |
|   | 34-0158-02 | Monongalia (Middle Fork Crow River) | Sup                |
|   | 34-0158-03 | Crow River Mill Pond (East)         | Sup                |
|   | 34-0158-04 | Crow River Mill Pond (Mid)          | Sup                |
|   | 34-0158-05 | Crow River Mill Pond (West)         | NA                 |
|   | 34-0051-01 | Wheeler (Southwest Bay)             | IF                 |
|   | 34-0051-02 | Wheeler (Northeast Bay)             | IF                 |

Imp= Impaired for impacts to aquatic recreation, Sup= Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

Table 2, continued. Assessment status of lakes in the NFC Watershed.

| HUC-10 Subwatershed                              | Lake ID    | Lake                  | Aquatic Recreation |
|--|------------|-----------------------|--------------------|
| Jewitts Creek-North Fork Crow River (0701020403) | 47-0134-02 | Ripley (West Portion) | Sup                |
|  | 47-0138-00 | Youngstrom            | IF                 |
|  | 47-0177-00 | Long                  | Imp                |
|  | 47-0183-00 | Hope                  | Imp                |
| Washington Creek (0701020404)                    | 47-0023-00 | Arvilla               | IF                 |
|  | 47-0046-00 | Washington            | Sup                |
|  | 47-0050-00 | Manuella              | Sup                |
|  | 47-0068-00 | Stella                | Sup                |
|  | 47-0082-00 | Dunns                 | Imp                |
|  | 47-0088-00 | Richardson            | Imp                |
|  | 47-0119-00 | Minnie-Belle          | Sup                |
| Big Swan Lake (0701020405)                       | 43-0073-00 | Hook                  | Imp                |
|  | 47-0014-00 | Spencer               | IF                 |
|  | 47-0015-00 | Jennie                | Imp                |
|  | 47-0016-00 | Wolf                  | IF                 |
|  | 47-0026-00 | Long                  | Sup                |
|  | 47-0032-00 | Spring                | Imp                |
|  | 47-0038-00 | Big Swan              | Imp                |
|  | 47-0064-00 | Erie                  | Sup                |
| 86-0293-00-00                                    | Collinwood | Imp                   |                    |
| North Fork Crow River (0701020406)               | 47-0002-00 | Francis               | Sup                |
|  | 47-0040-00 | Mud                   | IF                 |
|  | 86-0134-01 | Upper Maple           | Sup                |
|  | 86-0190-00 | Ann                   | Imp                |
|  | 86-0199-00 | Howard                | Imp                |
|  | 86-0263-00 | Cokato                | Imp                |
|  | 86-0264-00 | Brooks                | Imp                |
|  | 86-0273-00 | French                | Imp                |
|  | 86-0274-00 | Dans                  | IF                 |
|  | 86-0250-00 | Smith                 | Imp                |
|  | 86-0274-00 | West Lake Sylvia      | Sup                |
|  | 86-0288-00 | John                  | Sup                |
|  | 86-0289-00 | East Lake Sylvia      | Sup                |
|  | 86-0217-00 | Granite               | Imp                |
|  | 86-0221-00 | Camp                  | Imp                |
|  | 86-0199-   | Howard                | Imp                |
| 86-0184-00                                       | Dutch      | Imp                   |                    |

Imp= Impaired for impacts to aquatic recreation, Sup= fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed

Table 2, continued. Assessment status of lakes in the NFC Watershed.

| HUC-10 Subwatershed                                | Lake ID    | Lake               | Aquatic Recreation |
|--|------------|--------------------|--------------------|
|  | 0086-0190  | Ann                | Imp                |
|  | 86-0188-00 | Emma               | Imp                |
|  | 86-0193-00 | Mary               | Sup                |
|  | 86-0182-00 | Rock               | Imp                |
|  | 86-0106-00 | Little Waverly     | Imp                |
|  | 86-0114-00 | Waverly            | Imp                |
|  | 86-0120-00 | Ramsey             | Imp                |
|  | 86-0097-00 | Carrigan           | IF                 |
|  | 86-0143-01 | Upper Maple        | Sup                |
|  | 86-0119-00 | Sullivan           | IF                 |
|  | 86-0127-00 | Albert             | Imp                |
|  | 86-0122-00 | Light Foot         | Imp                |
|  | 86-0086-00 | Fountain           | Imp                |
|  | 86-0112-00 | Malardi            | Imp                |
|  | 86-0107-00 | Deer               | Imp                |
|  | 86-0090-00 | Buffalo            | Imp                |
|  | 86-0046-00 | Crawford           | Sup                |
| North Fork Crow River<br>(0701020406)<br>Continued | 86-0041-00 | Dean               | Imp                |
|  | 86-0053-01 | Little Pulaski     | IF                 |
|  | 86-0053-02 | Pulaski (Main Bay) | Sup                |
| Crow River<br>(0701020407)                         | 86-0051-00 | Constance          | Imp                |
|  | 86-0063-00 | Green Mountain     | IF                 |
|  | 86-0009-00 | Martha             | Sup                |
|  | 86-0011-00 | Charlotte          | Sup                |
|  | 86-0031-00 | Pelican            | Imp                |
|  | 86-0023-00 | Beebe              | Imp                |
|  | 86-0020-00 | Wilhelm            | IF                 |
|  | 27-0200-00 | Rattail            | IF                 |
|  | 27-0191-01 | Sarah (West Bay)   | Imp                |
|  | 27-0191-02 | Sarah (East Bay)   | Imp                |
|  | 27-0199-00 | Hafften            | Imp                |
|  | 27-0177-00 | Prairie            | IF                 |
|  | 27-0171-00 | Sylvan             | IF                 |
|  | 27-0169-00 | Cowley             | Imp                |
|  | 86-0001-00 | Foster             | Imp                |

Imp= Impaired for impacts to aquatic recreation, Sup= Fully supporting aquatic recreation, IF= Insufficient data to make an assessment, NA= Not assessed



## 2.2 Water Quality Trends

Long-term water quality was recorded at site S000-004 on the Crow River near Dayton, Minnesota from 1953 to 2009 for TSS, BOD, TP, Nitrite/Nitrate, Unionized Ammonia, chloride, and pH (Table 3). The MPCA used this dataset to analyze the long-term (1953 to 2009) and short-term (1995 to 2009) water quality trends (Seasonal Kendall Trend Test) in the NFC watershed (MPCA, 2011). Most parameters saw no significant change ( $p < 0.1$ ) in long-term or short-term trends; however, total suspended solids decreased significantly from 1995 to 2009 and Nitrite/Nitrate and chloride increased significantly from 1953 to 2009 (MPCA, 2011).

Table 3. Water quality trends of the Crow River near Dayton, where green values indicate an improving trend in water quality for that parameter while red values indicate a degrading trend in water quality for that parameter (MPCA, 2011)

| Parameter                 | Historical Trend<br>(1953-2009) | Recent Trend<br>(1995-2009) |
|---------------------------|---------------------------------|-----------------------------|
| Total Suspended Solids    | no trend                        | -35%                        |
| Biochemical Oxygen Demand | no trend                        | no trend                    |
| Total Phosphorus          | no trend                        | no trend                    |
| Nitrite/ Nitrate          | +371%                           | no trend                    |
| Unionized Ammonia         | no trend                        | no trend                    |
| Chloride                  | +893%                           | no trend                    |
| pH                        | no trend                        | no trend                    |

## 2.3 Stressors and Sources

In order 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 evaluation of pollutant 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. There are three stressor identification documents (SID) that were prepared for NFC AUIDs with biotic impairments. These documents are available at:

<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/watersheds/north-fork-crow-river.html>

Section 3 of this report provides further detail on stressors and pollutant sources.

### Stressors of Biologically-Impaired Stream Reaches

There are currently five streams in the NFC that are impaired for biotic integrity, which also have stressor ID reports published (MPCA, 2012; MPCA, 2013; MPCA, 2014; MPCA). The primary causes for IBI impairments in Table 4 are low dissolved oxygen and excess deposited and bedded sediment (MPCA, 2012; MPCA, 2013; MPCA, 2014; MPCA).

Table 4. Primary stressors to aquatic life in biologically-impaired reaches in the NFC Watershed.

| HUC-10 Subwatershed                 | AUID (Last 3 digits) | Stream                 | Reach Description                                | Biological Impairment | Primary Stressor |         |            |           |                     |                   |         |                             |   |
|-------------------------------------|----------------------|------------------------|--|-----------------------|------------------|---------|------------|-----------|---------------------|-------------------|---------|-----------------------------|---|
|                                     |                      |                        |  |                       | Dissolved Oxygen | Nitrate | Phosphorus | Turbidity | Fish Passage (dams) | Altered Hydrology | Habitat | Deposited & Bedded Sediment |   |
| Lake Koronis-North Fork Crow River  | 504                  | Crow River, North Fork | Lk Koronis to M Fk Crow R                        | Macroinvert.          |                  |         |            |           |                     |                   |         | ●                           | ● |
| Jewitts Creek-North Fork Crow River | 514                  | Grove Creek            | Unnamed Cr to N Fk Crow R                        | Fish & Macroinvert.   | ●                |         |            | ●         |                     |                   |         |                             | ● |
|                                     | 552                  | Unnamed Creek          | T120 R31W S32, south line to Jewitts Cr          | Fish & Macroinvert.   | ●                |         |            |           |                     | ●                 |         |                             | ● |
|                                     | 585                  | Jewitts Creek          | Headwaters (Lk Ripley 47-0134-00) to N Fk Crow R | Fish & Macroinvert.   | ●                |         |            |           |                     |                   |         |                             | ● |
| North Fork Crow River               | 543                  | Unnamed Creek          | Unnamed Cr to Unnamed Cr                         | Macroinvert.          | ●                |         |            |           |                     | ●                 | ●       |                             |   |
| Crow River                          | 502                  | Crow River             | S Fk Crow R to Mississippi R                     | Fish & Macroinvert.   | ●                |         |            | ●         |                     |                   |         |                             |   |

## Pollutant Sources

Point and non-point sources of pollution were identified through previous TMDL processes, which are outlined in Table 5 and Table 6. Although each subwatershed in the NFC is unique, land use is similar throughout the 8 digit HUC watershed, which results in common pollutant sources in most streams or lakes. Section 3 uses the pollution source assessment to identify possible implementation steps and timelines for impaired and un-impaired stream reaches and lakes.

Table 5. Point Sources in the NFC Watershed

| HUC-10 Subwatershed  | Point Source                           |           |                       | Pollutant reduction needed beyond current permit conditions/limits? | Notes  |
|--|--|-----------|-----------------------|---|--|
|  | Name                                   | Permit #  | Type                  |   |  |
| Lake Koronis-<br>North Fork<br>Crow River<br><br>(701020401) | Paynesville GWP                        | MNG790109 | Municipal stormwater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|  | AMPI – Paynesville                     | MN0044326 | Industrial wastewater | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|  | Paynesville WWTP                       | MN0020168 | Municipal stormwater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|  | Brooton WWTP                           | MN0066753 | Municipal stormwater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|  | Jennie-O Turkey Store - Groen Farm     | MNG440598 | CAFO                  | No  | Zero Discharge Permit  |
|  | Jennie-O Turkey Store - Wilner Farm    | MNG440097 | CAFO                  | No  | Zero Discharge Permit  |
|  | Jennie-O Turkey Store - Fritz Farm     | MNG440097 | CAFO                  | No  | Zero Discharge Permit  |
|  | Paul Magedanz Farm 1                   | MN0069841 | CAFO                  | No  | Zero Discharge Permit  |
|  | Jennie-O Turkey Store - Pearson Farm   | MNG440598 | CAFO                  | No  | Zero Discharge Permit  |
|  | Anderson Farms - Stern Farm            | MNG440980 | CAFO                  | No  | Zero Discharge Permit  |
|  | Jennie-O Turkey Store - Munson Brood   | MNG440097 | CAFO                  | No  | Zero Discharge Permit  |
|  | Jennie-O Turkey Store - Roseville Farm | MNG440097 | CAFO                  | No  | Zero Discharge Permit  |

Table 5, continued. Point Sources in the NFC Watershed.

| HUC-10 Subwatershed   | Point Source                             |           |                       | Pollutant reduction needed beyond current permit conditions/limits? | Notes  |
|---|--|-----------|-----------------------|---|--|
|   | Name                                     | Permit #  | Type                  |   |  |
| Lake Koronis-North Fork Crow River<br>(0701020401)<br>Continued | Freddy's Chicks Inc - Home Site          | MNG441243 | CAFO                  | No  | Zero Discharge Permit  |
|   | Anderson Farms - West Qtr Finish Barns   | MNG441097 | CAFO                  | No  | Zero Discharge Permit  |
|   | Anderson Farms - Jim's Place             | MNG440967 | CAFO                  | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Ironside         | MNG440875 | CAFO                  | No  | Zero Discharge Permit  |
| Middle Fork Crow<br>(0701020402)                                | Atwater WWTP                             | MN0022659 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|   | Green Lake SSWD WWTP                     | MN0052752 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|   | Belgrade WWTP                            | MN0051381 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|   | Bushmills Ethanol                        | MN0067211 | Industrial Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L   |
|   | Jennie-O Turkey Store - Roulet Farm      | MNG440103 | CAFO                  | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Galaxy Brood     | MNG440103 | CAFO                  | No  | Zero Discharge Permit  |
|   | COJO Dairy                               | MNG441087 | CAFO                  | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Martin Farm      | MNG440104 | CAFO                  | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Manannah Brood   | MNG440103 | CAFO                  | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Wilcox Lake Farm | MNG440103 | CAFO                  | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Gausdahl Farm    | MNG440875 | CAFO                  | No  | Zero Discharge Permit  |

Table 5, continued. Point sources in the NFC Watershed.

| HUC-10 Subwatershed                                 | Point Source                            |           |                      | Pollutant reduction needed beyond current permit conditions/limits? | Notes  |
|---|---|-----------|----------------------|---|--|
|   | Name                                    | Permit #  | Type                 |   |  |
| Middle Fork Crow<br>(0701020402)<br>Continued       | Jennie-O Turkey Store - Belgrade 3      | MNG440875 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Bach Farm       | MNG440103 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Belgrade 2      | MNG440875 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Belgrade 1      | MNG440875 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Thorson Farm    | MNG440598 | CAFO                 | No  | Zero Discharge Permit  |
|   | Sonset Ridge                            | MNG441086 | CAFO                 | No  | Zero Discharge Permit  |
|   | Willmar Poultry Farms Inc - Highway 71  | MNG440123 | CAFO                 | No  | Zero Discharge Permit  |
| Jewitts Creek-North Fork Crow River<br>(0701020403) | Litchfield WWTP                         | MN0023973 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|   | Grove City WWTP                         | MN0023574 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|   | Shoreview Farm Inc                      | MNG440408 | CAFO                 | No  | Zero Discharge Permit  |
|   | Sparboe Farms Inc                       | MNG440447 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Ross Farm       | MNG440104 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Johnson Grower  | MNG440104 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - Johnson Brooder | MNG440104 | CAFO                 | No  | Zero Discharge Permit  |
|   | Jennie-O Turkey Store - White Oak Farm  | MNG440104 | CAFO                 | No  | Zero Discharge Permit  |
| Kandi Pork Inc                                      | MNG440833                               | CAFO      | No                   | Zero Discharge Permit   |  |

Table 5, continued. Point Sources in the NFC Watershed.

| HUC-10 Subwatershed                   | Point Source                          |           |                       | Pollutant reduction needed beyond current permit conditions/limits? | Notes  |
|---------------------------------------|---------------------------------------|-----------|-----------------------|---|--|
|                                       | Name                                  | Permit #  | Type                  |   |  |
| Washington Creek<br>(0701020404)      | Darwin WWTP                           | MNG580150 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                                       | Dassel WWTP                           | MN0054127 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
| North Fork Crow River<br>(0701020406) | Faribault Foods - Cokato              | MN0030635 | Industrial wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L   |
|                                       | Buffalo WWTP                          | MN0040649 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                                       | Annandale/Maple Lake/Howard Lake WWTP | MN0066966 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                                       | Cokato WWTP                           | MN0049204 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                                       | Montrose WWTP                         | MN0024228 | Municipal Wastewater  | No  | WLAs based on current permitted TSS limit of 45 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                                       | Great River Energy of Dickinson       | MN0049077 | Industrial wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L   |
|                                       | Northern Lights 2009-2010 Zone EF     | MN0069396 | Industrial wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L   |
|                                       | Woodland Dairy Inc                    | MN0064041 | CAFO                  | No  | Zero Discharge Permit  |
|                                       | Forsman Farms Inc                     | MNG440334 | CAFO                  | No  | Zero Discharge Permit  |
|                                       | Alpha Foods LLP                       | MNG440324 | CAFO                  | No  | Zero Discharge Permit  |

Table 5, continued. Point Sources in the NFC Watershed.

| HUC-10 Subwatershed        | Point Source                  |           |                      | Pollutant reduction needed beyond current permit conditions/limits? | Notes  |
|----------------------------|-------------------------------|-----------|----------------------|---|--|
|                            | Name                          | Permit #  | Type                 |   |  |
| Crow River<br>(0701020407) | Rogers WWTP                   | MN0029629 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                            | Meadows of Whisper Creek WWTP | MN0066753 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                            | Saint Michael WWTP            | MN0020222 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                            | Greenfield WWTP               | MN0063762 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                            | Rockford WWTP                 | MN0024627 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |
|                            | Otsego East WWTP              | MN0064190 | Municipal Wastewater | No  | WLAs based on current permitted TSS limit of 30 mg/L, fecal coliform limit of 200 organisms/100 mL |

Table 6. Nonpoint Sources in the NFC Watershed. Relative magnitudes of contributing sources are indicated.

| HUC-10 Subwatershed                             | Stream/Reach (AUID) or Lake (ID) | Pollutant      | Pollutant Sources           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |   |
|---|----------------------------------|----------------|-----------------------------|-----------------------------------|------------------------|----------|-----------------------|---------------------|--------------|------------------------------|--------------------|----------------|------------|----------------|----------------------------|--------------|--------------|---|
|   |                                  |                | Fertilizer & manure run-off | Livestock overgrazing in riparian | Failing septic systems | Wildlife | Stream Channelization | Upland soil erosion | Urban Runoff | Internal TP Sediment Release | Aquatic Vegetation | Upstream Lakes | Rough Fish | WWTP Discharge | In-stream Algal production | Sediment BOD | Bank Erosion |   |
| Lake Koronis-North Fork Crow River (0701020401) | Rice lake (73-0196)              | TP             | -                           |                                   |                        |          |                       |                     |              |                              | TM                 |                |            |                |                            |              |              |   |
| Middle Fork Crow River (0701020402)             | Nest (34-0154)                   | TP             | >                           |                                   |                        |          |                       |                     |              |                              | -                  | Δ              | -          |                |                            |              |              | - |
| Jewitts Creek-North Fork River (0701020403)     | Long (47-0177)                   | TP             | -                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            | Δ              |                            |              |              |   |
|   | Hope (47-0183)                   | TP             | -                           |                                   |                        |          |                       |                     |              |                              | -                  |                | TM         |                |                            |              |              |   |
|   | Grove Creek (515)                | Turbidity      |                             |                                   |                        |          |                       |                     | -            |                              |                    |                | TM         |                |                            | TM           |              |   |
|   |                                  | <i>E. coli</i> | -                           | TM                                | TM                     | TM       |                       |                     |              |                              |                    |                |            |                |                            |              |              |   |
|   | Jewitts Creek (585)              | <i>E. Coli</i> | -                           | TM                                | TM                     | TM       |                       |                     |              |                              |                    |                |            |                |                            |              |              | > |
|   |                                  | DO             |                             |                                   |                        |          |                       |                     | -            |                              |                    |                |            |                |                            |              |              |   |
| Washington Creek (0701020404)                   | Richardson (47-0088)             | TP             | -                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            | Δ              |                            |              |              |   |
|   | Dunns (47-0082)                  | TP             |                             |                                   | >                      |          |                       |                     |              |                              | -                  |                | >          | Δ              |                            |              |              |   |
| Big Swan (0701020405)                           | Hook (43-0073)                   | TP             | >                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            | Δ              |                            |              |              |   |
|   | Jennie (47-0015)                 | TP             | -                           |                                   |                        |          |                       |                     |              |                              | >                  | Δ              |            | Δ              |                            |              |              |   |
|   | Collinwood (86-0293)             | TP             | -                           |                                   |                        |          |                       |                     |              |                              | >                  | >              | Δ          |                | Δ                          |              |              |   |
|   | Spring (47-0032)                 | TP             | >                           |                                   | >                      |          |                       |                     |              |                              | >                  | -              | Δ          |                | Δ                          |              |              |   |
|   | Big Swan (47-0038)               | TP             | -                           |                                   |                        |          |                       |                     |              |                              |                    |                | TM         | Δ              | TM                         |              |              |   |

Key: - = High > = Moderate TM = Low Δ = Potential source, relative magnitude unknown



Table 6, continued. Nonpoint Sources in the NFC Watershed. Relative magnitudes of contributing sources are indicated.

| HUC-10 Subwatershed                | Stream/Reach (AUID) or Lake (ID) | Pollutant | Pollutant Sources           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |
|------------------------------------|----------------------------------|-----------|-----------------------------|-----------------------------------|------------------------|----------|-----------------------|---------------------|--------------|------------------------------|--------------------|----------------|------------|----------------|----------------------------|--------------|--------------|
|                                    |                                  |           | Fertilizer & manure run-off | Livestock overgrazing in riparian | Failing septic systems | Wildlife | Stream Channelization | Upland soil erosion | Urban Runoff | Internal TP Sediment Release | Aquatic Vegetation | Upstream Lakes | Rough Fish | WWTP Discharge | In-stream Algal production | Sediment BOD | Bank Erosion |
| North Fork Crow River (0701020406) | Brooks (86-0264)                 | TP        | >                           |                                   | >                      |          |                       |                     |              |                              | -                  | Δ              |            |                |                            |              |              |
|                                    | Cokato (86-0263)                 | TP        | -                           |                                   | >                      |          |                       |                     |              |                              |                    | Δ              |            | Δ              |                            |              |              |
|                                    | French (86-0273)                 | TP        | -                           |                                   | >                      |          |                       |                     |              |                              |                    |                |            | Δ              |                            |              |              |
|                                    | Smith (86-0250)                  | TP        | >                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            |                |                            |              |              |
|                                    | Granite (86-0217)                | TP        | -                           |                                   |                        |          |                       |                     |              |                              | -                  | Δ              |            | Δ              |                            |              |              |
|                                    | Camp (86-0221)                   | TP        | -                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            |                |                            |              |              |
|                                    | Howard (86-0199)                 | TP        | >                           |                                   |                        |          |                       |                     |              |                              | -                  | Δ              |            | Δ              |                            |              |              |
|                                    | Dutch (86-0184)                  | TP        | -                           |                                   |                        |          |                       |                     |              |                              | -                  | Δ              |            | Δ              | ™                          |              |              |
|                                    | Rock (86-0182)                   | TP        | >                           |                                   | >                      |          |                       |                     |              |                              | -                  | Δ              |            | Δ              |                            |              |              |
|                                    | Little Waverly (86-0106)         | TP        | -                           |                                   |                        |          |                       |                     |              |                              | >                  |                | >          | Δ              |                            |              |              |
|                                    | Waverly (86-0114)                | TP        | -                           |                                   |                        |          |                       |                     |              | >                            | -                  | Δ              |            | Δ              | ™                          |              |              |
|                                    | Ramsey (86-0120)                 | TP        | -                           |                                   | >                      |          |                       |                     |              |                              | >                  | Δ              |            | Δ              |                            |              |              |
|                                    | Albert (86-0127)                 | TP        | >                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            | Δ              |                            |              |              |
|                                    | Light Foot (86-0122)             | TP        | -                           |                                   | >                      |          |                       |                     |              |                              | -                  | Δ              |            | Δ              |                            |              |              |
|                                    | Fountain (86-0273)               | TP        | ™                           |                                   | ™                      |          |                       |                     |              |                              | -                  |                |            |                |                            |              |              |

Key: - = High > = Moderate ™ = Low Δ = Potential source, relative magnitude unknown

Table 6, continued. Nonpoint Sources in the NFC Watershed. Relative magnitudes of contributing sources are indicated.

| HUC-10 Subwatershed                          | Stream/Reach (AUID) or Lake (ID) | Pollutant      | Pollutant Sources           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|--|----------------------------------|----------------|-----------------------------|-----------------------------------|------------------------|----------|-----------------------|---------------------|--------------|------------------------------|--------------------|----------------|------------|----------------|----------------------------|--------------|--------------|--|
|  |                                  |                | Fertilizer & manure run-off | Livestock overgrazing in riparian | Failing septic systems | Wildlife | Stream Channelization | Upland soil erosion | Urban Runoff | Internal TP Sediment Release | Aquatic Vegetation | Upstream Lakes | Rough Fish | WWTP Discharge | In-stream Algal production | Sediment SOD | Bank Erosion |  |
| North Fork Crow River Continued (0701020406) | Malardi (86-0112)                | TP             | >                           |                                   |                        |          |                       |                     |              |                              | -                  |                |            |                |                            |              |              |  |
|  | Deer (86-0107)                   | TP             |                             |                                   |                        |          |                       |                     |              |                              | >                  | Δ              | -          | Δ              |                            |              |              |  |
|  | Buffalo (86-0090)                | TP             | >                           |                                   | >                      |          |                       |                     |              |                              |                    | -              | Δ          | -              | Δ                          |              |              |  |
|  | Dean (86-0041)                   | TP             | -                           |                                   | TM                     |          |                       |                     |              |                              |                    | -              |            |                |                            |              |              |  |
|  | Mill Creek (515)                 | DO             | -                           |                                   |                        |          | >                     |                     |              |                              |                    |                |            | -              |                            |              |              |  |
|  |                                  | Turbidity      |                             |                                   |                        |          |                       |                     |              |                              |                    |                | Δ          |                |                            |              | TM           |  |
|  | Count Ditch 31 (667)             | DO             | -                           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  |                                  | <i>E. coli</i> | -                           | TM                                | TM                     | TM       |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  | Unnamed Creek (668)              | Turbidity      |                             |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  | North Fork Crow River (503)      | Turbidity      |                             |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  | Ann (86-0190)                    | TP             | -                           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
| Emma (86-0188)                               | TP                               | -              |                             |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
| Crow River (0701020407)                      | Constance (86-0051)              | TP             | >                           |                                   | >                      |          |                       |                     |              |                              |                    |                |            | Δ              |                            |              |              |  |
|  | Pelican (86-0031)                | TP             | >                           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  | Beebe (86-0023)                  | TP             | -                           |                                   | >                      |          |                       |                     |              |                              |                    |                |            |                | Δ                          |              | >            |  |
|  | Hafften (86-0199)                | TP             | >                           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  | Foster (86-0001)                 | TP             | -                           |                                   |                        |          |                       |                     |              |                              |                    |                |            |                | Δ                          |              |              |  |
|  | Crow River (502)                 | <i>E. coli</i> | >                           | -                                 | TM                     |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  |                                  | Turbidity      | TM                          |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
| Regal Creek (542)                            | DO                               |                |                             |                                   |                        |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |
|  | <i>E. coli</i>                   | -              | TM                          | TM                                | TM                     |          |                       |                     |              |                              |                    |                |            |                |                            |              |              |  |

Key: ~ = High > = Moderate TM = Low Δ = Potential source, relative magnitude unknown

## 2.4 TMDL Summary

The TMDL studies have been conducted that include the [North Fork Crow and Lower Crow Bacteria, Turbidity, and Low Dissolved Oxygen TMDL](#) (Wenck Assoc., approved 2013), [Rice Lake Excess Nutrient TMDL](#) (Wenck Associates, approved 2012), [Diamond Lake](#) (Houston Eng., approved 2011), [Ann and Emma Lakes](#) (Wenck Assoc., approved 2012) and [North Fork Crow River TMDL: Bacteria, Nutrients, and Turbidity](#) (Wenck Assoc., *In review.*) These documents contain allocation load reductions for stream and lake impairments, which are summarized for reference in Table 7 and Table 8 of this report. Additionally, Section 3 prioritizes watersheds into protection and restoration areas using pollutant loading analysis, which also outlines strategies for watershed loading reductions. The comprehensive TMDL reports for the NFC can be found at the links provided above.

Table 7. Allocation summary for completed lake TMDLs in the NFC River watershed.

| HUC-10   | Lake (ID)            | Pollutant | Allocations (lbs/year) |                                      |                 |                 |               |                |      |            |                  |                  | Percent Reduction |
|--|----------------------|-----------|------------------------|--------------------------------------|-----------------|-----------------|---------------|----------------|------|------------|------------------|------------------|-------------------|
|  |                      |           | Wasteload Allocation   |                                      |                 | Load Allocation |               |                |      |            | MOS              | RC               |                   |
|  |                      |           | WWTFs                  | Construction & Industrial Stormwater | MS4 Communities | Watershed Load  | Internal Load | Upstream Lakes | SSTS | Atmosphere | Margin of Safety | Reserve Capacity |                   |
| Lake Koronis-North Fork Crow River (701020401)   | Rice Lake (73-0196)  | TP        | 3,144                  | 9                                    | --              | 23,393          | 445           | --             | --   | 301        | 1,484            | --               | 53%               |
| Middle Fork Crow (0701020402)                    | Nest (34-0154)       | TP        | 1,017                  | 14                                   | --              | 1,280           | 747           | 2,389          | 0    | 241        | 299              | --               | 13%               |
|  | Diamond (34-0044)    | TP        | --                     | --                                   | --              | 1,550           | 227           | 343            | 0    | 258        | 668              | --               | 44%               |
| Jewitts Creek-North Fork Crow River (0701020403) | Hope (47-0183)       | TP        | --                     | 165                                  | --              | 250             | 147           | --             | 0    | 60         | 33               | --               | 85%               |
|  | Long (47-0177)       | TP        | --                     | 152                                  | --              | 1,936           | 276           | 361            | 0    | 184        | 153              | --               | 89%               |
| Washington Creek (0701020404)                    | Richardson (47-0088) | TP        | --                     | 12                                   | --              | 452             | 61            | --             | 0    | 26         | 29               | --               | 57%               |
|  | Dunns (47-0082)      | TP        | --                     | 0.3                                  | --              | 17              | 157           | 113            | 0    | 34         | 17               | --               | 73%               |
| Big Swan Lake (701020405)<br>Continued           | Hook (43-0073)       | TP        | --                     | 3                                    | --              | 298             | 339           | --             | 0    | 73         | 38               | --               | 66%               |
|  | Jennie (47-0015)     | TP        | --                     | 14                                   | --              | 1,271           | 851           | 96             | 0    | 254        | 131              | --               | 12%               |

Table 7, continued. Allocation summary for all completed lake TMDLs in the NFC River Watershed.

| HUC-10                                    | Lake (ID)               | Pollutant | Allocations (lbs/year) |                                      |                 |                 |               |                |      |            |                  |                  | Percent Reduction |
|---|-------------------------|-----------|------------------------|--------------------------------------|-----------------|-----------------|---------------|----------------|------|------------|------------------|------------------|-------------------|
|   |                         |           | Wasteload Allocation   |                                      |                 | Load Allocation |               |                |      |            | MOS              | RC               |                   |
|   |                         |           | WWTFs                  | Construction & Industrial Stormwater | MS4 Communities | Watershed Load  | Internal Load | Upstream Lakes | SSTS | Atmosphere | Margin of Safety | Reserve Capacity |                   |
| Big Swan Lake<br>(701020405)<br>Continued | Collinwood<br>(86-0293) | TP        | --                     | 47                                   | --              | 1,531           | 147           | 478            | 0    | 152        | 124              | --               | 72%               |
|   | Spring<br>(47-0032)     | TP        | --                     | 0.9                                  | --              | 62              | 166           | 38             | 0    | 52         | 17               | --               | 57%               |
|   | Big Swan<br>(47-0038)   | TP        | --                     | 38                                   | --              | 1,194           | 58            | 1,059          | 0    | 166        | 132              | --               | 63%               |
| North Fork<br>Crow River<br>(701020406)   | Brooks<br>(86-0254)     | TP        | --                     | 0.2                                  | --              | 7               | 69            | --             | 0    | 21         | 5                | --               | 57%               |
|   | Cokato<br>(86-0263)     | TP        | 794                    | 46                                   | --              | 2,800           | 77            | 30             | 0    | 130        | 204              | --               | 34%               |
|   | Smith<br>(86-0250)      | TP        | --                     | 3                                    | --              | 87              | 133           | --             | 0    | 50         | 14               | --               | 86%               |
|   | French<br>(86-0273)     | TP        | --                     | 7                                    | --              | 674             | 105           | --             | 0    | 83         | 46               | --               | 13%               |
|   | Granite<br>(86-0217)    | TP        | --                     | --                                   | --              | 357             | 296           | --             | 0    | 78         | 15               | --               | 50%               |
| Camp<br>(86-0221)                         | TP                      | --        | 3                      | --                                   | 128             | 248             | --            | 0              | 26   | 12         | --               | 70%              |                   |

Table 7, continued. Allocation summary for all completed lake TMDLs in the NFC River Watershed.

| HUC-10   | Lake (ID)                | Pollutant | Allocations (lbs/year) |                                      |                 |                 |               |                |      |            |                  |                  | Percent Reduction |
|--|--------------------------|-----------|------------------------|--------------------------------------|-----------------|-----------------|---------------|----------------|------|------------|------------------|------------------|-------------------|
|  |                          |           | Wasteload Allocation   |                                      |                 | Load Allocation |               |                |      |            | MOS              | RC               |                   |
|  |                          |           | WWTFs                  | Construction & Industrial Stormwater | MS4 Communities | Watershed Load  | Internal Load | Upstream Lakes | SSTS | Atmosphere | Margin of Safety | Reserve Capacity |                   |
| North Fork Crow River (701020406)<br>Continued | Deer (86-0107)           | TP        | --                     | 1.6                                  | --              | 143             | 220           | 1,793          | 0    | 39         | 116              | --               | 55%               |
|  | Dutch (86-0184)          | TP        | --                     | 7                                    | --              | 75              | 48            | 90             | 0    | 39         | 14               | --               | 87%               |
|  | Little Waverly (86-0106) | TP        | --                     | 33                                   | --              | 420             | 120           | 1,478          | 0    | 79         | 112              | --               | 85%               |
|  | Waverly (86-0114)        | TP        | --                     | 5                                    | --              | 444             | 534           | 123            | 0    | 116        | 64               | --               | 9%                |
|  | Rock (86-0182)           | TP        | --                     | 1                                    | --              | 66              | 148           | --             | 0    | 148        | 7                | --               | 44%               |
|  | Ramsey (86-0120)         | TP        | --                     | 12                                   | --              | 756             | 180           | 72             | 0    | 74         | 58               | --               | 47%               |
|  | Albert (86-01270)        | TP        | --                     | 1                                    | --              | 32              | 22            | --             | 0    | 14         | 4                | --               | 87%               |
|  | Light Foot (86-0122)     | TP        | --                     | 27                                   | --              | 411             | 21            | 171            | 0    | 15         | 33               | --               | 84%               |
|  | Buffalo (86-0090)        | TP        | --                     | 19                                   | 274             | 799             | 643           | 1,445          | 0    | 371        | 186              | --               | 66%               |
|  | Ann (86-0190)            | TP        | --                     | 18                                   | --              | 1,181           | 229           | --             | 0    | 83         | 80               | --               | 82%               |
|  | Emma (86-0188)           | TP        | --                     | 4                                    | --              | 284             | 193           | 985            | 0    | 42         | 78               | --               | 60%               |
|  | Fountain (86-0086)       | TP        | --                     | 18                                   | --              | 130             | 362           | --             | 0    | 102        | 32               | --               | 87%               |
|  | Malardi (86-0112)        | TP        | --                     | 3                                    | --              | 55              | 43            | --             | 0    | 26         | 7                | --               | 95%               |
| Dean (86-0041)                                 | TP                       | --        | 8                      | --                                   | 75              | 47              | --            | 0              | 42   | 9          | --               | 91%              |                   |
| Crow River (701020407)                         | Constance (86-86-0051)   | TP        | --                     | 1                                    | <1              | 54              | 125           | --             | 0    | 39         | 11               | --               | 75%               |
|  | Beebe (86-0023)          | TP        | --                     | 2                                    | --              | 78              | 214           | --             | 0    | 66         | 19               | --               | 48%               |
|  | Pelican (86-0031)        | TP        | --                     | 29                                   | 243             | 1,129           | 2,678         | 69             | 0    | 827        | 260              | --               | 74%               |
|  | Hafften (27-0199)        | TP        | --                     | <1                                   | --              | 12              | 38            | 101            | 0    | 10         | 9                | --               | 34%               |
|  | Foster (86-0001)         | TP        | --                     | 9                                    | 220             | --              | 135           | --             | 0    | 27         | 20               | --               | 87%               |

Of the aforementioned approved TMDL studies, with the exception of the *North Fork and Lower Crow Bacteria, Turbidity, and Low Dissolved Oxygen TMDL*, all have a corresponding approved implementation plan. The restoration strategies set forth in this document will serve as the basis for the NF & Lower Crow TMDL implementation as well as the draft North Fork Crow Bacteria, Nutrients and Turbidity TMDL.

**Table 8. Allocation summary for all completed bacteria and sediment TMDLs in the NFC River watershed.**

| HUC-10   | Stream/Reach (AUID) | Pollutant      | Flow Zone | E. coli Allocations (billions organisms/day)<br>Sediment Allocations (tons/year) |                                    |                 |                  | Percent Reduction |
|--|---------------------|----------------|-----------|--|------------------------------------|-----------------|------------------|-------------------|
|  |                     |                |           | Wasteload Allocation   |                                    | Load Allocation | MOS              |                   |
|  |                     |                |           | WWTFs  | Regulated Stormwater (CSW/ISW/MS4) | Watershed Load  | Margin of Safety |                   |
| Jewitts Creek-North Fork Crow River (0701020403) | Grove Creek (514)   | <i>E. coli</i> | Very High | 1.1  | --                                 | 268             | 30               | 0%                |
|  |                     | TSS            |           | <0.1   | --                                 | 6.6             | 0.3              | 0%                |
|  |                     | <i>E. coli</i> | High      | 1.1  | --                                 | 104             | 12               | 0%                |
|  |                     | TSS            |           | <0.1   | --                                 | 2.5             | 0.1              | 40%               |
|  |                     | <i>E. coli</i> | Mid       | 1.1  | --                                 | 40              | 4.5              | 47%               |
|  |                     | TSS            |           | <0.1   | --                                 | 1.0             | 0.1              | 45%               |
|  |                     | <i>E. coli</i> | Low       | 1.1  | --                                 | 15              | 1.8              | 50%               |
|  |                     | TSS            |           | <0.1   | --                                 | 0.4             | <0.1             | 0%                |
|  | <i>E. coli</i>      | Dry            | 1.1       | --   | 8.4                                | 1.1             | 72%              |                   |
|  | TSS                 |                | <0.1      | --   | 0.2                                | <0.1            | 0%               |                   |
|  | Jewitts Creek (585) | <i>E. coli</i> | Very High | 11.3   | 28.8                               | 183.4           | 24.8             | 0%                |
|  |                     |                | High      | 11.3   | 11.3                               | 71.7            | 10.5             | 0%                |
|  |                     |                | Mid       | 11.3   | 4.0                                | 25.2            | 4.5              | 0%                |
|  |                     |                | Low       | 11.3   | 1.3                                | 8.3             | 2.3              | 41%               |
| Dry  |                     |                | 11.3      | 0.2  | 1.4                                | 1.4             | 55%              |                   |
| Jewitts Creek-North Fork Crow River (0701020406) | Unnamed Creek (667) | <i>E. coli</i> | Very High | --   | --                                 | 172             | 19               | 40%               |
|  |                     |                | High      | --   | --                                 | 14              | 1.5              | 19%               |
|  |                     |                | Mid       | --   | --                                 | 1               | <1               | 67%               |
|  |                     |                | Low       | --   | --                                 | <1              | <1               | 62%               |
|  |                     |                | Dry       | --   | --                                 | <1              | <1               | 86%               |
|  | Unnamed Creek (668) | TSS            | Very High | --   | --                                 | 3.7             | 0.2              | 0%                |
|  |                     |                | High      | --   | --                                 | 0.7             | <0.1             | 0%                |
|  |                     |                | Mid       | --   | --                                 | 0.1             | <0.1             | 0% <sup>1</sup>   |
|  |                     |                | Low       | --   | --                                 | <0.1            | <0.1             | 0% <sup>1</sup>   |
|  |                     |                | Dry       | --   | --                                 | 0.0*            | 0.0*             | 0% <sup>1</sup>   |

Table 8, continued. Allocation summary for all completed bacteria and sediment TMDLs in the NFC River Watershed

| HUC-10   | Stream/Reach (AUID)   | Pollutant | Flow Zone | E. coli Allocations (billions organisms/day)<br>Sediment Allocations (tons/year) |                                    |                         |                  | Percent Reduction |
|--|-----------------------|-----------|-----------|--|------------------------------------|-------------------------|------------------|-------------------|
|  |                       |           |           | Wasteload Allocation   |                                    | Load Allocation         | MOS              |                   |
|  |                       |           |           | WWTFs  | Regulated Stormwater (CSW/ISW/MS4) | Watershed Load          | Margin of Safety |                   |
| Jewitts Creek-North Fork Crow River (0701020406) (continued) | Mill Creek (515)      | TSS       | Very High | --   | 13.0                               | 70.0                    | 6.5              | 0%                |
|  |                       |           | High      | --   | 2.6                                | 14.2                    | 1.3              | 0%                |
|  |                       |           | Mid       | --   | 0.5                                | 2.7                     | 0.3              | 33%               |
|  |                       |           | Low       | --   | 0.1                                | 0.5                     | <0.1             | 0%                |
|  |                       |           | Dry       | --   | <0.1                               | 0.2                     | <0.1             | 20%               |
|  | North Fork Crow (503) | TSS       | Very High | 2.8  | 20.8                               | 345                     | 3.8              | 35%               |
|  |                       |           | High      | 2.8  | 8.5                                | 135                     | 12.1             | 40%               |
|  |                       |           | Mid       | 2.8  | 2.4                                | 36.6                    | 2.0              | 13%               |
|  |                       |           | Low       | 2.8  | 1.0                                | 12.5                    | 0.7              | 46%               |
|  |                       |           | Dry       | 2.8  | 0.7                                | 6.8                     | 0.2              | 0%                |
| Crow River (0701020407)                                      | Crow River (502)      | E. coli   | Very High | 109  | 242                                | 5,758 (NFC)<br>593(LC)  | 1,367            | 5%                |
|  |                       | TSS       |           | 3.4  | 59.5                               | 308(NFC)<br>32(LC)      | 23               | 39%               |
|  |                       | E. coli   | High      | 109  | 138                                | 3,326 (NFC)<br>333 (LC) | 778              | 32%               |
|  |                       | TSS       |           | 3.4  | 20.4                               | 103(NFC)<br>11(LC)      | 21               | 87%               |
|  |                       | E. coli   | Mid       | 109  | 72                                 | 1,641 (NFC)<br>169 (LC) | 406              | 41%               |
|  |                       | TSS       |           | 3.4  | 5.8                                | 27(NFC)<br>2.8(LC)      | 3.4              | 41%               |
|  |                       | E. coli   | Low       | 109  | 23                                 | 454 (NFC)<br>47 (LC)    | 129              | 26%               |
|  |                       | TSS       |           | 3.4  | 2.3                                | 8.7(NFC)<br>0.9(LC)     | 1.3              | 26%               |
|  |                       | E. coli   | Dry       | 109  | 7                                  | 65 (NFC)<br>7 (LC)      | 38               | 0%                |
|  |                       | TSS       |           | 3.4  | 1.6                                | 4.8(NFC)<br>0.5(LC)     | 0.4              | 0%                |
|  | Regal Creek (542)     | E. coli   | Very High | --   | 173.4                              | 234.0                   | 45.3             | 1%                |
|  |                       |           | High      | --   | 60.3                               | 81.4                    | 15.7             | 0%                |
|  |                       |           | Mid       | --   | 18.2                               | 24.6                    | 4.8              | 46%               |
|  |                       |           | Low       | --   | 6.6                                | 8.9                     | 1.7              | 83%               |
| Dry  |                       |           | --        | 3.7  | 5.0                                | 1.0                     | 81%              |                   |

\* No flow during median conditions

<sup>1</sup>Insufficient data

## 2.5 Protection Considerations

Even though there will be significant restoration efforts in the NFC, there are areas identified for protection as well. Of the 74 stream reaches that have been assessed, four fully support aquatic life and one fully supports aquatic recreation, while 20 are impaired for aquatic life and 16 are impaired for aquatic recreation. Of the 90 lakes assessed, 46% are impaired for aquatic recreation, 33% are fully supporting aquatic recreation, and 21% have insufficient data to make an assessment.

The following protection efforts are already underway and/or ongoing in the NFC:

### Partner Organizations

#### **CROW**

The Crow River Organization of Water (CROW) has received a Clean Water Partnership (CWP) grant to develop protection strategies for individual chains of lakes aimed at maintaining the current water quality. These studies focus on water quality control, rough fish management, invasive species management, and other strategies to protect these resources. The Crow Lakes Protection and Resource Investigation CWP Project furthers CROW's diagnostic and assessment program by using a TMDL-like process to assess and protect high valued lakes. The Project's "virtual TMDL" studies will evaluate lake water quality relative to the MPCA eutrophication standards, assess external and internal TP loads, quantify maximum TP allocations, and identify TP reduction (or stabilization) plans or strategies for source areas. The Project will focus on ten lakes: Minnie-Belle, Manuella, Stella, Lake Washington, Francis, West Sylvia, East Sylvia, John, Charlotte, and Martha. These lakes are located throughout Meeker and Wright counties, are highly used recreational lakes with adjacent park lands: Greater Minnesota Girl Scout Council on Lake Charlotte (48.53 acres); Koinonia Retreat Center on East Sylvia (86.4 acres); St. John's Lutheran Camp on both East/West Sylvia (39.2 acres); and Lake Manuella Park (2 acres). These key lakes are parts of lake chains in which the whole chain is not impaired, and the protection strategies developed through this project will complement the TMDL implementation efforts to focus on comprehensively managing the chain as a system.

All of the lakes also are significant components because they provide quality water to the NFC River which is locally and regional important because it empties into the Mississippi River 20 miles upstream from the Minneapolis Water Plant intake. The Mississippi River provides drinking water to Minneapolis and provides most of the flow to the lower Mississippi Recreational area and the lower Mississippi Wildlife Refuge before flowing into Lake Pepin. The Crow River is a major river system in Wright County that directly drains two thirds of the county. It is a major recreational area in its own right, but also flows into the Mississippi River; a premier smallmouth bass fishery. At Project completion, diagnostic studies and implementation plans for 100% of the non-impaired chain of lakes in the NFC River Watershed will be completed.

#### **NFCRWD**

North Fork Watershed District has been awarded a 2013 Clean Water Fund Conservation Drainage Grant. The District is planning on implementing agricultural BMPs, including 100 Alternative Inlets (rock inlets or dense pattern tile intakes) and two saturated buffers, to reduce the nutrients, sediment and volume of water being transported by field tile. Implementation of these practices and continued education of landowners will hopefully lead to further



acceptance from the agricultural community leading to landowner's installation of these BMP's improving water quality.

The NFC River Watershed is mainly agricultural and has numerous public and private drainage ditches. These ditches have become overwhelmed by land use change and sub-surface drainage, and are major contributors to the sediment and nutrient loading into the NFC River and District Lakes. The District received a Clean Water Assistance grant to assist in the protection and restoration of the District's water resources and help the District reach the Rice Lake TMDL phosphorous reductions goals. The District has landowners willing to contribute land on public drainage systems to retain water and restore wetlands at three locations with total anticipated yearly pollutant removal of 200 tons of total suspended sediment (TSS) and 235 pounds of phosphorus (TP).

## MFWD

In 2011, the Middle Fork Watershed District partnered with Ducks Unlimited and the Diamond Lake Area Recreational Association to investigate the feasibility of actively managing water levels on the Hubbard, Schultz, and Wheeler chain of lakes to enhance their condition. Much of this feasibility work was completed with funding from Minnesota's Outdoor Heritage Fund as recommended by the Lessard-Sams Outdoor Heritage Council. The project has been deemed feasible, and in 2013 the Middle Fork Crow River Watershed District initiated the Hubbard, Schultz, and Wheeler lakes project.

## DNR

The Minnesota DNR maintains a list of high priority shallow lakes for wildlife protection in the Crow River watershed. All shallow lakes of Minnesota were identified using Arc GIS by querying out of the lakes layer using the criteria of less than 15 feet deep and greater than 50 acres in size. Priority status would be given to those adjacent to or completely within public lands.

Many of these lakes have completed TMDLs while the remaining are either not assessed (IF) or support (FS) beneficial uses. These IF and FS shallow lakes also need protection strategies focused on maintaining or improving wildlife habitat. Additional information can be found in Appendix B: DNR Watershed Conditions Report.

## Tools

### MNLeap

The MPCA conducted MNLeap model (a lake assessment tool developed by the MPCA) assessments for each of the protection lakes to determine their best possible water quality conditions (MPCA 2010). General lake assessment for the NFC was aggregated by HUC 11 watershed units to determine if they were best suited to general protection or restoration strategies. The following HUC 11 watershed units were identified to have good water quality, therefore placed in protection status, based on a combination of MNLeap model assessment and observed water quality data: (See Appendix C)

- Upper Middle Fork Crow River
- Central Middle Fork Crow River
- Washington Creek

- Louzers Lake Outlet

The following HUC 11 watershed units were identified for restoration practices to prevent further water quality impacts (threatened): (See Appendix C)

- Upper NFC River
- Mill Creek

### Stressor Identification (SID)

Conclusion from the NFC River SID Report states, “Index of Biological Integrity (IBI) scores are quite low throughout the length of the NFC/Lower Crow River mainstem. As a result, it is difficult to identify areas of outstanding ecological health that are deserving of protection status based solely on IBI data. Without question, the majority of implementation efforts in this watershed must be in the form of restoration, effective use of best management practices, and education and outreach. However, a stream reach located approximately two miles west of Paynesville, Minnesota has a good riparian corridor of mature trees and streambanks which are relatively stable. Coarse substrate for gravel spawning fish and darter species is abundant and substrate embeddedness appeared to be lower compared to other sites in the area. Fish IBI scores at site 96UM004, which is located in the upper portion of this potential protection priority area, are some of the highest on the NFC.

“Stream reconnaissance efforts revealed a few reaches of the NFC that may represent “best available” conditions for supporting healthy fish/macroinvertebrate populations. Most of these locations do not have biological data associated with them. Future monitoring in the watershed should target these locations to assess their condition and status as potential protection targets.”

All of the streams and lakes that are currently supporting their beneficial uses (aquatic life and recreation), should have protection strategies developed. Strategies for addressing protection of these waters are further discussed in Section 3 of this report.

## 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, 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 needed to voluntarily implement best management practices. Thus, effective ongoing civic engagement is an essential part of the overall plan for moving forward.

CROW has been approved for state funding for the purpose of creating a single watershed plan for the NFC through the *One Watershed, One Plan* (1W1P) granting process. The 1W1P effort will require participation by 20+ organization/agency stakeholders in the NFC watershed that include: two watershed districts, two metro-water management authorities, and seven SWCDs. The CROW will include additional planning members by establishing a Memorandum of Understanding (MOU) between the aforementioned and CROW. Project partners are poised and eager to apply their knowledge and skills to make this project a success.

The 1W1P approach will provide a unique opportunity/catalyst for cost-effective coordination and implementation of local government and State government initiatives within the watershed. The 1W1P will serve as a “road-map” for the coordination and strengthening of local activities/plans, which will identify the most cost-effective solutions to accomplish water quality and quantity management, and establish a comprehensive framework for finance and implementation. A multi-jurisdictional standard, i.e., performance provision of the Plan, can serve to diffuse and deflect local politics in enforcement issues. Another very significant benefit of the 1W1P will be the efficiencies gained by updating only one plan every 10 years as compared to the current status of updating 10 separate and often overlapping water management plans every 10 years. The 1W1P is a natural progression with the WRAP reports for targeting actions to improve water quality, identify point and nonpoint sources of pollution that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources. For more information on the 1W1P refer to: <http://www.bwsr.state.mn.us/planning/1W1P/index.html>

### 3.1 Targeting of Geographic Areas

Targeting has been used at several scales to help identify priority areas in the NFC. The following discussion begins at the state and basin scale and moves to smaller more focused areas based on the specific tools used for this project.

#### State and Mississippi Basin Scale

The *Minnesota Nutrient Reduction Strategy* (MPCA, 2013) was developed in response to concern about excessive nutrient levels that pose a substantial threat to Minnesota’s lakes and rivers, as well as downstream waters including the Great Lakes, Lake Winnipeg, the Mississippi River, and the Gulf of Mexico. In recent decades, nutrient issues downstream of Minnesota have reached critical levels, including the effect of nutrients in the Gulf of Mexico which resulted in a dead zone, eutrophication issues in Lake Winnipeg, and algal blooms in the Great Lakes. Several state-level initiatives and actions highlighted the need for a statewide strategy that ties separate but related activities together to further progress in making nutrient reductions. Minnesota conducted both nitrogen and phosphorus assessments to identify nutrient source contributions. The main nutrient sources to the Mississippi River are Phosphorus from agricultural cropland runoff, wastewater, and streambank erosion, and Nitrogen from agricultural tile drainage and water leaving cropland via groundwater. The associated Phase I milestones for the Mississippi River basin N and P are 20% and 35% reduction from baseline by 2025 respectively. Additional milestones call for 30% (N) and 45% (P) by 2035 and 45% reduction from baseline in N by 2045.

*Nitrogen in Minnesota Surface Waters* (MPCA, 2013) was developed in response to a concern for human health when elevated Nitrogen levels reach drinking water supplies. The 10 mg/l nitrate-N drinking water standard established for surface and groundwater drinking water sources and for cold water streams is exceeded in numerous wells and streams. As noted in the Nutrient Reduction study above, the concern about nitrogen (N) in surface waters has grown due to nitrogen’s role in causing a large oxygen-depleted hypoxic zone in the Gulf of

Mexico, and an increasing body of evidence showing toxic effects of nitrate on aquatic life. The purpose of this study was to provide an assessment of the science concerning N in Minnesota waters so that the results could be used for current and future planning efforts, thereby resulting in meaningful goals, priorities, and solutions.

More specifically, the purpose of this project was to characterize N loading to Minnesota’s surface waters, and assess conditions, trends, sources, pathways, and potential BMPs to achieve nitrogen reductions in our waters. The Nitrogen study contains a spreadsheet tool called the NBMP tool. (NBMP is described in more detail in the nitrogen study report chapter F1.) The NBMP tool was applied to the NFC watershed to calculate approximate acres of BMP adoption necessary to achieve roughly a 20% N reduction, which also aligns with the NRS Phase I reduction goal for N. Table 9 displays results of the NBMP tool.

Table 9. BMPs needed to achieve watershed goals.

| Combination of needed BMPs                             | North Fork Crow (acres) |
|--|-------------------------|
| Reduce avg. N application rate 30 lbs (corn after soy) | 158,000                 |
| Perennials in riparian and marginal lands              | 19,000                  |
| Constructed wetlands to treat tile water               | 9,000                   |
| Controlled drainage or bioreactors                     | 6,000                   |
| Cover Crops  | 55,000                  |

### HUC 8 Scale

A wide variety of tools (datasets and GIS) were available to target geographic areas that are in need of restoration or protection (Table 10). Since the pollutants of primary concern in the NFC watershed are Total Phosphorous (TP), bacteria, suspended solids (turbidity) and nitrogen, a specific set of tools was used to assess the pollutant loading throughout the entire NFC watershed. The tools that were used in this WRAP report are:

- Hydrological Simulation Program – Fortran (HSPF)
  - o Hydrology
  - o Sediment Load
  - o Total Phosphorus Load
  - o Nitrogen Load
- Watershed Bacteria Production by Source
- Environmental Benefit Index (EBI)

In addition to the tools used to target protection and restoration areas on a major basin scale (i.e. North Fork Crow Watershed), others were used on a finer scale in the TMDL process to target specific pollutant loading sources in each impaired watershed. The source assessment and reduction strategies derived from these focused tools are also summarized in Table 11. These tools include:

- The Revised Universal Soil Loss Equation (RUSLE)
- Watershed Bacteria Production by Source

- In Lake Nutrient Response Model (BATHTUB)
- Stream Power Index Using Light Detection and Ranging (LiDAR)

### Priorities Based on HSPF Results

The HSPF model (see description in Table 11) for the NFC watershed was constructed by RESPEC, a consulting firm under contract with the MPCA. A detailed report summarizing calibration and validation results is available [here](#). The HSPF model was first divided into 43 HUC-12 watersheds. To provide more detail the HUC-12 watersheds were further divided into subwatersheds based on differences in available climatology data and landscape characteristics such as a strategically located tributary or lake. The model simulated a period from 1996-2009 in one hour time steps. Results for average annual runoff and average annual load for TP, TN and TSS are shown in Figures 3-6.

The HSPF generated maps allow a quick visual comparison that can be used to generally identify priority areas for protection and restoration based on the aggregated HUC-12 subwatersheds. The following Table (Table 10) is a compilation of the general visual comparison of the HSPF and the EBI scores (Figure 7).

Table 10. HSPF map based priority subwatersheds within HUC-12s

| Aggregated HUC 12       | Restoration |    |    |     |          |     | Protection |    |    |     |          |     |
|-------------------------|-------------|----|----|-----|----------|-----|------------|----|----|-----|----------|-----|
|                         | Runoff      | TN | TP | TSS | Bacteria | EBI | Runoff     | TN | TP | TSS | Bacteria | EBI |
| Co Ditch 7 - NFCR       |             |    |    |     |          |     | X          | X  | X  | X   |          |     |
| Lake Koronis - NFCR     | X           |    |    |     | X        | X   | X          | X  |    | X   |          | X   |
| Upper Middle Fork Crow  |             |    |    |     | X        | X   | X          |    | X  | X   |          | X   |
| Lower Middle Fork Crow  |             |    |    |     | X        |     | X          |    |    | X   |          |     |
| Grove Creek             | X           |    |    | X   |          |     |            |    |    |     |          |     |
| Jewitts Creek           |             | X  |    |     |          |     |            |    |    |     |          |     |
| City of Kingston - NFCR |             |    |    |     | X        |     |            |    |    |     |          |     |
| Washington Creek        | X           |    | X  | X   |          | X   |            |    |    |     | X        | X   |
| Rock Lake -NFCR         | X           |    |    | X   |          | X   |            |    |    |     |          | X   |
| Big Swan Lake           |             |    | X  | X   |          | X   |            |    | X  |     | X        | X   |
| Cokato Lake             |             |    | X  |     |          |     |            |    |    |     |          |     |
| Twelvemile Creek        | X           |    | X  |     |          |     |            |    |    |     |          |     |
| Mill Creek              |             |    |    |     |          | X   |            |    |    |     | X        | X   |
| North Fork Crow River   | X           | X  | X  | X   |          |     |            |    |    |     | X        |     |
| Pelican Lake            | X           |    |    | X   |          | X   |            |    |    |     |          | X   |
| Crow River              |             | X  |    |     |          | X   |            |    |    |     |          | X   |

### Priorities Based on the SID Results

#### Improving habitat in channelized streams

Once a ditch is constructed or a stream channelized, it will attempt to return to a natural, stable state by meandering (Hansen et al., 2006). Due to differences in management approach, some ditches are not actively cleaned out and have begun to function like natural streams again. Examples of unmaintained and “naturalizing” drainage ditches occur in the NFC watershed, and several of them achieve fish and macroinvertebrate IBI scores that

are higher than ditches that are routinely cleaned and straightened. In the NFC watershed there are 15 county ditch systems consisting of approximately 100 miles of total ditch length. There are also many miles of private ditch networks in the watershed and a buried tile system containing 11,280 feet of underground drainage tile. Due to the prevalence of agricultural ditching in the NFC watershed, it was identified as a potential cause of fish and invertebrate impairments.

### **Loss of riparian buffer zones**

The NFC/Lower Crow River watershed becomes increasingly populated and developed from the city of Kingston, Minnesota east to the confluence with the Mississippi River. Near the cities of Rockford and St. Michael, individual residences and multi-home sub-developments are more common features of the riparian corridor. The presence of turf grass lawns in the immediate riparian corridor of the river can increase runoff rates (Figure 3) and nutrient (Figure 4 and 5) delivery to surface waters, increase bank erosion rates, and decrease shading and woody debris/detritus inputs that provide habitat and support aquatic food webs.

### **Animal Agriculture**

Animal agriculture is a prominent land-use in the NFC/Crow River watershed. Large tracts of pasture land are common features of the landscape in this region of Minnesota, supporting herds of cattle, horses, sheep, and swine. In the NFC watershed, pasture areas in the riparian corridor are quite common in the headwaters area and Alluvium Outwash watershed zone upstream of and around Paynesville, Minnesota (Figure 1).

Uncontrolled grazing of riparian corridors can negatively impact habitat for fish, macroinvertebrates, and other organisms found in riparian zones. Some common impacts are (1) wider, shallower, less stable stream channel (Rosgen, 1996); (2) increased bank erosion and sediment deposition; and (3) reduced shading, woody debris, and fish cover.

### **Cultivated Cropland**

The predominant land use in the NFC is cultivated cropland. In most locations along the river, vegetated buffers of varying width and quality are in place to separate cultivated land from the active stream channel and floodplain. However, several areas along the NFC River lack buffers and have shown high susceptibility to erosion and lateral channel migration. The development of priority areas in this watershed should include areas where adequate buffers are not in place. (Also see Riparian Vegetation discussion in Appendix B.)

### **Priorities Based on EBI Results**

The Environment Benefit Index (EBI) is an assessment to help guide the allocation of funds, planning effort, technical support, and landowner support through a compilation of six categories of assessment of benefit.

- Wildlife Habitat Cover Benefits
- Water Quality Benefits
- Air Quality Benefits
- Erodibility Index
- Enduring Benefit Factor
- Cost Effectiveness

The goal is to target areas where the most efficient and effective practices and management tools can be placed onto the landscape.

The conservation value of a parcel of land is based on several factors:

- Soil erosion risk of the land based on soil and slope characteristics
- Water quality risk of the land based on the shape of the terrain and its proximity to surface water
- Habitat quality based on the Statewide Conservation and Preservation Plan

These factors are integrated into an Environmental Benefits Index - a score which represents a summary of the above factors (Figure 8). This methodology has unique characteristics; it includes soils and landscape (terrain) analysis which are relatively new to conservation targeting efforts. It addresses erosion potential and runoff potential and includes surface water quality, and wildlife habitat factors. Finally, the EBI integrates these layers to address multiple conservation benefits simultaneously.

### Priorities Based on DNR Watershed Data Report and WHAF

Recently, the Minnesota DNR developed the [Watershed Health Assessment Framework \(WHAF\)](#) which provides a comprehensive overview of the ecological health of Minnesota's watersheds). The WHAF is based on a "whole-system" approach that explores how all parts of the system work together to provide a healthy watershed. The WHAF divides the watershed's ecological processes into five components: biology, connectivity, geomorphology, and hydrology and water quality. A suite of watershed health index scores have been calculated that represent many of the ecological relationships within and between the five components. These scores have been built into a statewide GIS database that is compared across Minnesota to provide a baseline health condition report for each of the 81 major watersheds in the state. The DNR has applied the condition report to larger (HUC-8) watersheds, and more recently has applied the framework at smaller (HUC-12) subwatershed levels. Moving forward, the WHAF will be a helpful resource in monitoring and assessing the health of the NFC River watershed as restoration and protection practices are implemented. Refer to Appendix B for the complete DNR watershed report and detailed WHAF information for the NFC watershed which includes protection and restoration areas.

Specific DNR recommendations are:

- Bonanza Valley GWMA -- enhancing recharge areas and promoting wetland restoration to facilitate groundwater recharge to minimize effects to groundwater resources
- Calcareous Fens -- areas surrounding these fens should be considered for protection due to their unique and rare nature
- Riparian connectivity should be protected where it exists and restored in areas where it is lacking
- Perennial cover should be protected where it exists and restored in areas where it is lacking

### Protection Lake Prioritization

Priority lakes for protection were chosen based on the criteria of having two or more of the following attributes:

- DNR designated wild rice lake and/or priority shallow lake
- FS lakes with a downward water quality trend
- FS lakes located in a predominantly impaired HUC-11
- Lakes with an active lake association

Lake physical characteristics, water quality, biological attributes and status are summarized in Appendix C.

Table 11. Tools for prioritizing and targeting watershed restoration efforts.

| Tool   | Description  | How can/was the tool (be) used?  | Notes  | Analysis Scale                  |
|--|--|--|--|---------------------------------|
| <p><b>Hydrological Simulation Program – FORTRAN (HSPF) Model</b></p> | <p>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).</p>   | <p>Incorporates watershed-scale and non-point 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, a groundwater component and flow of water and transport/ transformation of chemical constituents in stream reaches. HSPF was used to supply watershed and SSTS loads for each lake.</p> | <p>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.</p>   | <p>Impaired watershed Scale</p> |
| <p><b>Watershed Bacteria Production by Source</b></p>                | <p>Uses literature rates and available data/estimates of all known bacteria sources in the watershed to calculate total watershed bacteria production. Bacteria sources for this assessment include: wildlife (primarily birds and deer), feedlot and livestock, total # of septic systems and estimated failure rates, wastewater treatment facility effluent, and pet populations for urban areas.</p> | <p>This tool helps estimate the total amount of bacteria produced in a given watershed or subwatershed. On a large watershed scale, results are helpful in identifying subwatersheds with higher rates of bacteria production to focus monitoring efforts and potential BMPs.( Fig. 7)</p>   | <p>Bacteria production analysis was originally developed to aid TMDL source assessment for the NFC River Watershed <i>E. coli</i> impaired reaches. This analysis was extended to include all NFC River sub-watersheds (non-impaired reaches) for use in the WRAPS report.</p> | <p>Impaired watershed Scale</p> |
| <p><b>Light Detection and Ranging (LiDAR)</b></p>                    | <p>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.</p>  | <p>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. Not used this cycle.</p>   | <p>The layers are available on the MN Geospatial Information website for most counties.</p>  | <p>Impaired Watershed Scale</p> |
| <p><b>Environmental Benefits Index (EBI)</b></p>                     | <p>Integrated tool using GIS and raster datasets to create a source grid with soil erodibility, terrain analysis and biological habitat scores.</p>  | <p>This tool can help target lands with a high potential for precipitation runoff and soil erosion to surface waters. The application can identify areas for conservation practices and restoration projects.(Fig. 8)</p>  | <p>This tool nearly covers the entire state of Minnesota; however gaps in coverage exist where source data were not available.</p>   | <p>Impaired Watershed Scale</p> |
| <p><b>Revised Universal Soil Loss Equation</b></p>                   | <p>RUSLE predicts the long term average annual rate of erosion on a field slope based on rainfall pattern, soil type, topography, land use and management practices.</p>   | <p>This model provides an assessment of existing soil loss from upland sources and the potential to assess sediment loading through the application of Best Management Practices. This tool was used as a screening tool to identify where the areas of greatest potential soil loss may be occurring.</p>   | <p>It is important to note that model results represent the maximum amount of soil loss that could be expected under existing conditions and have not been calibrated to field observations or observed /monitored data.</p>   | <p>Subwatershed Scale</p>       |



Table 11, continued. Tools for prioritizing and targeting watershed restoration efforts.

| Tool                            | Description   | How can the tool be used?   | Notes  | Analysis Scale     |
|---------------------------------|---|---|--|--------------------|
| <b>BATHTUB Model</b>            | Simulates average total phosphorus, chlorophyll-a and Secchi depth for deep and shallow lakes.  | The tool can be used to estimate changes in water quality based on changes in external and internal sources of nutrient loading. This tool was used to set allocations for impaired lakes | The models can be used for future lake planning to assess effects of changes in land use and nutrient loads.   | Individual Lakes   |
| <b>Stream Power Index (SPI)</b> | Stream Power Index (SPI) is a GIS exercise that calculates the erosive power of overland flow, which can be used to help identify potential flow erosion. | The stream power index analysis can identify and prioritize geographic areas that may be contributing sediment by means of stream bank erosion.   | This tool focused on areas near (<500 feet) the main-stem channel and major tributary channels since sediment erosion from these areas is more likely to be effectively delivered to the impaired reach. | Subwatershed Scale |

### North Fork Crow River, Average Annual Runoff, 1996-2009

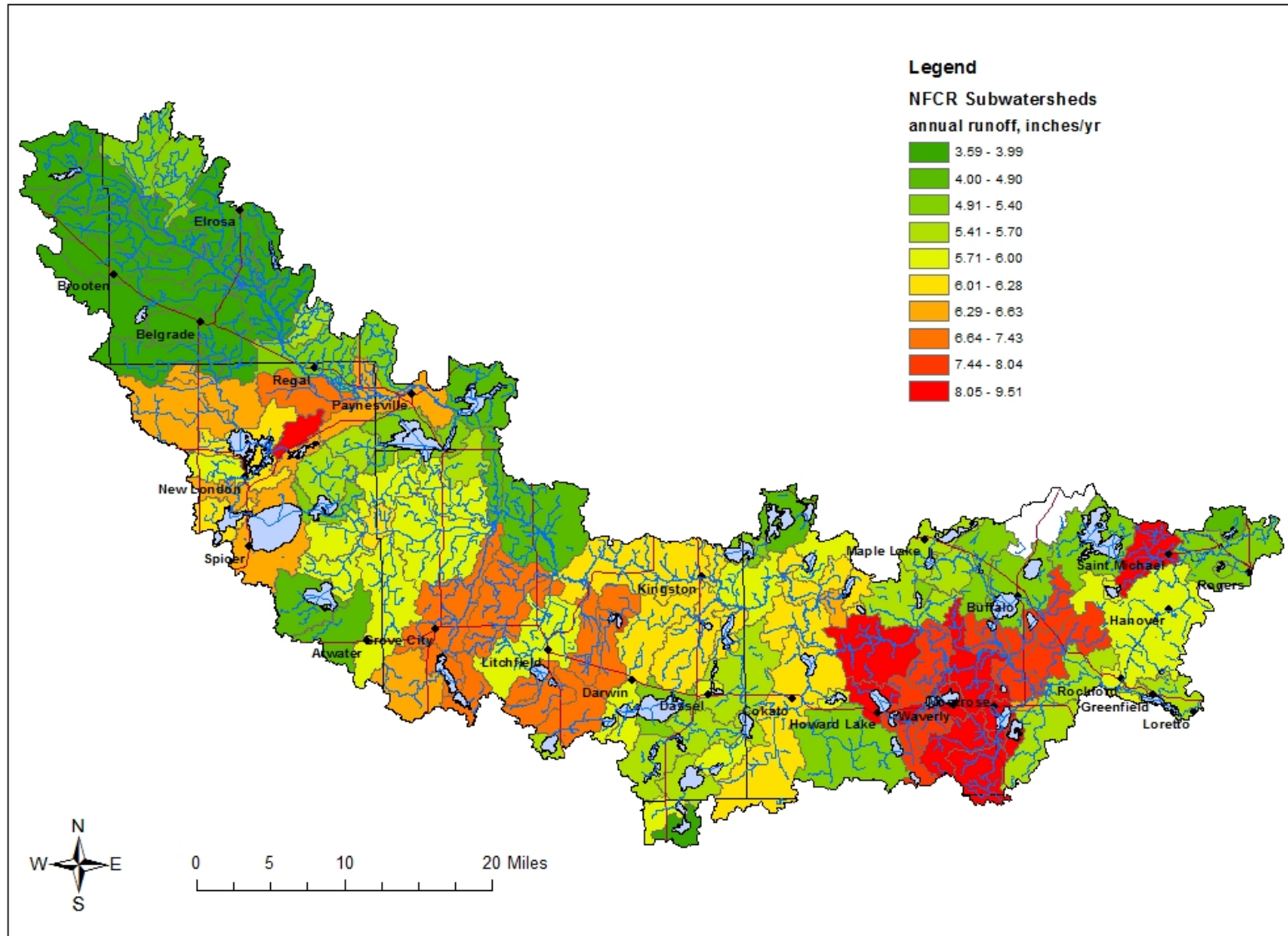


Figure 3. Annual runoff by sub-watershed in the NFC watershed

### North Fork Crow River, Total Nitrogen, Average Annual Load, 1996-2009

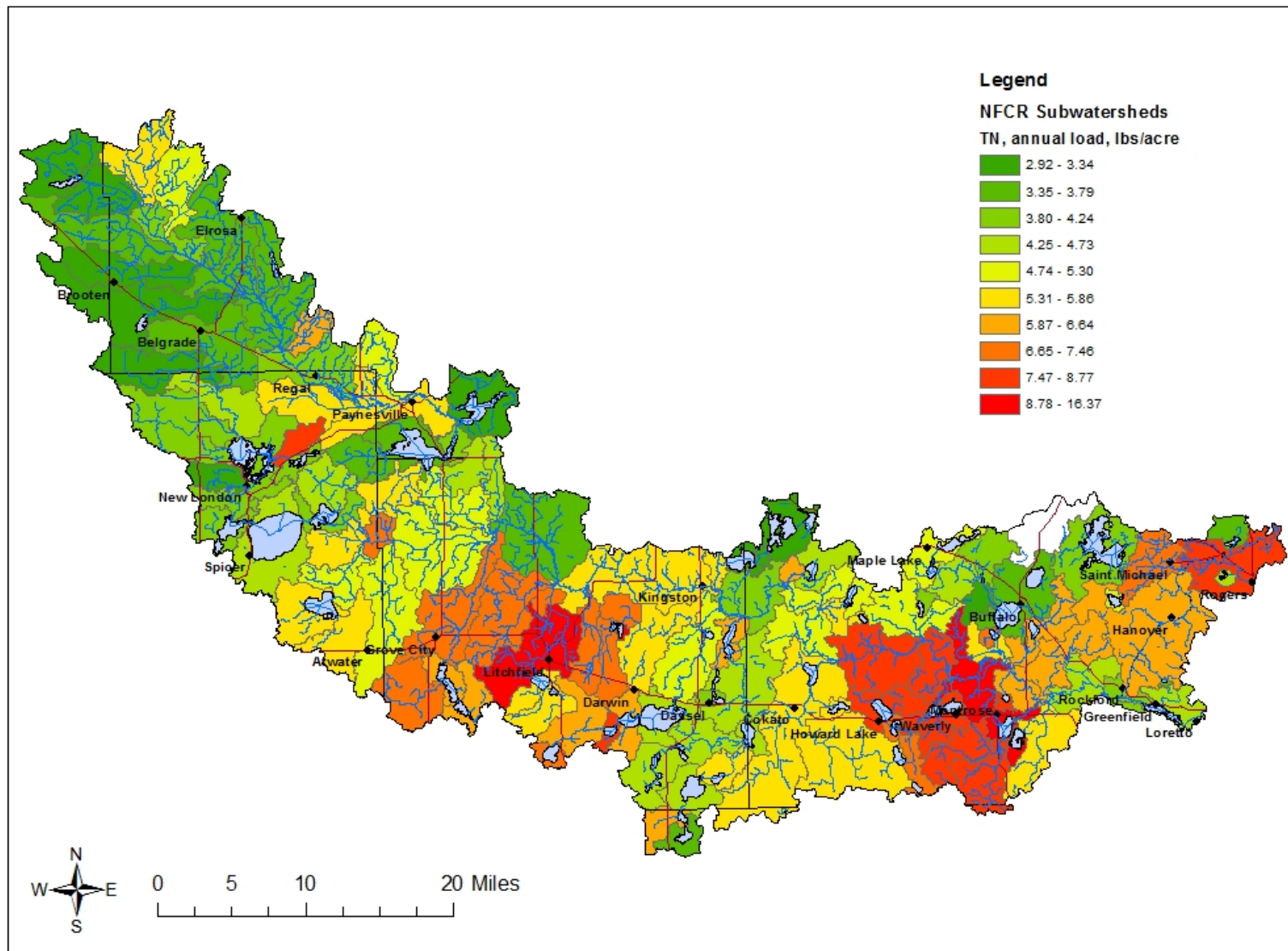


Figure 4. Total nitrogen loading by sub-watershed in the NFC watershed.

# North Fork Crow River, Total Phosphorus, Average Annual Load, 1996-2009

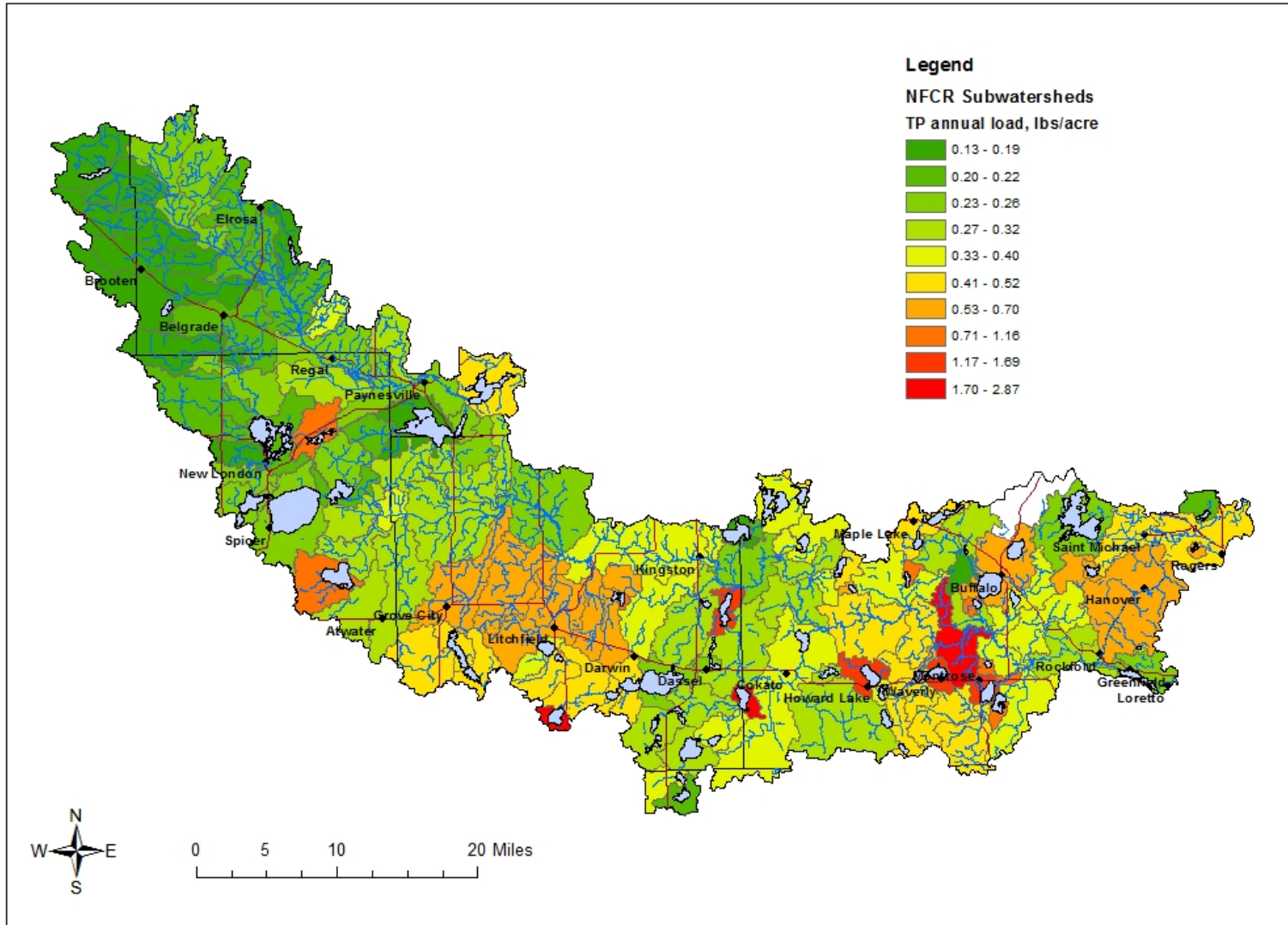


Figure 5. Total phosphorous loading by sub-watershed in the NFC watershed

## North Fork Crow River, TSS, Average Annual Load, 1996-2009

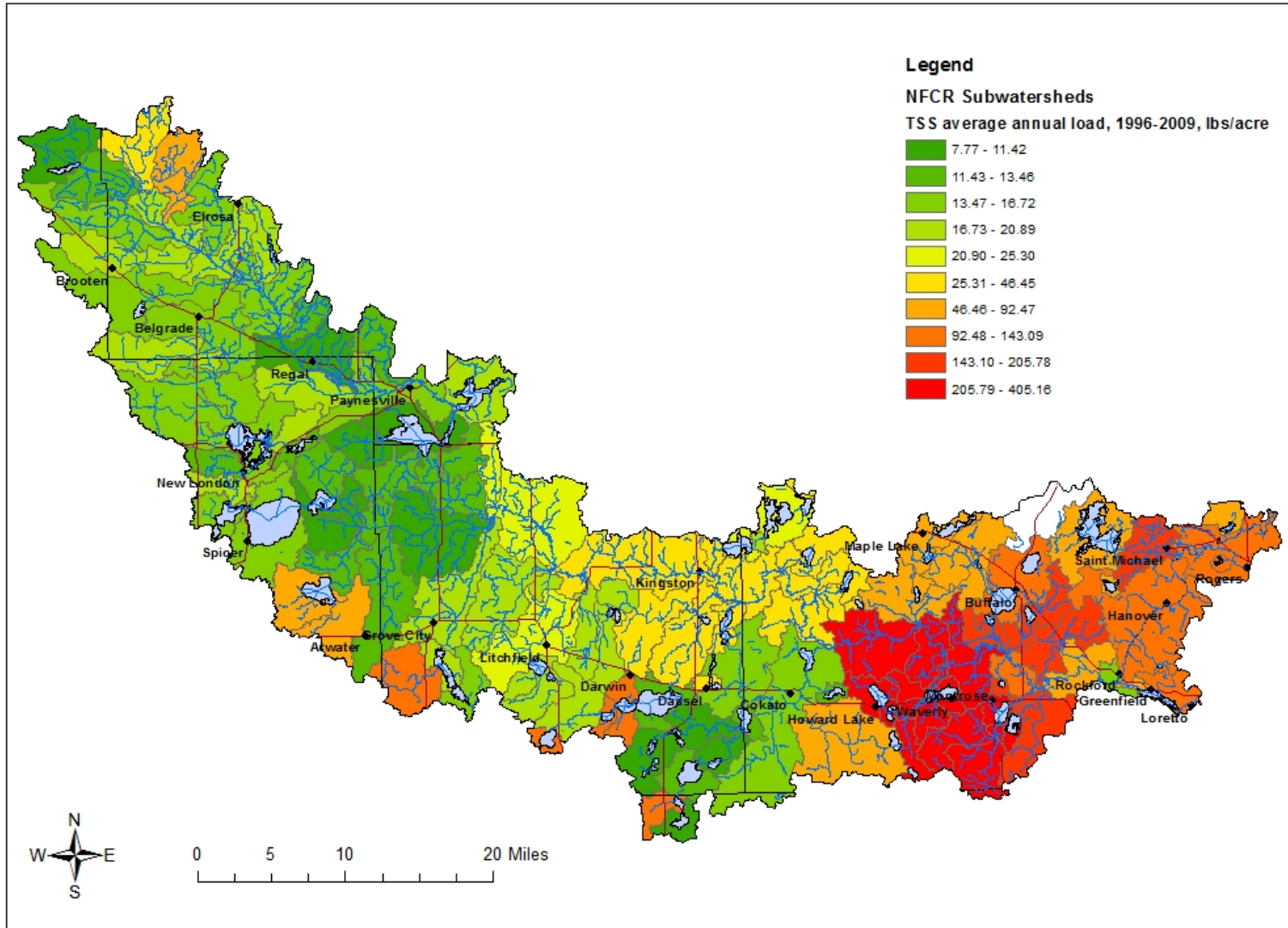


Figure 6. Sediment loading by sub-watershed in the NFC watershed

North Fork Crow River, Bacteria Production Rates, 1996-2009

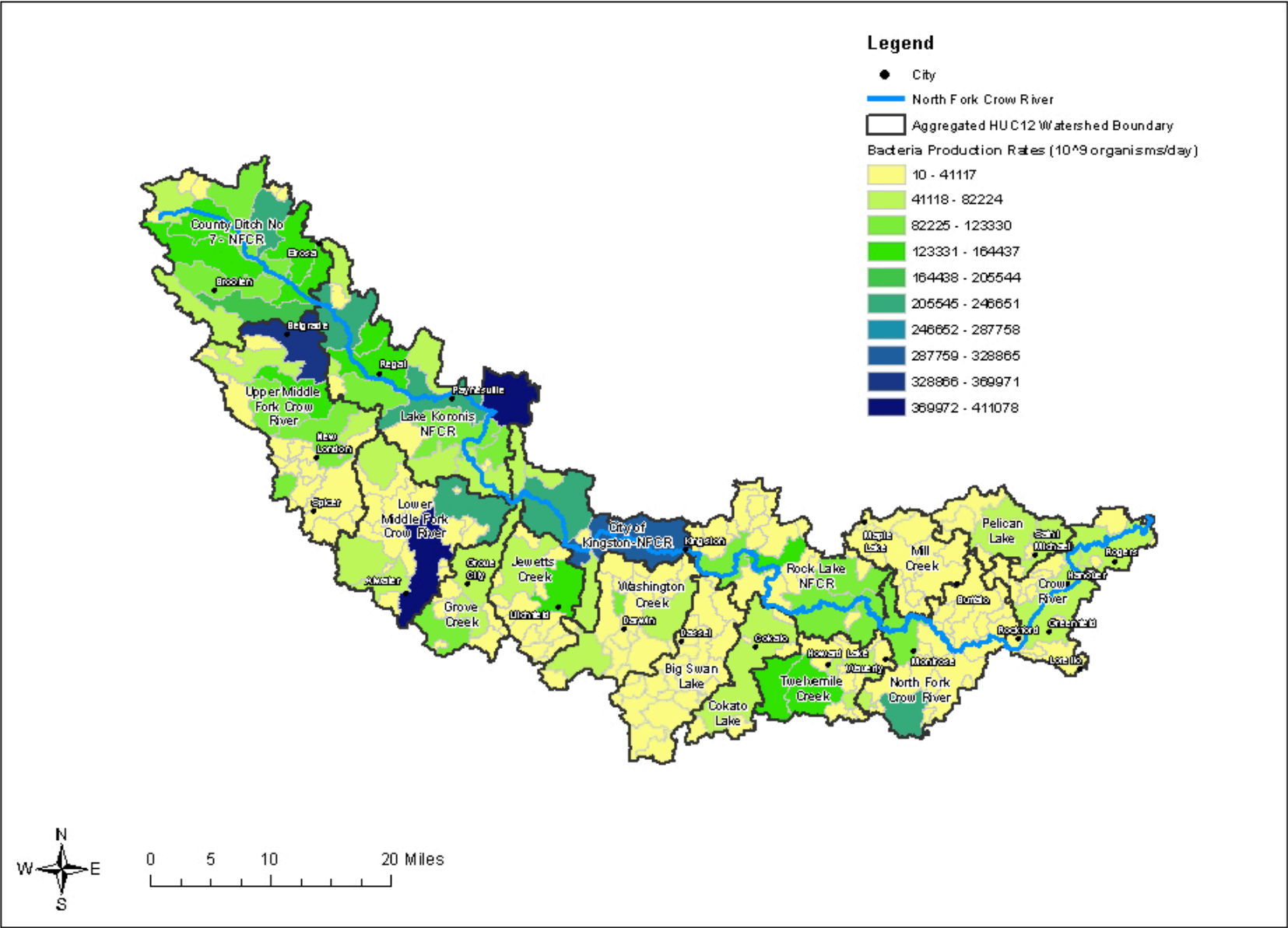


Figure 7. Bacteria loading by sub-watershed in the NFC watershed.

# North Fork Crow River Environmental Benefit Index (EBI)

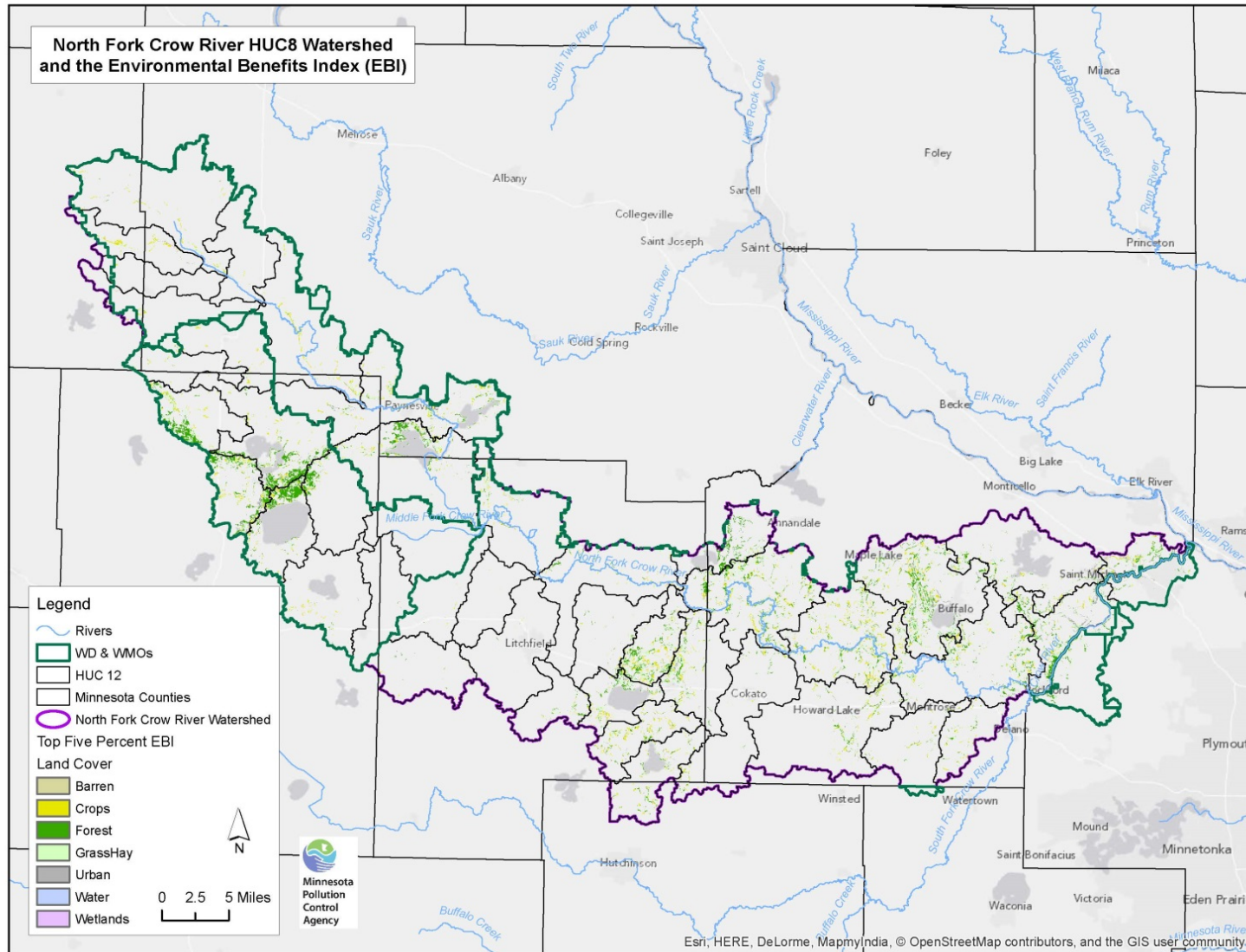


Figure 8. Board of Soil and Water Resources Environmental Benefit Index (EBI) tool top 5% priority areas within the NFC watershed.

North Fork Crow River, Subwatershed Strategy, 1996-2009

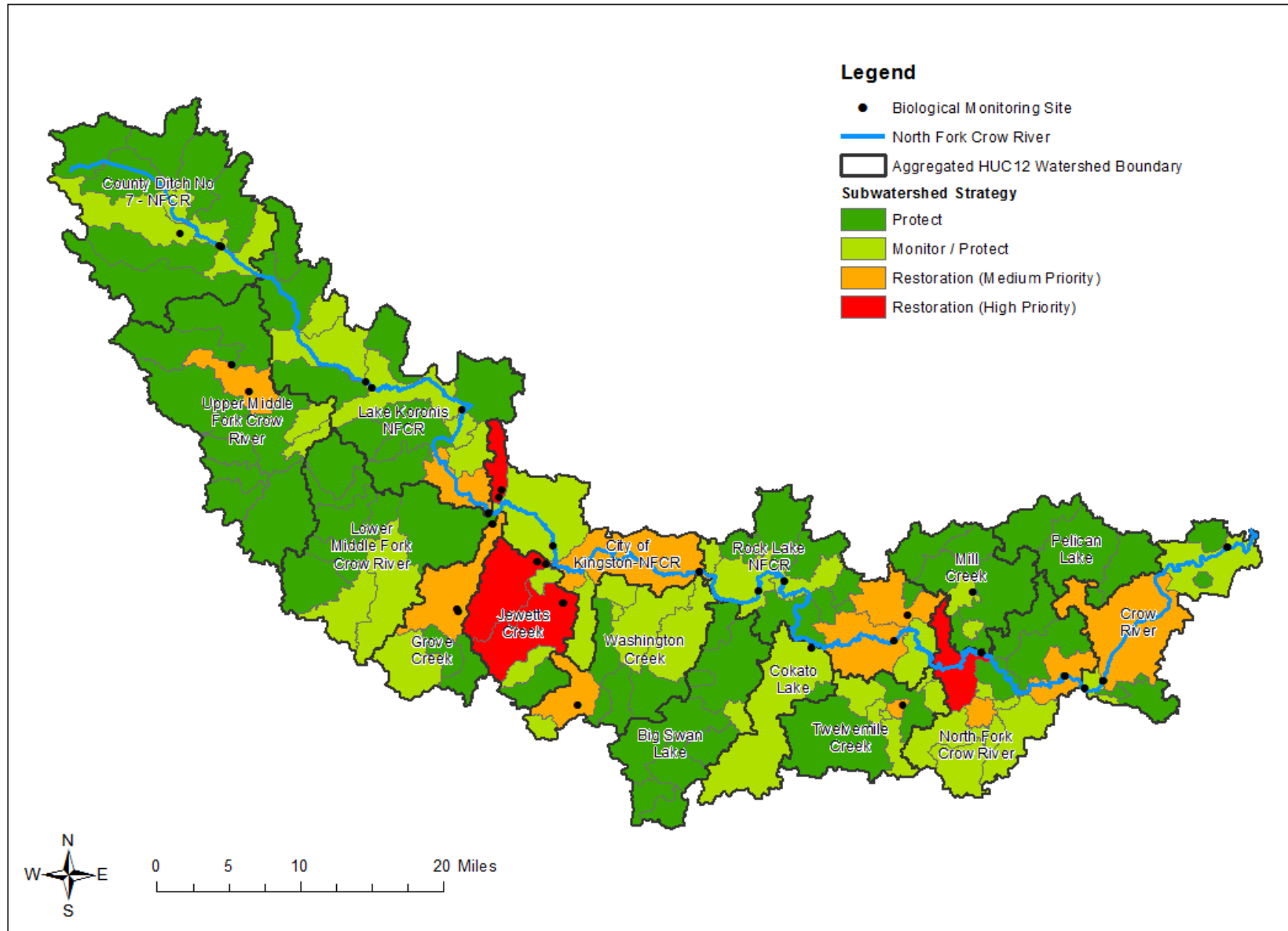
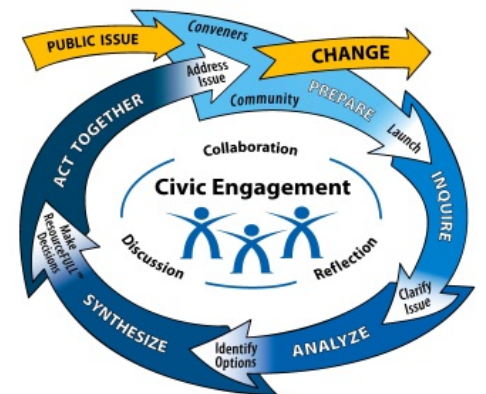


Figure 9. Subwatershed targeting in the NFC watershed for protection and restoration planning.



## 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/>



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www.extension.umn.edu/community  
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### Accomplishments and Future Plans

Local stakeholders in the NFC watershed met to develop a Civic engagement planning team, made up of staff from watershed districts, CROW, DNR and SWCD. The team developed a plan to create diverse ownership in the water resources of the NFC watershed. The team explored what we were doing well and what to accomplish for diverse ownership. A civic engagement plan was developed that outlined deliverables for prioritized projects.

- Contact or Meet Ag Community groups and look for ways to assist and work together
- Recognition & Publicizing of Efforts in the watershed
  - o Annual Watershed Wide Open House
  - o Project of the Year
  - o MPCA’s NFC Story Map
- Expand Recreational Opportunities
  - o Paddle the Crow River Day
  - o Paddler Patch
  - o Fishing Clinics
- Establish Local Media Partnerships
  - o Participate in a call in show for local radio
- Build Volunteer Programs
  - o Volunteer for every lake and stream stretch
  - o Volunteer Recognition program
- Expand Youth Education Programs
  - o Expand Middle Fork Crow River Watershed District’s In-School program
  - o Develop additional Envirothon and YES teams as needed
  - o Developing Community Education programs
- Storm Water Task Force
- Address SSTS/Unsewered Community Issues

The NFC WRAPS was on public notice from October 13, 2014, through November 12, 2014.

### 3.3 Restoration & Protection Strategies

The Subwatershed Strategy map (Figure 9) was created by overlaying and combining into one map the following layers: Human Disturbance Score, Watershed Bacteria Production by Source, Fish and Macroinvertebrate IBI Scores, TN Average Annual Load, TP Average Annual Load and TSS Average Annual Load by assigning weighted values (1 = low impact/pollutant loading to 4 = Very High impact/pollutant loading) to all subwatersheds in each map. The weighted values were determined based on equal interval classification of each individual layer. A final score for each subwatershed was calculated by adding up all the scores and again applying an equal interval classification. Thus, the final map (Fig. 9) represents the sum of all the subwatershed scores. This exercise is intended to give a general sense of which areas in the watershed should be targeted for restoration, and those that should be targeted for protection. It is important to note here that this is a **generalization** since areas that could not be assessed for fish and macroinvertebrate IBI may reflect “protection” is warranted, when it may actually be another management category. For this reason, the biological monitoring sites are displayed on this map to help distinguish the more generalized watershed areas from the more clearly defined areas. Results of the final overlay were divided into the four management categories described below:

**High Priority Restoration** – Two or more of the layers combined scores indicate very high degradation/impact and pollutant loading. These subwatersheds should be considered high priority for restoration and BMP implementation planning

**Moderate Priority Restoration** – Two or more of the layers combined scores indicate high to very high degradation/impact and pollutant loading. These subwatersheds should be considered a moderate to high priority for restoration and BMP implementation planning.

**Monitor/Protect** – Most of the layers combined scores indicate moderate to low levels of degradation/impact and pollutant loading. These subwatersheds should be monitored and protected to ensure resources do not become degraded or impaired.

**Protection** – Most of the layers combined scores currently indicate low levels of degradation/impact and pollutant loading. These subwatersheds should be targeted for protection planning.

Since these groupings and analyses are intended to help identify general areas, (subwatersheds) where restoration and protection planning/efforts may begin to focus, a more detailed analyses within each subwatershed will need to be done to help watershed organizations and state agencies better target specific BMPs, programs and funding activities.

The water quality and protection strategies for the NFC River watershed were developed in collaboration with State, Federal and Local partners. The development of the broad restoration and protection strategies by these groups drew on several resources including: monitoring and assessment and stressor identification (previously discussed in this report), an analysis of the pollutant reduction necessary to meet water quality standards (previously mentioned completed TMDL studies), and the restoration and protection assessment mapping discussed above. The final list of broad restoration and protection strategies for each 10-digit HUC in the NFC River watershed is presented in Table 12. These strategies represent first priorities. Because a strategy is not identified as a priority in a particular watershed does not necessarily mean that strategy is not appropriate for that location.

The Restoration and Protection strategies presented in Table 12 are intended to be further refined into specific implementation projects and applied by local working groups to target conservation practices. The strategies can be further refined (i.e. spatially targeted) using any number of tools available, some of which are presented and

discussed throughout this report. Eventually, the refined restoration and protection strategies may be reflected in local water plans, comprehensive watershed plans, and applications for federal and state clean water funds. The NFC has been selected as a pilot 1W1P watershed which will begin a process to unify the various plans (local water plans and WD comprehensive plans) within the watershed with the WRAPS.

The NFC River watershed is highly agricultural with a mix of row crops and animal agriculture. Because much of the watershed is predominantly agriculture and contains large numbers of animal units throughout the watershed, most of the strategies are applicable throughout the watershed. However, many of the strategies are presented on a lake-by-lake basis to include other important sources such as stormwater and internal phosphorus release.

Table 12 also contains a list of the impaired waters in the NFC River watershed along with restoration goals and appropriate strategies. (Refer to the NFC TMDL documents and Implementation Plans for resource specific strategies and implementation.) Protection strategies are provided on a watershed-wide scale and generalized for unimpaired streams and lakes. However, more detail should be developed for the protection strategies based on the factors that may result in the most stress on those resources. For example, lakes that may receive heavy development pressure in the future should focus on stormwater rules to protect water quality while lakes in agricultural drainages may need to focus on agricultural practices. In general, most of the waterbodies in need of protection are in the agricultural portions of the watershed.

The timeline for achieving water quality standards is at least 50 to 100 years due to the size of the watershed, number and magnitude of the impairments. The “Timeline” in Table 12 aligns with the MN Nutrient Reduction Strategy milestone goals which describe a 45% reduction overall from baseline in both P and N by 2045. With that in mind, realistic 10-year milestones for each of the impaired waters are identified to ensure progress toward achieving the NRS milestone goals is made. Water quality monitoring from future WRAPS projects can be used to assess progress toward meeting the NRS goals and water quality standards. As the water quality dynamics within the watershed are better understood, management activities will be changed or refined to efficiently meet the TMDLs and lay the groundwork for de-listing the impaired reaches. Adaptive management will be employed throughout implementation to set new milestones and utilize new technology as it is developed.

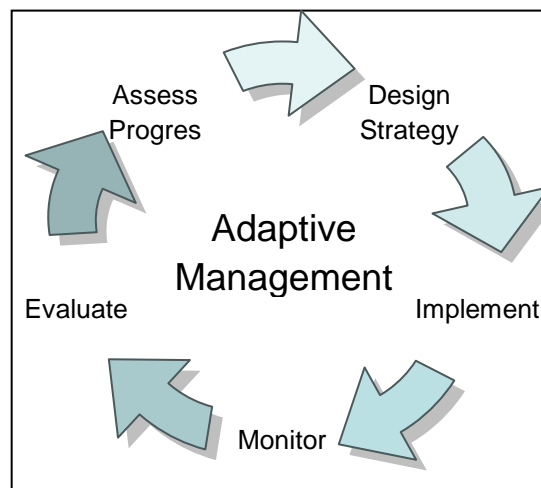


Figure 10. Adaptive management

Table 12. Restoration and Protection Strategies.

| HUC-10 Subwatershed                             | Waterbody and Location |  | Parameter (incl. non-pollutant stressors) | Water Quality      |                                 | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               | Stakeholder and WHAF Based Strategies |                         |                              |                             |                                     | Timeline                       | Interim 10-yr Milestones |
|---|------------------------|--|---|--------------------|---------------------------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|-------------------------------|---------------------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|--------------------------|
|   | Waterbody (ID)         | Location and Upstream Influence Counties |   | Current Conditions | Goals / Targets                 |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement | Ground Water Protection               | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                          |
| All   | Unimpaired Streams     | All                                      | Suspended Solids                          | Varies             | 90% of samples ≤42 mg/L TSS     | NFC Watershed Wide                 |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 4 BMPs                    |                                |                          |
|   |                        |  | <i>E. coli</i>                            | Varies             | Geometric Mean ≤ 126 org/100 mL | NFC Watershed Wide                 | A,B,C, I, J   | A, B, C E, I, J                           | A, B, E, I, J              |                        |                               |                            |                              |                      |                                 |                          |                       |                     | F                             |                               |                                       |                         |                              |                             | 20 yrs                              | Implement 5 BMPs               |                          |
|   |                        |  | Biologic habitat                          | Varies             | Varies                          | NFC Watershed Wide                 |   |   |                            | A, B, G, I, J          |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 3 BMPs         |
| All   | Unimpaired Lakes       | All                                      | Nutrients                                 | Varies             | Varies                          | NFC Watershed Wide                 | A, B, C, I, J   | A, B, C E, I, J                           | A, B, E, I, J              |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 5 BMPs                    |                                |                          |
| All   | Priority Shallow Lakes | All                                      | Nutrients                                 | Varies             | Varies                          | NFC Watershed Wide                 | A, B, C, I, J   | A, B, C E, I, J                           | A, B, E, I, J              |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 2 BMPs                    |                                |                          |
| Lake Koronis-North Fork Crow River (0701020401) | Rice Lake (73-0196)    | Stearns                                  | TP  | 55 to 62 µg/L      | Summer TP Mean ≤ 40 µg/L        | Contributing Watershed             |   |   | A, B, E, J                 |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 2 BMPs                    |                                |                          |
|   | North Fork Crow (504)  | Stearns                                  | Biota (Bedded Sediment)                   |                    |                                 | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, G, H, J                 |                               |                                       |                         |                              | 30 yrs                      | Implement 2 BMPs                    |                                |                          |
| Middle Fork Crow River (0701020402)             | Nest (34-0154)         | Kandiyohi                                | TP  | 45 µg/L            | Summer TP Mean ≤ 40 µg/L        | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 2 BMPs                    |                                |                          |
| Jewitts Creek North Fork River (0701020403)     | Long (47-0177)         | Meeker Kandiyohi                         | TP  | 385 µg/L           | Summer TP Mean ≤ 60 µg/L        | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 1 BMPs                    |                                |                          |
|   | Hope (47-0183)         | Meeker                                   | TP  | 257 µg/L           | Summer TP Mean ≤ 40 µg/L        | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 1 BMPs                    |                                |                          |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

<sup>1</sup>Responsible Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                         | Waterbody and Location |  | Parameter (incl. non-pollutant stressors) | Water Quality              |                              | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               | Stakeholder and WHAF Based Strategies |                         |                         |                              |                             | Timeline                            | Interim 10-yr Milestones       |                  |                  |
|---|------------------------|--|---|----------------------------|------------------------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|---------------------------------------|-------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|------------------|------------------|
|   | Waterbody (ID)         | Location and Upstream Influence Counties |   | Current Conditions         | Goals / Targets              |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement         | Ground Water Protection | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                  |                  |
| Jewitts Creek North Fork River (0701020403) | Grove Creek (514)      | Meeker                                   | <i>E. Coli</i>                            | Very High: 17 cfu/100 mL   | Very High: 0% Reduction      | Contributing Watershed             | A,B, C  | A, B, C, E                                | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       | F                   |                               |                                       |                         |                         |                              | 20 yrs                      | Implement 3 BMPs                    |                                |                  |                  |
|   |                        |  |   | High: 62 cfu/100 mL        | High: 0% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Mid: 237 cfu/100 mL        | Mid: 47% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Low: 252 cfu/100 mL        | Low: 50% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Dry: 445 cfu/100 mL        | Dry: 72% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  | Suspended Solids                          | Very High: 6 ton/d         | Very High: 0% Reduction      | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                | 30 yrs           | Implement 3 BMPs |
|   |                        |  |   | High: 26 mg/L              | High: 40% Reduction          |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Mid: 48 mg/L               | Mid: 45% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Low: 18 mg/L               | Low: 0% Reduction            |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  | Dissolved Oxygen                          | 10% of Samples ≤ 5 mg/L DO | 90% of samples ≥ 5.0 mg/L DO | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       | A,B, G              | F                             |                                       |                         |                         |                              |                             |                                     | 20 yrs                         | Implement 1 BMPs |                  |
|   | Jewitts Creek (585)    | Meeker                                   | <i>E. Coli</i>                            | Very High: 55 cfu/100 mL   | Very High: 0% Reduction      | Contributing Watershed             | A,B, C  | A, B, C, E                                | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             | 10 yrs                              | Implement 3 BMPs               |                  |                  |
|   |                        |  |   | High: 18 cfu/100 mL        | High: 0% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Mid: 74 cfu/100 mL         | Mid: 0% Reduction            |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Low: 214 cfu/100 mL        | Low: 41% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |
|   |                        |  |   | Dry: 282 cfu/100 mL        | Dry: 55% Reduction           |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |                  |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

<sup>1</sup>Responsible Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                                     | Waterbody and Location          |  | Parameter (incl. non-pollutant stressors) | Water Quality  |  | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               | Stakeholder and WHAF Based Strategies |                         |                         |                              |                             | Timeline                            | Interim 10-yr Milestones       |                  |
|---|---------------------------------|--|---|--|--|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|---------------------------------------|-------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|------------------|
|   | Waterbody (ID)                  | Location and Upstream Influence Counties |   | Current Conditions   | Goals / Targets  |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement         | Ground Water Protection | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                  |
| Jewitts Creek North Fork River (0701020403) (continued) | Jewitts Creek (585) (continued) | Meeker                                   | Dissolved Oxygen                          | 10% of Samples ≤ 5 mg/L DO                                       | 90% of samples ≥ 5.0 mg/L DO                             | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       | A,B,G               | F                             |                                       |                         |                         |                              |                             | 20 yrs                              | Implement 2 BMPs               |                  |
|   |                                 |  | Biota (DO and Bedded Sediment)            | See current conditions for Suspended solids and dissolved oxygen | See reductions for suspended solids and dissolved oxygen | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               | A, B, C                               | A,B,G                   | F                       |                              |                             |                                     |                                |                  |
| Washington Creek (0701020404)                           | Richardson (73-0196)            | Meeker                                   | TP  | 82 µg/L  | Summer TP Mean ≤ 40 µg/L                                 | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
|   | Dunns (47-0082)                 | Meeker                                   | TP  | 97 µg/L  | Summer TP Mean ≤ 40 µg/L                                 | Contributing Watershed             | A,B,C   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
| Big Swan -701020405                                     | Jennie (47-0015)                | Meeker                                   | TP  | 60 µg/L  | Summer TP Mean ≤ 60 µg/L                                 | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
|   |                                 | McLeod                                   |   |  |  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
|   | Collinwood (47-0293)            | Meeker                                   | TP  | 103 µg/L   | Summer TP Mean ≤ 40 µg/L                                 | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
|   |                                 | McLeod                                   |   |  |  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
|   | Spring (47-0032)                | Meeker                                   | TP  | 69 µg/L  | Summer TP Mean ≤ 40 µg/L                                 | Contributing Watershed             | A,B,C   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
|   |                                 | McLeod                                   |   |  |  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
|   | Hook (43-0073)                  | McLeod                                   | TP  | 121 µg/L   | Summer TP Mean ≤ 60 µg/L                                 | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
|   | Big Swan (47-0038)              | Meeker                                   | TP  | 92 µg/L  | Summer TP Mean ≤ 40 µg/L                                 | Contributing Watershed             |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 30 yrs                         | Implement 1 BMPs |
| McLeod  |                                 |  |   |  |  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                | 30 yrs           |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

<sup>1</sup>Responsible

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                | Waterbody and Location   |  | Parameter (incl. non-pollutant stressors) | Water Quality            |                          | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               | Stakeholder and WHAF Based Strategies |                         |                              |                             |                                     | Timeline                       | Interim 10-yr Milestones |
|------------------------------------|--------------------------|--|---|--------------------------|--------------------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|-------------------------------|---------------------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|--------------------------|
|                                    | Waterbody (ID)           | Location and Upstream Influence Counties |   | Current Conditions       | Goals / Targets          |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement | Ground Water Protection               | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                          |
| North Fork Crow River (0701020406) | Brooks (86-0264)         | Wright                                   | TP  | 64 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             | A,B,C   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Cokato (86-0263)         | Wright                                   | TP  | 49 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             | A,B,C   |   | A, B, E                    |                        |                               | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | French (86-0273)         | Wright                                   | TP  | 41 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             | A,B,C   |   | A, B, E                    |                        |                               | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Smith (86-0250)          | Wright                                   | TP  | 215 µg/L                 | Summer TP Mean ≤ 60 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        |                              |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Granite (86-0217)        | Wright                                   | TP  | 61 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Camp (86-0221)           | Wright                                   | TP  | 110 µg/L                 | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Howard (86-0199)         | Wright                                   | TP  | 83 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 3 BMPs               |                          |
|                                    | Dutch (86-0184)          | Wright                                   | TP  | 173 µg/L                 | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        |                              |                      | B                               | B                        |                       |                     | F                             |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Rock (86-0182)           | Wright                                   | TP  | 56 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             | A,B,C   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Little Waverly (86-0106) | Wright                                   | TP  | 394 µg/L                 | Summer TP Mean ≤ 60 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Waverly (86-0114)        | Wright                                   | TP  | 42 µg/L                  | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B                        | A,B                          |                      | B                               | B                        | A, B, D               | F                   |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
| Ramsey (86-0120)                   | Wright                   | TP                                       | 60 µg/L                                   | Summer TP Mean ≤ 40 µg/L | Contributing Watershed   | A,B,C                              |   | A, B, E                                   |                            | A,B, H                 | A,B                           | A,B                        |                              | B                    | B                               |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 2 BMPs                    |                                |                          |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

<sup>1</sup>Responsible

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                | Waterbody and Location |  |                | Parameter (incl. non-pollutant stressors)  | Water Quality   |                        | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               | Stakeholder and WHAF Based Strategies |                         |                              |                             |                                     | Timeline                       | Interim 10-yr Milestones |
|------------------------------------|------------------------|--|----------------|--|---|------------------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|-------------------------------|---------------------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|--------------------------|
|                                    | Waterbody (ID)         | Location and Upstream Influence Counties |                |  | Current Conditions  | Goals / Targets        |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement | Ground Water Protection               | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                          |
| North Fork Crow River (0701020406) | Albert (86-0127)       | Wright                                   | TP             | 137 µg/L   | Summer TP Mean ≤ 40 µg/L  | Contributing Watershed |                                    |   | A, B, E                                   |                            | A,B, H                 | A,B                           |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                          |
|                                    | Light Foot (86-0122)   | Wright                                   | TP             | 195 µg/L   | Summer TP Mean ≤ 40 µg/L  | Contributing Watershed | A,B,C                              |   | A, B, E                                   |                            | A,B, H                 | A,B                           | A,B                        |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 2 BMPs         |
|                                    | Fountain (86-0273)     | Wright                                   | TP             | 334 µg/L   | Summer TP Mean ≤ 60 µg/L  | Contributing Watershed | A,B,C                              |   | A, B, E                                   |                            | A,B, H                 | A,B                           | A,B                        |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 2 BMPs         |
|                                    | Malardi (86-0112)      | Wright                                   | TP             | 405 µg/L   | Summer TP Mean ≤ 60 µg/L  | Contributing Watershed |                                    |   | A, B, E                                   |                            | A,B, H                 | A,B                           |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 2 BMPs         |
|                                    | Deer (86-0090)         | Wright                                   | TP             | 83 µg/L  | Summer TP Mean ≤ 40 µg/L  | Contributing Watershed |                                    |   | A, B, E                                   |                            | A,B, H                 | A,B                           |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 2 BMPs         |
|                                    | Buffalo (86-0107)      | Wright                                   | TP             | 87 µg/L  | Summer TP Mean ≤ 40 µg/L  | Contributing Watershed | A,B,C                              |   | A, B, E                                   |                            | A,B, H                 | A,B                           | A,B                        |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 3 BMPs         |
|                                    | Dean (86-0041)         | Wright                                   | TP             | 211 µg/L   | Summer TP Mean ≤ 40 µg/L  | Contributing Watershed | A,B,C                              |   | A, B, E                                   |                            | A,B, H                 | A,B                           | A,B                        |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     | 30 yrs                         | Implement 2 BMPs         |
|                                    | Unnamed Creek (667)    | Wright                                   | <i>E. coli</i> | Very High: 209 cfu/100 mL<br>High: 155 cfu/100 mL<br>Mid: 383 cfu/100 mL<br>Low: 330 cfu/100 mL<br>Dry: 870 cfu/100 mL | Very High: 40% Reduction<br>High: 19% Reduction<br>Mid: 67% Reduction<br>Low: 62% Reduction<br>Dry: 86% Reduction | Contributing Watershed | A,B,C                              | A,B,C   | A, B, E                                   |                            |                        |                               |                            |                              |                      |                                 |                          | F                     |                     |                               |                               |                                       |                         |                              |                             |                                     | 20 yrs                         | Implement 3 BMPs         |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

<sup>1</sup>Responsible



Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                            | Waterbody and Location |  | Parameter (incl. non-pollutant stressors) | Water Quality   |  | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               | Stakeholder and WHAF Based Strategies |                         |                         |                              |                             | Timeline                            | Interim 10-yr Milestones       |
|--|------------------------|--|---|---|--|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|---------------------------------------|-------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|
|  | Waterbody (ID)         | Location and Upstream Influence Counties |   | Current Conditions  | Goals / Targets  |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement         | Ground Water Protection | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |
| North Fork Crow River (0701020406) (continued) | Unnamed Creek (668)    | Wright                                   | Suspended Solids                          | Very High: 10 mg/L<br>High: 5 mg/L<br>Mid: 1 mg/L<br>Low: 5 mg/L<br>Dry: 8 mg/L     | Very High: 0% Reduction<br>High: 0% Reduction<br>Mid: 0% Reduction<br>Low: 0% Reduction<br>Dry: 0% Reduction     | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              | 30 yrs                      | Implement 1 BMPs                    |                                |
|  | Mill Creek (515)       | Wright                                   | Suspended Solids                          | Very High: 10 mg/L<br>High: 27 mg/L<br>Mid: 63 mg/L<br>Low: 40 mg/L<br>Dry: 53 mg/L | Very High: 0% Reduction<br>High: 0% Reduction<br>Mid: 33% Reduction<br>Low: 0% Reduction<br>Dry: 20% Reduction   | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              | 30 yrs                      | Implement 1 BMPs                    |                                |
|  |                        |  | Dissolved Oxygen                          | 10% of Samples ≤ 5 mg/L DO  | 90% of samples ≥ 5.0 mg/L DO   | Contributing Watershed             | A,B,C   |   |                            | A, B, E                |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             | 20 yrs                              | Implement 1 BMPs               |
|  | North Fork Crow (503)  | Wright                                   | Suspended Solids                          | Very High: 153 ton/d<br>High: 133 ton/d<br>Mid: 56 ton/d<br>Low: 28 ton/d<br>Dry:14 | Very High: 36% Reduction<br>High: 40% Reduction<br>Mid: 13% Reduction<br>Low: 46% Reduction<br>Dry: 0% Reduction | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              | 30 yrs                      | Implement 3 BMPs                    |                                |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

<sup>1</sup>Responsible

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed     | Waterbody and Location |  | Parameter (incl. non-pollutant stressors) | Water Quality                |                          | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               | Stakeholder and WHAF Based Strategies |                         |                         |                              |                             | Timeline                            | Interim 10-yr Milestones       |                  |
|-------------------------|------------------------|--|---|------------------------------|--------------------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|---------------------------------------|-------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|------------------|
|                         | Waterbody (ID)         | Location and Upstream Influence Counties |   | Current Conditions           | Goals / Targets          |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement         | Ground Water Protection | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                  |
| Crow River (0701020407) | Constance (86-0051)    | Wright                                   | TP  | 91 µg/L                      | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             | A,B,C   |   | A, B, E                    |                        | A,B, H                        | A,B,E                      | A,B                          |                      | B                               | B                        |                       |                     |                               |                                       |                         |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                  |
|                         | Pelican (86-0031)      | Wright                                   | TP  | 137 µg/L                     | Summer TP Mean ≤ 60 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B,E                      | A,B                          |                      | B                               | B                        |                       |                     |                               |                                       |                         |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                  |
|                         | Beebe (86-0023)        | Wright                                   | TP  | 58 µg/L                      | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             | A,B,C   |   | A, B, E                    |                        | A,B, H                        | A,B,E                      | A,B                          |                      | B                               | B                        |                       |                     |                               |                                       |                         |                         |                              |                             | 30 yrs                              | Implement 2 BMPs               |                  |
|                         | Hafften (86-0199)      | Hennepin                                 | TP  | 55 µg/L                      | Summer TP Mean ≤ 40 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B,E                      |                              |                      | B                               | B                        |                       |                     |                               |                                       |                         |                         |                              |                             | 30 yrs                              | Implement 1 BMPs               |                  |
|                         | Foster (86-0001)       | Wright                                   | TP  | 259 µg/L                     | Summer TP Mean ≤ 60 µg/L | Contributing Watershed             |   |   | A, B, E                    |                        | A,B, H                        | A,B,E                      | A,B                          |                      | B                               | B                        |                       |                     |                               |                                       |                         |                         |                              |                             | 30 yrs                              | Implement 1 BMPs               |                  |
|                         | Regal Creek (542)      | Wright Hennepin                          | <i>E. coli</i>                            | Very High: 127 cfu/100 mL    | Very High: 1% Reduction  | Contributing Watershed             | A,B,C   | A,B,C                                     | A, B, E                    | A, B, E                | A, B, C                       |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     | 10 yrs                         | Implement 2 BMPs |
|                         |                        |  |   | High: 76 cfu/100 mL          | High: 0% Reduction       |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
| Mid: 232 cfu/100 mL     | Mid: 46% Reduction     |  |   |                              |                          |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
| Low: 720 cfu/100 mL     | Low: 83% Reduction     |  |   |                              |                          |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
| Dry: 675 cfu/100 mL     | Dry: 81% Reduction     |  |   |                              |                          |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              |                             |                                     |                                |                  |
|                         |                        | Dissolved Oxygen                         | 10% of Samples ≤ 5 mg/L DO                | 90% of samples ≥ 5.0 mg/L DO | Contributing Watershed   |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         |                              | 20 yrs                      | Implement 1 BMPs                    |                                |                  |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

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<sup>1</sup>Responsible

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                 | Waterbody and Location |  | Parameter (incl. non-pollutant stressors) | Water Quality                               |                                     | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               | Stakeholder and WHAF Based Strategies |                         |                              |                             |                                     | Timeline                       | Interim 10-yr Milestones |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|-------------------------------------|------------------------|--|---|---|-------------------------------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|-------------------------------|---------------------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|--------------------------|--------------------------|---------------|-----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--------|------------------|
|                                     | Waterbody (ID)         | Location and Upstream Influence Counties |   | Current Conditions                          | Goals / Targets                     |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement | Ground Water Protection               | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
| Crow River (0701020407) (continued) | Crow River (502)       | Wright Hennepin                          | Suspended Solids                          | Very High: 360 ton/d                        | Very High: 5% Reduction             | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              | 30 yrs                      | Implement 2 BMPs                    |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | High: 162 ton/d                             | High: 32% Reduction                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | Mid: 43 ton/d                               | Mid: 41% Reduction                  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | Low: 17 ton/d                               | Low: 26% Reduction                  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | Dry: 10 ton/d                               | Dry: 0% Reduction                   |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  | <i>E. coli</i>                            | Very High: 320 cfu/100 mL                   | Very High: 0% Reduction             | Contributing Watershed             |   |   | A, B, C, E                 | A, B, E                | A, B, E                       |                            |                              |                      |                                 |                          |                       |                     |                               | F                             |                                       |                         |                              |                             |                                     | 20 yrs                         | Implement 3 BMPs         |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | High: 1,770 cfu/100 mL                      | High: 0% Reduction                  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | Mid: 861 cfu/100 mL                         | Mid: 5% Reduction                   |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   | Low: 650 cfu/100 mL                         | Low: 13% Reduction                  |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  | Fish & Macroinverts                       | See current conditions for suspended solids | See reductions for suspended solids | Contributing Watershed             |   |   | A, B, E                    |                        |                               |                            |                              |                      |                                 | A, B                     | A, B                  | A, B, G             |                               |                               |                                       |                         |                              |                             |                                     | 20 yrs                         | Implement 2 BMPs         |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |
|                                     |                        |  |   |   |                                     |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          | Judicial Ditch #1 to NFC | DNR # 1800300 | All |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 30 yrs | Implement 1 BMPs |
|                                     |                        |  |   |   |                                     |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                               |                                       |                         |                              |                             |                                     |                                |                          |                          |               |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |        |                  |

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<sup>1</sup>Responsible

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed               | Waterbody and Location  |  | Parameter (incl. non-pollutant stressors) | Water Quality      |                 | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | Stakeholder and WHAF Based Strategies |                               |                               |                         |                         | Timeline                     | Interim 10-yr Milestones    |
|-----------------------------------|-------------------------|--|---|--------------------|-----------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|----------------------------------|--------------------------|-----------------------|---------------------------------------|-------------------------------|-------------------------------|-------------------------|-------------------------|------------------------------|-----------------------------|
|                                   | Waterbody (ID)          | Location and Upstream Influence Counties |   | Current Conditions | Goals / Targets |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/ Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration                   | NPDES Point Source Compliance | Riparian Corridor Enhancement | Ground Water Protection | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration |
| Unnamed Trib to Crow River        | DNR # 1808600           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| NFC above Unnamed trib sub-basin  | DNR # 1806600           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Unnamed trib CD #5 to NFC         | DNR # 1804200           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| NFC aboved Unnamed trib sub-basin | DNR # 1803700 & 1803600 | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Unnamed trib to NFC               | DNR # 1803600           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Crow River to Mississippi         | DNR # 1802100           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Washington Creek - CD #9          | DNR # 1806101           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Unnamed trib to NFC               | DNR # 1801600           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Unnamed trib to NFC               | DNR # 1801600           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |
| Unnamed trib to 12 Mile Creek     | DNR # 1807700           | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                  |                          |                       | A, B,C, D, E, H                       |                               | A, B,C, E, H                  | A, B,C, E, H            | A, B,C, E, H            | 30 yrs                       | Implement 2 BMPs            |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

<sup>1</sup>Responsible

Table 12, continued. Restoration and Protection Strategies.

| HUC-10 Subwatershed                | Waterbody and Location |  | Parameter (incl. non-pollutant stressors) | Water Quality      |                 | Estimated Scale of Adoption Needed | Strategies and Responsible Governmental Unit <sup>1</sup> |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               | Stakeholder and WHAF Based Strategies |                         |                         |                              |                             | Timeline                            | Interim 10-yr Milestones       |
|------------------------------------|------------------------|--|---|--------------------|-----------------|------------------------------------|---|---|----------------------------|------------------------|-------------------------------|----------------------------|------------------------------|----------------------|---------------------------------|--------------------------|-----------------------|---------------------|-------------------------------|---------------------------------------|-------------------------|-------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------------|
|                                    | Waterbody (ID)         | Location and Upstream Influence Counties |   | Current Conditions | Goals / Targets |                                    | Septic System Compliance                                  | Livestock, pasture and feedlot management | Crop and Manure management | Streambank Restoration | Internal TP Release Reduction | Cropland Erosion Reduction | Wetland Phosphorus Reduction | Shoreline Protection | Wetland Restoration/Enhancement | Roadside erosion Control | Stormwater management | Channel Restoration | NPDES Point Source Compliance | Riparian Corridor Enhancement         | Ground Water Protection | Surface Water Retention | Perennial Cover Preservation | Perennial Cover Restoration | Synced with the NRS milestone goals | Number of BMPs per 10 yr Cycle |
| Bonanza Valley                     | DNR # 1800401          | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, C, E, F, G, H, J        |                                       |                         |                         | 30 yrs                       | Implement 2 BMPs            |                                     |                                |
| NFC above Eagle Creek              | DNR # 1806200          | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, C, D, E, H              |                                       | A, B, C, D, E, H        | A, B, C, D, E, H        | 20 yrs                       | Implement 2 BMPs            |                                     |                                |
| NFC above CD #17 (Jewitt's Creek)  | DNR # 1806300          | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, C, D, E, H              |                                       | A, B, C, D, E, H        | A, B, C, D, E, H        | 20 yrs                       | Implement 2 BMPs            |                                     |                                |
| CD #36 to MF Crow                  | DNR # 1803800          | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, C, D, E, H, I           |                                       | A, B, C, D, E, H, I     | A, B, C, D, E, H, I     | 20 yrs                       | Implement 2 BMPs            |                                     |                                |
| MF Crow to Mud Lake                | DNR # 1803900          | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, C, D, E, H, I           |                                       | A, B, C, D, E, H, I     | A, B, C, D, E, H, I     | 20 yrs                       | Implement 2 BMPs            |                                     |                                |
| CD #37 to MF Crow                  | DNR # 1802400          | All                                      |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     | A, B, C, D, E, H, I           |                                       | A, B, C, D, E, H, I     | A, B, C, D, E, H, I     | 20 yrs                       | Implement 2 BMPs            |                                     |                                |
| Proposed BMPs in each 10 yr cycle. |                        |  |   |                    |                 |                                    |   |   |                            |                        |                               |                            |                              |                      |                                 |                          |                       |                     |                               |                                       |                         |                         | 162                          |                             |                                     |                                |

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection

Governmental Unit for Restoration Strategy (Governmental Unit in Bold will be considered Lead Entity): A = CROW; B= SWCD; C= County; D = City; E = NRCS; F = MPCA; G=Minnesota DNR H = Lake Association I=MFCRWD J=NFCRWD

<sup>1</sup>Responsible

Table 13. Key for Strategies Column.

| Strategy                                  | Practices (NRCS Code)   |
|---|---|
| <b>Nonpoint Source</b>                    |   |
| Livestock, pasture and feedlot management | Managed/restricted area fencing (382 and 472), pasture runoff controls, buffers (322/390), heavy use protection-stream crossing areas, alternative watering sources, rotational grazing   |
| Cropland and manure management            | Chemical addition to manure, spreading in sensitive areas, soil P testing, nutrient management (590), conservation and reduced tilling methods (329, 345 and 346), sediment and water control structures and basins (350), cover crops (340), grassed waterways, lined waterways and channels, manure runoff control, manure storage facilities (313) |
| Septic Systems                            | Imminent threat to public health and safety (ITPHS) upgrades, septic upgrades in shoreline areas  |
| Streambank restoration                    | Streambank stabilization (580), re-meanders, habitat improvement  |
| Internal P release (lakes)                | Chemical addition to lake sediment to immobilize Phosphorus release from sediment   |
| Shoreline protection                      | Shoreline protection (580), natural plantings, setbacks   |
| Wetland restorations                      | Restore degraded and impacted wetlands that may be P source (651)   |
| Roadside erosion control                  | Flow/erosion control basins near crossings to reduce sediment/flow (638)  |
| Dam/Culvert management                    | Assess culverts/dams for sizing, retention, fish passage and hydrologic function  |
| Channel Restoration                       |   |
| City Stormwater management                |   |
| Forestry management                       | Timber stand improvement (666), early habitat succession (647)  |
| <b>Point Source</b>                       |   |
| NPDES point source compliance             | All NPDES-permitted sources shall comply with conditions of their permits, which are written to be consistent with any assigned wasteload allocations   |

## 4. Monitoring Plan

Funding mechanisms for effectiveness monitoring are limited. However, there are a number of local entities that conduct monitoring in the NFC River watershed including but not limited to the Crow River Organization of Water, NFC River Watershed District, the Middle Fork Crow River Watershed District, and local SWCDs. Both the NFCRWD and the MFCRWD work under watershed management plans where monitoring activities are specified. Local entities continue to pursue funding to assess and monitor water quality in the NFC River watershed to fill identified data gaps, measure progress toward implementation goals for both protection and restoration and provide the basis for future planning and adaptive management. Some of the tools used by the local entities to measure implementation progress are:

- Annual local monitoring reports showing trends (if appropriate) and progress are produced, posted on websites and distributed by the CROW, NFCRWD and the MFCRWD.
- Numbers of BMPs funded by state/federal funds are reported and tracked annually through the BWSR eLINK reporting system which also calculates pollutant reductions.
- Annual reports and open houses highlight BMP protection and restoration projects.

### Current Monitoring Efforts

Table 14 below depicts the ongoing monitoring by entity in the NFC River watershed.

Table 14. NFC monitoring by entity.

| ENTITY | BASELINE | IMPLEMENTATION | FLOW | EFFECTIVENESS | TREND | VALIDATION |
|--------|----------|----------------|------|---------------|-------|------------|
| CROW   | X        |                |      |               |       | X          |
| NFCRWD | X        |                | X    | X             | X     | X          |
| MFWD   | X        |                | X    | X             | X     |            |
| SWCD   | X        |                |      |               | X     | X          |
| DNR    |          |                | X    |               |       |            |
| MPCA   | X        |                | X    |               | X     |            |

**CROW:** The CROW will continue to seek funding to help on-going monitoring for baseline conditions and validation of TMDL allocations. CROW will collaborate with local partners and the MPCA on the large scale effectiveness monitoring project.

**MFWD:** The Middle Fork Crow River Watershed District (MFCRWD) has received a Clean Water Partnership (CWP) grant to evaluate baseline water quality conditions on eight major recreational lakes, four shallow lakes, and five river monitoring locations. The MFCRWD works with volunteers to collect

water quality data on eight major recreational lakes: Long, Monongalia, George, Nest, Green, Elkhorn, Calhoun, and Diamond. Flow measurements and continuous stage measurements are collected at three of the five Middle Fork Crow River monitoring locations. The MFCRWD has also procured funds from the Board of Water and Soil Resources to implement conservation drainage practices and monitor their effectiveness for pollutant removal. Implementation activities for the Diamond Lake Nutrient TMDL are in progress and include connecting Diamond Lake residents to the Green Lake Regional Wastewater Treatment System, Upstream Management to Achieve Clear Water States within Hubbard, Schultz, and Wheeler Lakes, Implementation of Agricultural Conservation Practice Programs, Lakeshore and Urban Best Management Practices, and Macrophyte Management to Control Curly Leaf Pondweed. Implementation activities to control internal sources of TP loading in Nest and Diamond Lakes include Aquatic Macrophyte Management via chemical and mechanical methods. The District will continue to work with its partners to provide cost-share and technical assistance to implement water quality practices that address impairments and provide protection of non-impaired waters.

**NFCRWD:** The NFCRWD monitoring program includes annual monitoring of 4 recreational lakes, river sites along the NFC River and drainage ditches within its boundary. The lake samples are collected with help of volunteer boat drivers on Grove, Koronis, Pirz, and Rice Lakes. The NFCRWD works on projects which include agricultural and shoreline BMPs to improve water quality throughout the district. Monitoring data is collected to measure improvements. The NFCRWD applies to BWSR and the MPCA for funds to implement BMPs for water quality improvement. The Rice Lake TMDL was completed in 2011; continual monitoring of Rice Lake and the upstream reaches is utilized to detect significant changes in nutrient loading if any. The NFCRWD collects stream water samples from ice out to ice on. All samples are analyzed for nutrients, chemistry and flows at each stream site. Monitoring data is analyzed annually to help detect trends in nutrient loading.

**Wright SWCD:** The surface water monitoring activities in Wright County serve one of two goals; assist in the revelation of the existing condition of our surface water resources in the county or to identify the highest phosphorus exporting sub-watersheds within the Crow River Basin.

The Wright County Lake Monitoring Program is on its 16<sup>th</sup> year and consists of 30-35 lakes in the county. This program collects an integrated sample monthly May thru September (5 samples). Three parameters are collected: Secchi depth, Chl-a, and total phosphorus.

Long-term monitoring is conducted at the outflow of five basins at approximately the HUC-10 level. These sites are monitored monthly for total phosphorus and dissolved phosphorus levels. The stream stage is also continuously recorded. The size of these sub-basins range from 20,000 acres to 80,000 acres; it is at this scale we hope to recognize long term improvements in water quality.

Through the Wright SWCD's water monitoring efforts during the past six years, we have found that certain wetlands fulfill varying roles in the phosphorus cycle of our surface waters. Conventional wisdom has categorized our wetlands as the filters for our water systems. Our monitoring shows this to only be partially accurate. Wetlands are indeed very effective in the trapping of sediment from run-off. This phosphorus laden sediment under anaerobic conditions however, will ultimately be released as soluble



phosphorus. Identifying wetlands that are significant contributors in a lakeshed, is critical in the protection of a non-impaired lake or the rehabilitation of one which is impaired. Once identified and the total annual load calculated we will be able to prioritize these wetlands for future phosphorus reduction projects. For us to achieve the phosphorus targets identified by the TMDL and WRAPS process for impaired lakes or to further protect lakes that meet standards, the sequestering of this phosphorus is critical.

**DNR:** The DNR will be collecting additional geomorphology data relating the pattern and profile of the mainstem of the NFC and many of the major tributaries. The preliminary plan includes data collection on at least five reaches of the mainstem NFC and data collection on the following major tributaries:

- Sedan Brook
- Skunk River
- Middle Fork Crow River
- Stag Brook
- Grove Creek
- Jewitts Creek
- Battle Creek
- Washington Creek
- Collinwood Creek
- Sucker Creek

**MPCA:** Large scale effectiveness monitoring will be provided by the MPCA through on-going monitoring in the watershed including the major outlet monitoring program, the statewide Load Monitoring Network as well as the Intensive Watershed Monitoring (IWM) associated with the Watershed Approach. As part of the 10 year cycle, the IWM for the NFC will begin again in 2017 which will allow another round of watershed- wide data collection of biology, hydrology and chemistry that will be used for comparison with current conditions.

### Future Monitoring Needs

#### Stream Monitoring

Routine stream monitoring in the NFC River watershed is conducted by a number of agencies throughout the watershed. For example, the NFCRWD is currently targeting subwatersheds for intense monitoring to assess pollutant sources in the watershed. However, some special studies are needed to further understand the dynamics in the watershed. Following is a brief description of some of these studies.

#### *Synoptic Surveys*

The Dissolved Oxygen TMDL for 12-mile Creek relied upon model outputs and literature values for several of the model inputs. A targeted synoptic survey to fill these data gaps will improve our

understanding of dissolved oxygen in this stream. Similar work is needed in the main stem of the NFC River where DO violations occurred at high flows.

### Lake Monitoring

Inputs to lake response models for the TMDLs in the NFC River watershed relied upon an HSPF model calibrated at a much broader scale than the lakesheds. These HSPF generated inputs for external nutrients were used in the lake models when monitoring data was insufficient leading to increased uncertainty in the lake model results. Furthermore, internal loading for almost all of the lakes (excluding Buffalo, Fountain, Dean, Rice, Ann, and Emma Lakes) was based on lake response model residuals. Due to these modeling constraints, verification of model inputs should be the focus of the monitoring program moving forward. A few lakes such as Ann, Emma, and Nest Lake, had relatively robust watershed monitoring and therefore no validation is required. However, the majority of the lakes should have their primary inflow monitored for a minimum of 1 year and preferably 3 years. Internal loading should be monitored using laboratory sediment nutrient release assays to determine nutrient release rates. These data, combined with dissolved oxygen monitoring provide a more robust understanding of the role of external versus internal nutrient loading.

### Groundwater Monitoring

The upper portion of the NFC watershed coincides with the southeastern extent of the Bonanza Valley Aquifer system (see Figure 5, Appendix B), a regionally important groundwater resource which is highly utilized by area landowners for high capacity use, the majority of which is for crop irrigation. The Bonanza Valley aquifer system has been recently designated as a Groundwater Management area by the Minnesota DNR for several reasons, including the high density of existing users, the rapidly increasing demand for water for high-capacity systems, and potential negative implications for ecosystem services, all of which are significant concerns for the sustainability of this resource for ecosystems, water quality, and the ability of future generations to meet their needs. The DNR is currently undergoing a major planning cycle with the goal of ensuring sustainability of use within this system as well as assessing any significant issues to natural resources to ensure sustainability and continuation of ecosystem services throughout this area.

The Minnesota legislature created groundwater management areas as a tool for the DNR to address difficult groundwater-related resource challenges. The purpose of the Bonanza Valley pilot planning project is to learn how to effectively create and establish GWMA's in other areas of the state facing similar groundwater management challenges.

There are currently a number of observation wells in place within the Bonanza Valley area; however, additional wells may be necessary to accurately gauge the water level variations within these aquifers. (See Appendix B for more information on the Bonanza Valley GWMA.)

## Inventory Updates

Updated Feedlot/animal number inventories and SSTS in the subwatersheds that have a high potential to contribute to bacteria impairments will be need to be updated to achieve reduction goals.

## Volunteer Monitoring

Expanding both the citizen stream and lake monitoring programs (CSMP and CLMP) in the watershed would help to obtain data in areas that have not been assessable due to either lack of access or staff time and local resources will help to improve the monitoring dataset that would enable measuring improvements and developing trends.

## HSPF Modeling

*HSPF Modeling of the Sauk River, Crow River, and South Fork Crow River, (RESPEC 2012)* has the following recommendations for future HSPF modeling that were created based on “lessons learned” in the process of formulating, calibrating, and executing the models. The Crow models are well calibrated and can be used for future evaluations and studies. Internal loading should be incorporated into lake modeling in the future. However, further refinement of internal loading approach is recommended to reduce the numerous runs required for its implementation and potentially represent additional internal loading processes.

- Scenario 3—Point Sources at Permitted Levels-should be refined with input from the MPCA staff. The complex, interrelated nature of HSPF and the changes in discharges over time make the results from this scenario not intuitive to understand. Therefore, refinements should be made to add clarity on an individual point-source level.
- The Crow and Sauk Watersheds have an abundance of flow and water-quality data. This level of data collection should be continued if possible. Additionally, sediment source apportionment data, tillage transects, septic tank studies, and other supplemental information cited in the HSPF report were very helpful for modeling and should be continued.
- To further improve the model calibration, particularly for sediment and water temperature, additional stream cross-sectional and lake outlet hydraulics information should be collected.
- Currently, the model combines the watershed loading from chemical and organic fertilizers. If required for specific management scenarios, the watershed loading should be split to represent manure specifically. Additional information and methodology would be required to implement this recommendation.

## General Conclusions

- Protection and restoration strategies in Table 12 are dictated by the predominantly agricultural land use in the NFC
- Lake TMDLs were completed for all nutrient impaired NFC lakes on the 2012 303(d) list
- Stream TMDLs were completed for NFC impaired stream reaches on the 2010 303(d) list
- Aquatic recreation is impaired due to excessive nutrients and E.coli while the primary stressors to the stream biology are low dissolved oxygen and excess deposited and or bedded sediment
- Monitoring and modeling data gaps still exist to further understand the NFC watershed dynamics
- The timeline for achieving water quality standards in the NFC is at least 50 to 100 years due to the size of the watershed, number and magnitude of the impairments

## 5. References and Further Information

- Wenck Associates, Inc. 2011. [Ann Lake and Lake Emma Excess Nutrient TMDL](#). October 2011.
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- Wenck Associates, Inc. 2013. [North Fork Crow and Lower Crow Bacteria, Turbidity, and Low Dissolved Oxygen TMDL](#). May 2013.
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- Minnesota Pollution Control Agency. 2010. [Assessment Report of Selected Lakes within the North Fork Crow River Watershed Upper Mississippi River Basin](#). November 2010.
- Minnesota Pollution Control Agency. 2011. [North Fork Crow River Watershed Monitoring and Assessment Report](#). December 2011
- Minnesota Pollution Control Agency. 2012. [North Fork Crow River Watershed Biotic Stressor Identification Report](#). Winter 2012.
- Minnesota Pollution Control Agency. 2013. [Grove Creek Biotic Stressor Identification Report](#). October 2013.
- Minnesota Pollution Control Agency. 2013. Jewitts Creek Biotic Stressor Identification Report. Unpublished.

### North Fork Crow Reports

North Fork Crow reports referenced in this document are available at the North Fork Crow Watershed webpage: <http://www.pca.state.mn.us/jsrida>

### North Fork Crow Story Map

<http://pca-gis02.pca.state.mn.us/nfcr/index.html>

## Appendix A: North Fork Crow Priority Shallow Lakes

These shallow lakes are deemed high priority lakes by the Minnesota DNR based on adjacent public lands and wildlife habitat. (See Appendix B for more information on shallow lakes.)

| LAKE       | Lake ID  | Area (Acres) |
|------------|----------|--------------|
| Calhoun    | 34006200 | 1018.85      |
| Mud        | 34015800 | 2997.55      |
| Unnamed    | 34016100 | 441.63       |
| Unnamed    | 34016600 | 133.50       |
| Unnamed    | 34051000 | 443.21       |
| Unnamed    | 34052700 | 615.25       |
| Unnamed    | 34061100 | 231.02       |
| Unnamed    | 34061200 | 312.83       |
| Echo       | 43008100 | 83.02        |
| Spencer    | 47001400 | 147.59       |
| Wolf       | 47001600 | 262.36       |
| Arvilla    | 47002300 | 137.85       |
| Round      | 47010200 | 266.33       |
| Stone      | 47013100 | 162.56       |
| Unnamed    | 47013200 | 116.12       |
| Youngstrom | 47013800 | 153.23       |
| Minnesota  | 47014000 | 126.73       |
| Madsen     | 47014600 | 334.71       |
| Unnamed    | 47014800 | 129.73       |
| Horseshoe  | 47015100 | 180.03       |
| Thoen      | 47015400 | 397.19       |
| Popple     | 47017300 | 73.14        |
| Long       | 47017700 | 787.03       |
| Unnamed    | 47018700 | 75.85        |
| Unnamed    | 47018900 | 130.86       |
| Lund       | 47019200 | 188.95       |
| Miller     | 47019400 | 101.41       |
| Peterson   | 47019800 | 137.19       |
| Unnamed    | 73026800 | 66.62        |

| LAKE             | Lake ID  | Area (Acres) |
|------------------|----------|--------------|
| Unnamed          | 73027700 | 146.31       |
| Tamarack         | 73027800 | 493.61       |
| Raymond          | 73028500 | 75.29        |
| Rice             | 86000200 | 60.67        |
| Pelican          | 86003100 | 2317.33      |
| Mud              | 86004400 | 130.86       |
| Green Mountain   | 86006300 | 156.02       |
| Mud              | 86008500 | 611.48       |
| Fountain         | 86008600 | 538.48       |
| Varner           | 86009100 | 100.16       |
| Little Waverly   | 86010600 | 338.00       |
| Malardi          | 86011200 | 153.57       |
| School Section   | 86018000 | 39.37        |
| Unnamed          | 86019100 | 152.90       |
| Willima          | 86020900 | 259.03       |
| White            | 86021400 | 121.60       |
| Smith            | 86025000 | 294.61       |
| Shakopee         | 86025500 | 152.56       |
| Grass            | 86025700 | 424.23       |
| Unnamed          | 86027700 | 79.11        |
| Swan             | 86029500 | 465.57       |
| Beaver Dam       | 86029600 | 221.08       |
| Unnamed          | 86044200 | 76.60        |
| Unnamed          | 86003500 | 76.14        |
| Ox Yoke          | 27017800 | 318.47       |
| Little Kandiyohi | 34009600 | 975.35       |
| Unnamed          | 34001900 | 68.24        |

WATERSHED DATA  
REPORT—NORTH  
FORK CROW RIVER  
WATERSHED

*August 14, 2014*

Ethan Jenzen,  
Area Hydrologist

Minnesota Department of  
Natural Resources

## Summary of this report

The NFC River watershed is an eight digit Hydrologic Unit Code (HUC) watershed draining approximately 1476 mi<sup>2</sup> of a mixture of agricultural and forested land. The following report is a summary of existing data and collective information related to the hydrology, connectivity, geomorphology, and human alteration/use available in the watershed.

This document is intended to be a working report that continues to progress as more data and information in regards to the above mentioned watershed components is collected during the next five years. Recommendations will be made for targeted watershed practices, including recommendations for protection or restoration directed activities, based on the data presented.

## Methods

### Hydrology

Watershed discharge data can be used to review daily, monthly, seasonal, annual and long-term trends within a watershed and examine changes in the discharge characteristics such as periods of low or zero flow, flood frequency, base flow volume, and seasonal variability. Discharge data for the NFC River were reviewed from the Rockford site (USGS/DNR# 18087001). At this point, only the long-term trend analysis for this site (which includes the South Fork Crow as well, as this particular site is downstream of the confluence) has been completed. In the future, additional comparative and trend analyses will be conducted using discharge data from various other gage sites located on the mainstem NFC throughout the watershed, including the Rockford (Farmington Ave, DNR# 18088001), Koronis Lake Outlet (18055001), Middle Fork Crow River (18033001), and Manannah (18063001) gage locations.

### Double Mass Curve Analysis

A double mass curve is an analysis based on a cumulative comparison of an independent and dependent variable. This is useful in hydrological data as it allows examination of the relationship between two variables. This technique was used to compare precipitation and stream discharge relationships (annual and seasonal) and well elevation fluctuations relative to precipitation. When plotted, a straight line indicates consistency in the relationship while a break in the slope would mean a change in the relationship.

When used with long-term discharge data sets, the curve can demonstrate when the change in the relationship began to occur. All double mass curves presented are runoff (discharge/watershed area) and monthly precipitation in inches. All discharge values are converted to inches by dividing total volume by the watershed area (the annual discharge converted to acre-ft. and then to inches of runoff over the watershed). Additional information on double mass curve development and interpretation can be found on the following website:

<http://pubs.usgs.gov/wsp/1541b/report.pdf>

### Precipitation

Precipitation data is based on the long-term data collection location nearest to the stream data collection site. All precipitation data is acquired through the “High Density Radius Retrieval” website maintained by the Minnesota State Climatology Office. Precipitation data is used to examine long-term trends within a watershed, and the relationship and response of discharge, runoff, and baseflow conditions relative to recorded precipitation totals. Long-term precipitation data was available at Rockford (site# 217020) in Minnesota.

## Groundwater Usage

Permitted groundwater usage will be reviewed to examine changes in type of usage and volume over time. Data will be collected through the State Water Use Data System (SWUDS) from 1988-2013. The data will be used to review total volume appropriated, volume appropriated by county, aquifer type, and well level fluctuations relative to precipitation. This data has not yet been analyzed, but will be included as a portion of the report with the next iteration of intensive monitoring and assessment commencing in 2017.

## WHAF

The DNR has recently developed the Watershed Health Assessment Framework (WHAF). The WHAF is a suite of watershed health index scores that have been calculated and represent many of the important ecological relationships within and between the components. These scores are built on statewide GIS data that is compared consistently across Minnesota to provide a baseline health condition report for each of the 81 major watersheds in the state. More information can be located at <http://www.dnr.state.mn.us/whaf/index.html>. For the purpose of this study, the information displayed is on a 12-digit HUC scale.

## Riparian Connectivity

Riparian connectivity analyses were done using ArcMap, and the Minnesota DNR Watershed Health Assessment Framework (WHAF). Specifically, near channel areas of the mainstem NFC and significant tributaries were analyzed for the presence of perennial vegetation and continuous buffers. At the present time, this analysis is incomplete and will require additional study for field level verification. Several of the major tributaries were selected for additional analysis based on field observations of good riparian habitat and continuous buffers. These tributaries were then prioritized for additional study during the upcoming field seasons. These tributaries include Grove Creek and Stag Brook, and several portions of the mainstem NFC.

Riparian vegetation and habitat will be qualitatively assessed at each field survey site. Type of vegetation, root depth, root density, and weighted root density (i.e., [root depth/study bank height] \* root density) are all measured to help assess the quality of vegetation for that particular stream reach. Lack of quality in vegetation typically relates to poor stream stability and high sediment supply through bank erosion.

## Results

### Hydrology

Stream flow data in the NFC River watershed were collected at the Rockford gage site. Stream data collection at Rockford began in 1910 through the USGS, but was discontinued in 1920. The site was reestablished in April of 1935 and is currently operating. This data set is ideal for in-depth analysis of changes over time, as it is a continual record from 1935 to the present. Long-term data allows for better analysis within a watershed and can help show trends or pinpoint when relationships changed.

It is important to note that this gage site incorporates the entirety of the Crow River watershed, including both the North and South Fork watersheds, and therefore any changes indicated may not reference changes specifically indicative of hydrology impacts in the North Fork watershed. For this study, however, the discharge data from the Rockford site was used as it is the largest and most continuous data set for this watershed.



## Double Mass Curves

Double mass curves were developed for the data collected at the Rockford gage site. Precipitation data was collected from the Rockford area as well. This gage does include winter discharge data, and as such, all available data was used in the development of these curves. The double mass curve for this site (Figure 1) displays two distinct relationships over the period of record. From 1935-1982, a relatively linear relationship between precipitation and runoff is observed. The relationship noted from 1983-2013 displays a significantly higher volume of runoff during this timeframe than was noted earlier. This change in the relationship that runoff is increasing independent of the amount of rain in this watershed. As both low and high annual precipitation volumes were recorded during the period of record from 1935-1982 and 1983-2013, it is apparent that these relationships are not directly affected by periods of wet or dry conditions, and is likely a result in changes to the flow pathways or hydrologic alterations within the watershed itself.

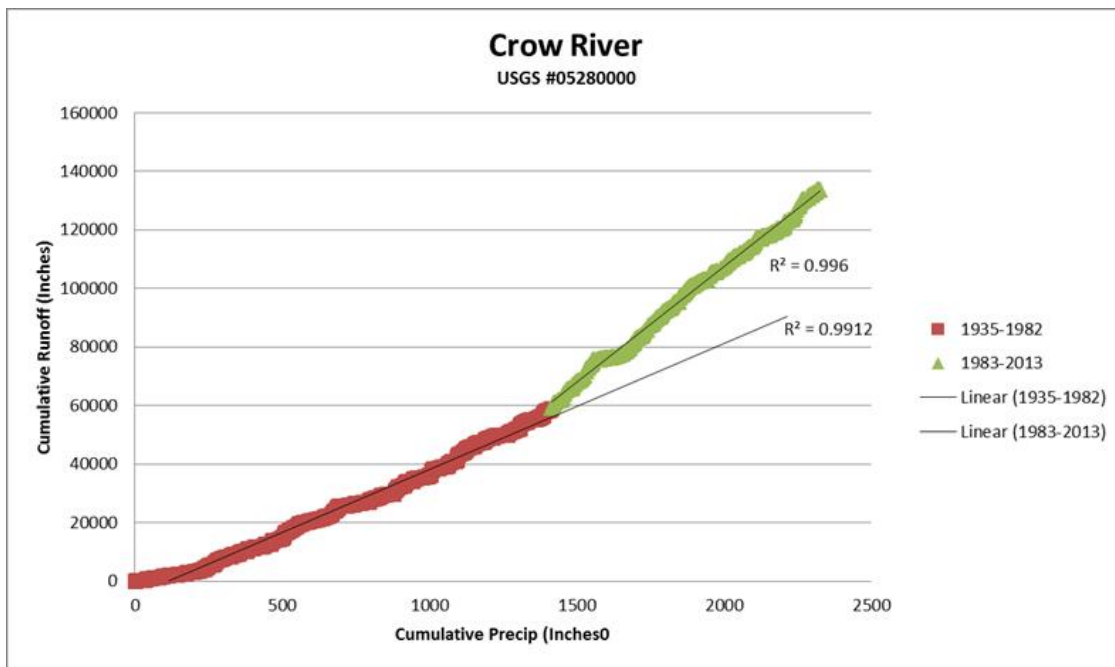


Figure 1: Preliminary Double Mass Curve for the Crow River at Rockford, showing the relationship between precipitation and river discharge.

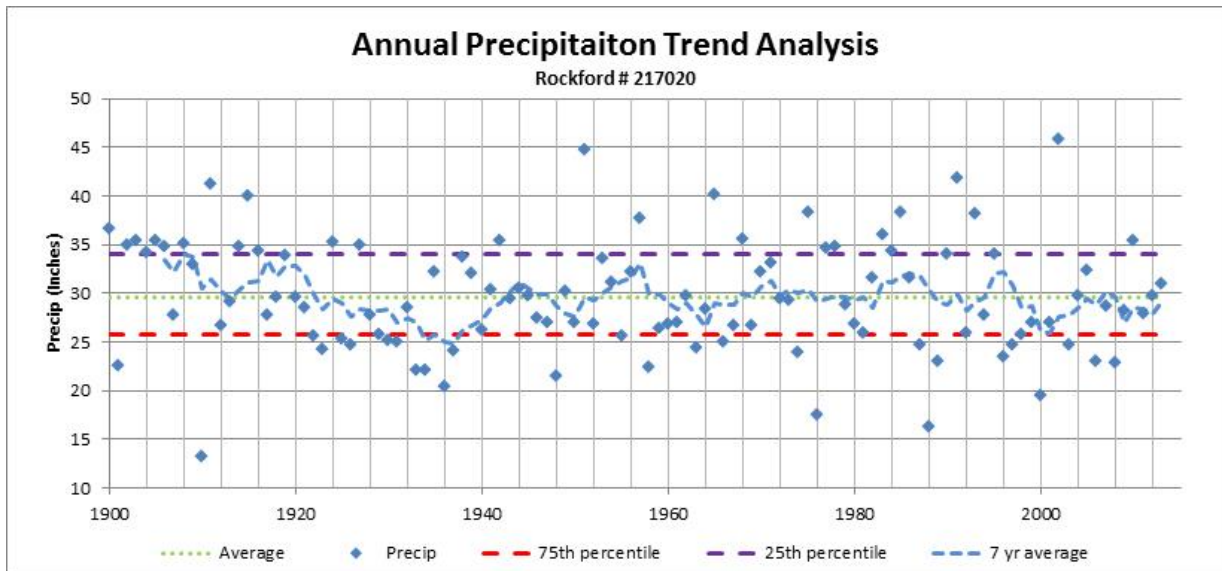


Figure 2: Preliminary Trend Analysis of Precipitation at the Rockford gaging station

This hydrograph (Figure 2) depicts cumulative runoff (discharge over watershed area inches) and monthly precipitation over time. This also shows that in recent years, runoff volumes are increasing while precipitation is remaining relatively steady over the period of record. This may be in relation to a number of changes in hydrology, land use, and alteration of the landscape, including decreases in watershed storage capacity, changes in agricultural cropping patterns, increased hydrologic alteration including pattern drainage, and other alterations that move water off the landscape.

A double mass curve was also generated for the Middle Fork Crow River (Figure 3). Stream flow data in the Middle Fork Crow River watershed were collected at the Kandiyohi County Road 2 gage site. Stream data collection at this site began in 1949 through the USGS, but was discontinued in 1996. The site was reestablished in April of 1996 through DNR/USGS agreement but was discontinued in 2013. This data set is ideal for in-depth analysis of changes over time, as it is a nearly continual record from 1949 to the present.

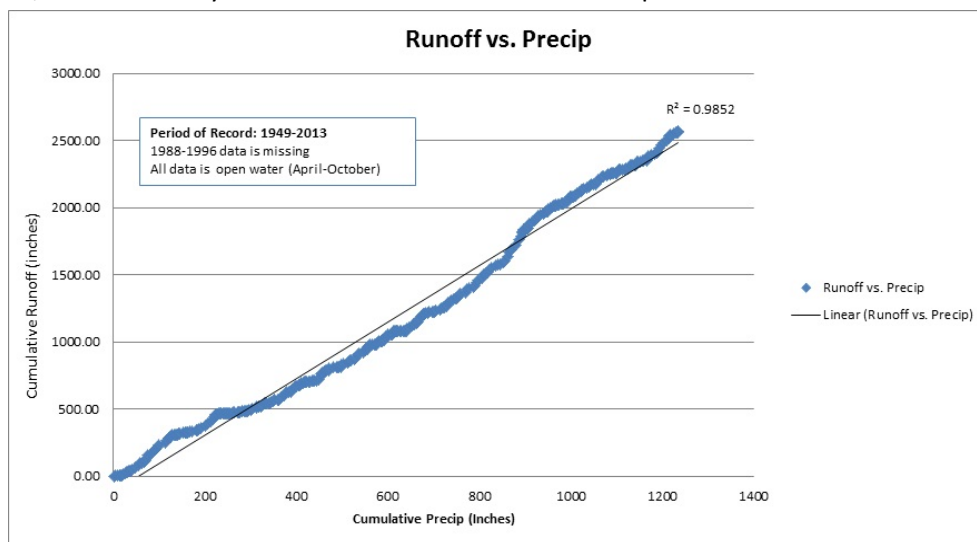


Figure 3: Preliminary Double Mass Curve for the Middle Fork Crow River at the Kandiyohi County Road 2 gaging site, showing the relationship between precipitation and river discharge.

The data displayed in this curve (Figure 3) is significantly different from the curve for the Crow River at Rockford. The runoff relationship displayed at this location is relatively linear over the entire period of record, and does not display an increase in runoff per unit discharge as displayed in the Rockford curve. This data shows no net increase in discharge over the period or record. This indicates a more stable precipitation to discharge with less hydrologic alteration throughout the watershed. This is likely related to a number of factors within the watershed, including the significant amount of depressional storage available in the number of lakes and wetlands along the mainstem of the river, and less alteration of hydrology as a whole within the subwatershed over the period of record. Precipitation was also relatively stable within the watershed over the period of record. As both low and high annual precipitation volumes were recorded during this period, it is apparent that the precipitation/runoff relationships are not directly affected by periods of wet or dry conditions.

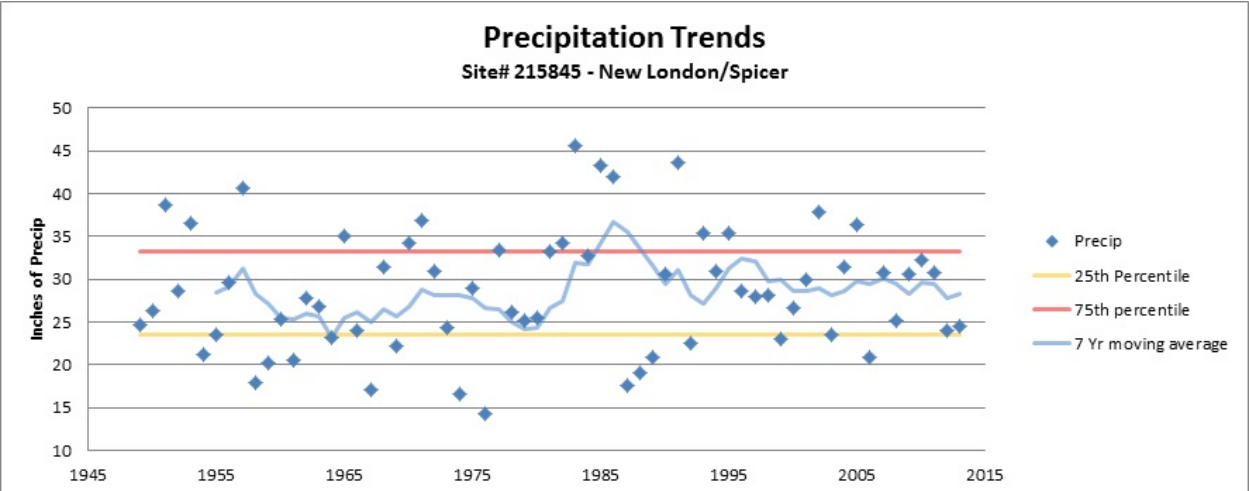


Figure 4: Preliminary Precipitation Trends for the Middle Fork Crow River Watershed at the New London/Spicer site.

**Additional Hydrology Information**

Additional analyses, including discharge characteristics such as periods of low or zero flow, flood frequency, base flow volume, and seasonal variability will be conducted prior to the next iteration of the watershed study commencing in 2017, and will have more analyses specifically referencing the North Fork watershed. Specifically, additional comparative and trend analyses will be conducted using discharge data from various other gage sites throughout the watershed, including the Rockford (Farmington Avenue site, DNR# 18088001), Koronis Lake Outlet (18055001), Middle Fork Crow River (18033001), and Manannah (18063001) gage sites. These data sets are significantly shorter in duration; however, smaller data sets can still provide useful data to analyze for smaller, more recent shifts or changes within the period of record.

**Groundwater**

This groundwater usage and observation well data has not yet been analyzed as a part of trend analysis and water level fluctuations in aquifers, but will be included as a portion of the report with the next iteration of watershed monitoring commencing in 2017.

The upper portion of the NFC watershed coincides with the southeastern extent of the Bonanza Valley Aquifer system (Figure 5), a regionally important groundwater resource which is highly utilized by area landowners for high capacity use, the majority of which is for crop irrigation. The Bonanza Valley aquifer was recently designated

a Groundwater Management Area (GWMA) by the Minnesota DNR, due to significant concern related to potential overuse and contamination of the groundwater resource. The DNR will be undergoing a major planning cycle with the goal of ensuring sustainability of use within this system as well as assessing any significant issues to natural resources to ensure sustainability and continuation of ecosystem services throughout this area.

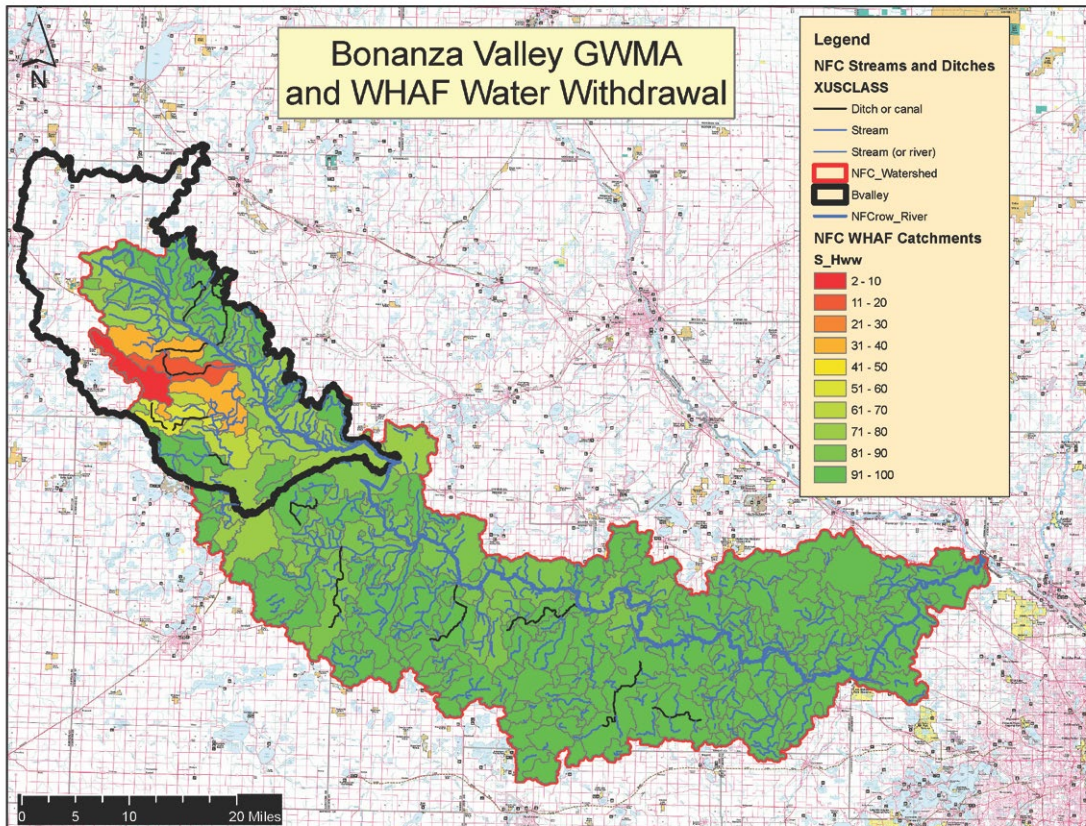


Figure 5: Bonanza Valley GWMA and WHAF Water Withdrawal Scores

There is currently a network of water level observation wells in-place within the Bonanza Valley area; however, additional wells may be necessary to accurately gage the water level variations within these aquifers. Data will be presented as it becomes available.

The WHAF layer detailing water withdrawal is noted in Figure 5. Water withdrawals can lower water tables and reduce water storage in aquifers. In turn, withdrawals may: reduce discharge to or increase recharge from surface waters to depleted aquifers; increase recharge from other aquifers; increase the fluctuation in surface water levels; or cause permanent damage to an aquifer. Furthermore, the withdrawal of surface water can reduce the flow in streams and the water levels in lakes and wetlands, which in turn can reduce recharge to or increase discharge from ground water. The Bonanza Valley GWMA contains the subwatersheds with the lowest WHAF scores for water withdrawal, indicating that the water withdrawn from groundwater units is the highest in proportion to surface runoff, and has the greatest potential for effects to surface water systems.

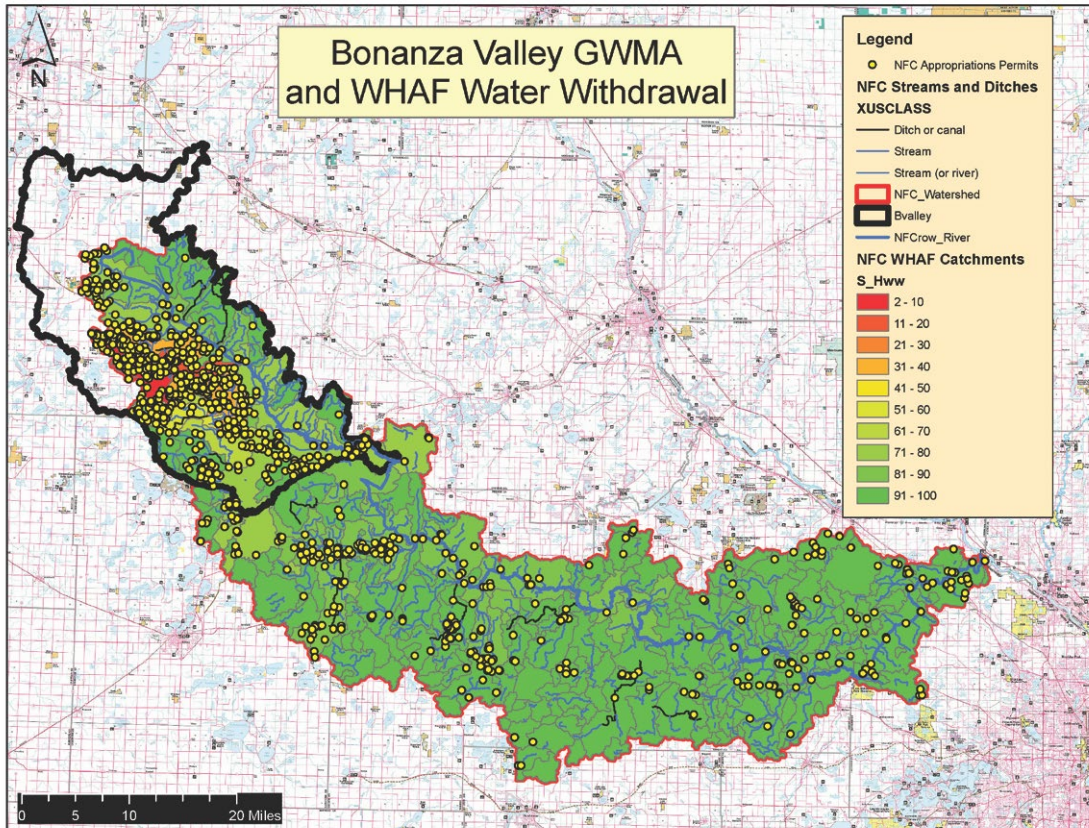


Figure 6: Appropriations permit locations within the NFC Watershed.

Currently, there are 614 high capacity wells associated with 414 appropriations permits within the Bonanza Valley portion of the NFC Watershed (Figure 6). Analysis done of the State Water Use Data System (SWDUS) system conducted prior to the onset of the GWMA show significant use of shallow/surficial wells in proximity to the mainstem river and/or major tributaries. Appropriation from the surficial/shallow system may have significant effects on discharge within the streams during low flow conditions, and may result in exacerbation of existing impairments (such as DO) or concentration of nutrients. Additional study will be conducted on this parameter in this area.

In addition, there are a significant number of high capacity wells in proximity to the Middle Fork Crow River east of Lake Calhoun Kandiyohi County, and the same concerns apply to this reach.

**Wetlands** - Similarly, groundwater withdrawals in the vicinity of wetlands and shallow lakes can have significant effects on water levels within the basins. Several studies are currently underway within the Bonanza Valley area, including one study on the Burbank USFWS Waterfowl Production Area, with respect to determination of the effects of high capacity use on nearby wetlands, and it is anticipated that this information will be available for inclusion in the report to accompany the WRAPS report commencing 2017.

As there is significant potential for impacts to surface waters, restoration strategies and priorities in this area should include enhancing recharge areas and promoting wetland restoration to facilitate groundwater recharge to minimize effects to groundwater resources.

## Shallow Lakes

Minnesota's diverse wildlife populations are influenced in large part by our state's abundant water resources. While all lakes support wildlife needs, it is the shallow water zone, characterized by aquatic plants and generally less than 15 feet deep, that provides the most important wildlife habitat. There are more than 5000 shallow lakes over 50 acres in size in Minnesota. These lakes have permanent or semi-permanent water regimes and are typically dominated by wetland habitat (less than 15 feet deep). Although water quality degradation, altered watersheds, modified outlets, urban development, intensive agriculture and exotic species have reduced their wildlife benefits, shallow lakes remain a critical habitat component for Minnesota's wildlife. (MNDNR, 2010)

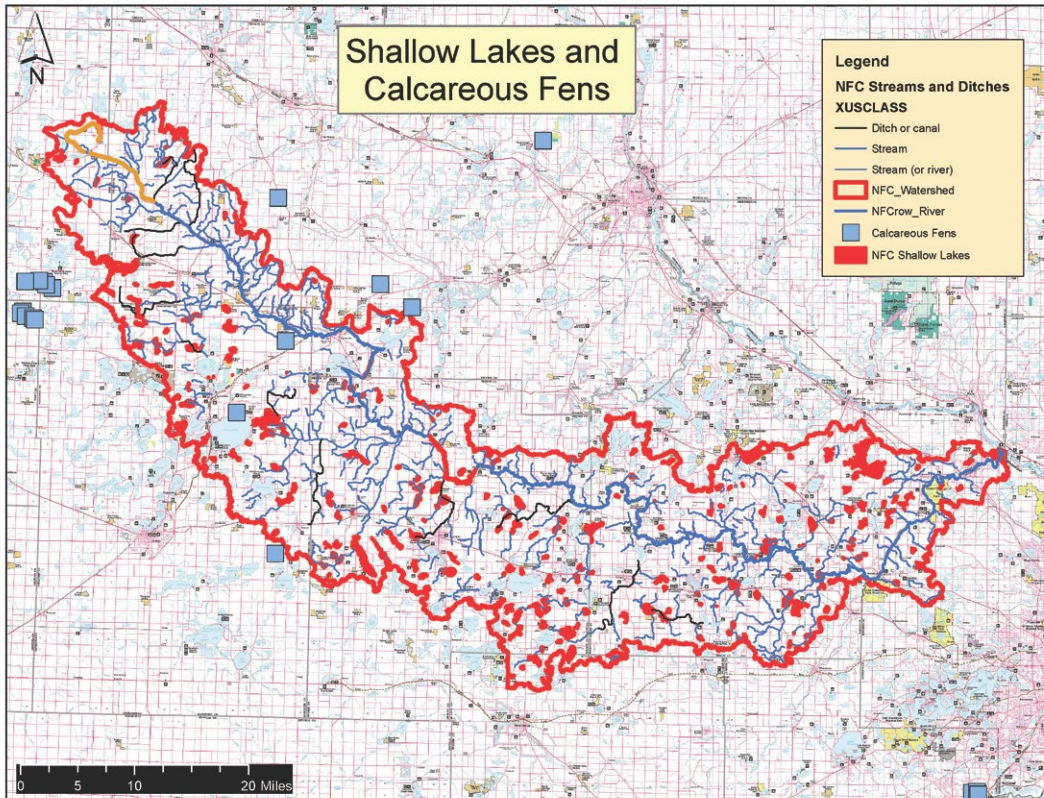


Figure 7: NFC Shallow Lakes and Calcareous Fens

The NFC watershed contains 263 shallow lakes identified using this criteria (Figure 7). Although water quality degradation, altered watersheds, modified outlets, urban development, intensive agriculture and exotic species have reduced their wildlife benefits, shallow lakes remain a critical habitat component for Minnesota's wildlife. At the time of this study, priority for management was given to shallow lakes located either adjacent to or completely within currently owned state lands. Other information is considered for specific projects potentially outside of this priority scale, including involvement of partners and willingness of riparian landowners to conduct the project.

Shallow lakes and their immediate watersheds, due to the importance of these basins to habitat and the sensitivity to water quality changes as well as the high potential for restoration and management, are also priority areas for both protection and restoration activities. As per information gathered from DNR shallow lake surveys within the NFC watershed, there are shallow lakes basins with good water quality that exist in a clear water state.

### Calcareous Fens

In addition, there are several rare water resource features that are present due to unique geologic conditions that warrant protection. Specifically, calcareous fens develop in areas where mineral-rich groundwater is discharged from underlying calcareous mineral soil and forced through peat soils by artesian pressure. These communities are very rare, as they are dependent on specific geologic and hydrologic conditions, including upwelling of cold, anoxic water, and are very sensitive to minor changes in these conditions. Several plant species are found only in calcareous fens in Minnesota. In addition, it has been noted that fens are present in a number of settings, but are typically close to higher-elevation groundwater recharge areas (MNDNR, 2005). Due to rarity and sensitive nature of these sites, calcareous fens and the surrounding areas must be considered for protection from development and groundwater diversion and/or overuse. There are currently two of these unique water features designated within the NFC watershed (Figure 7).

### Geomorphology

At the time of this report, six stream reaches within the NFC watershed have undergone basic reconnaissance site visits (Figure 9) to gather information related to stream condition, overall pattern, and profile. Two reaches were assessed using the BANCS method, including the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) methods to estimate the nature of stream bank erosion consistent with the stream assessment methods developed and taught by Dr. Dave Rosgen. These surveys were conducted to better determine the general condition of the stream with the intention of returning to the stream to conduct more detailed analyses based on stream bed pattern and profile. In addition, these reconnaissance surveys also allow for a qualitative assessment of the stream corridor, relating to access to the floodplain, riparian vegetation, development presence of major bed features, and location of potential priority project/practice locations.

At this point in the study, stream and valley type have not yet been determined. This will be a portion of the additional information collected during more intensive study within these stream reaches in coming years.

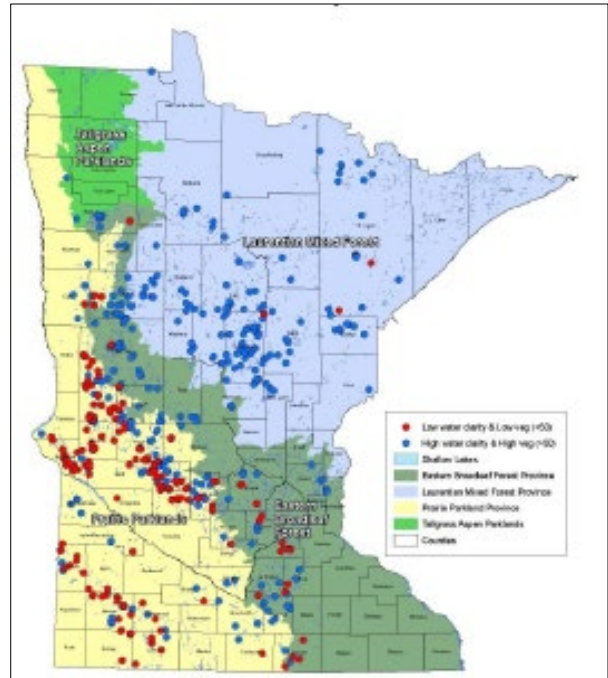


Figure 8: Shallow Lakes and most recently surveyed condition (MNDNR, 2010).

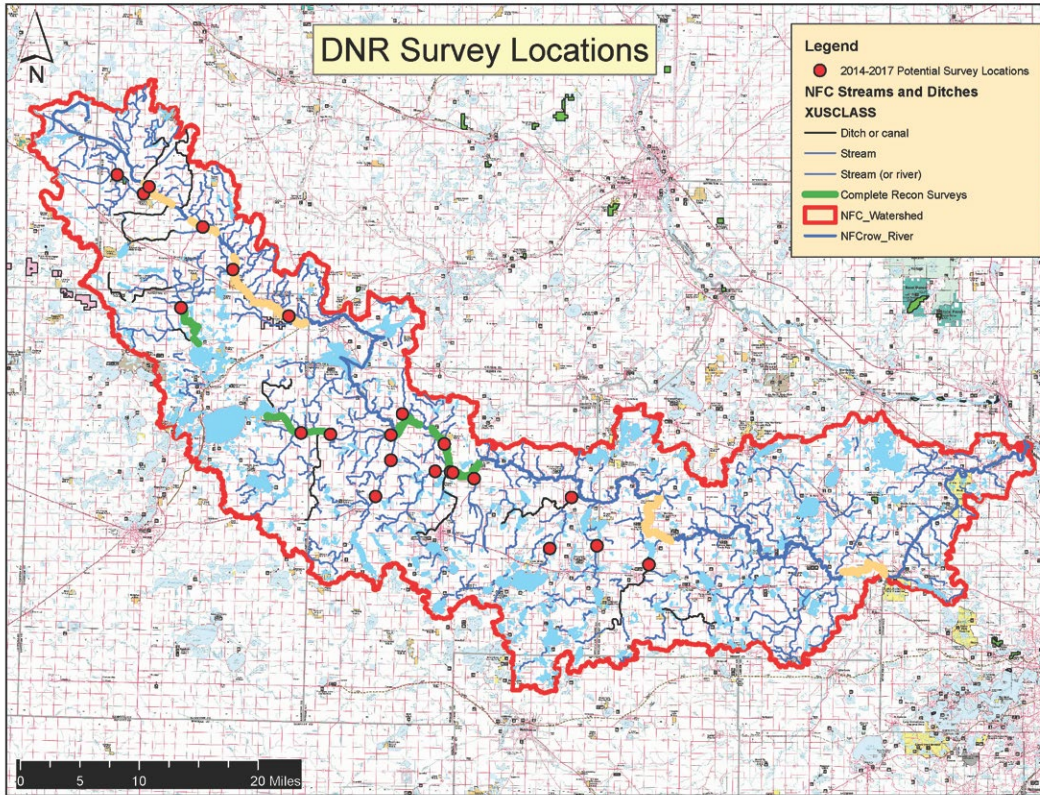


Figure 9: DNR Stream Reconnaissance and Potential Detailed Survey Site Locations

At the time of this study, the specific locations of the stream surveys were not coordinated with PCA staff. For the upcoming round of major watershed monitoring and assessment commencing in 2017 for the NFC watershed, additional detailed survey locations will be coordinated with local PCA staff to coincide with priority tributaries and locations on the mainstem river.



## Reach 1: Middle Fork Crow River, Kandiyohi County Rd 35 to Mud Lake

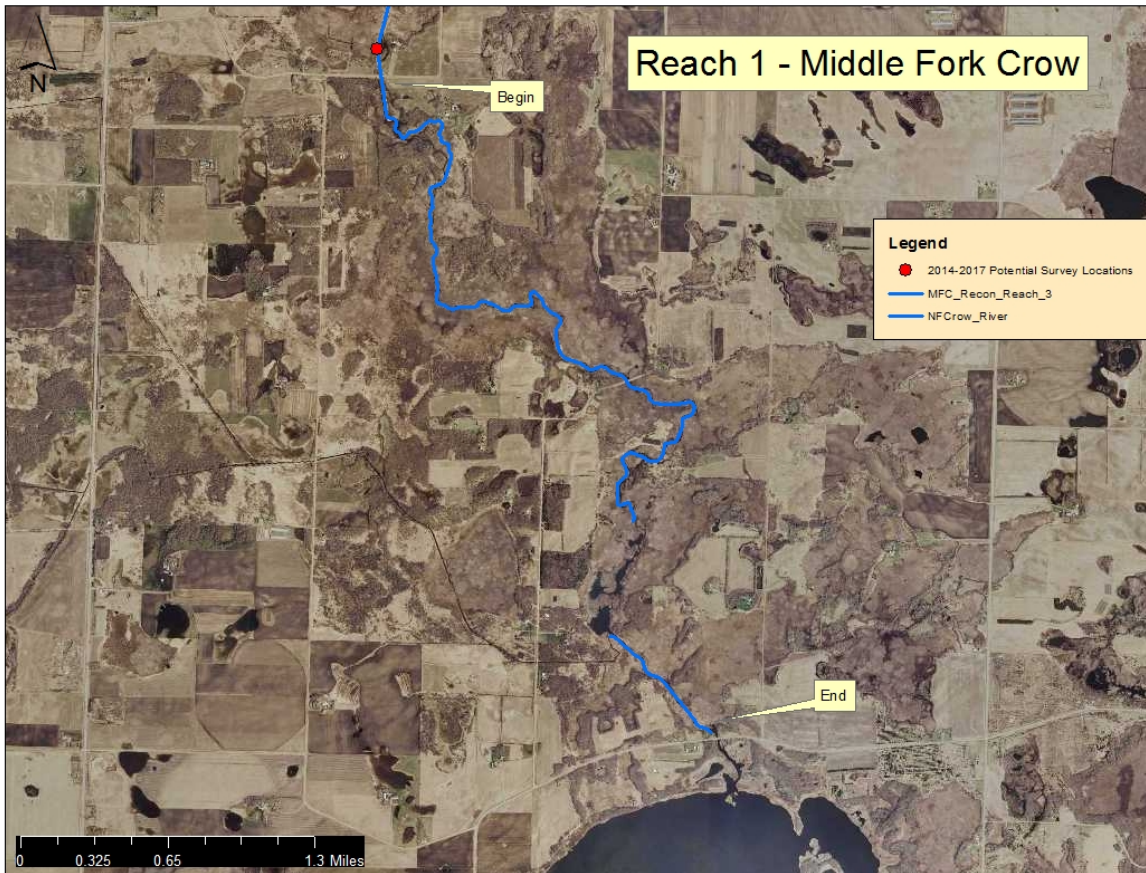


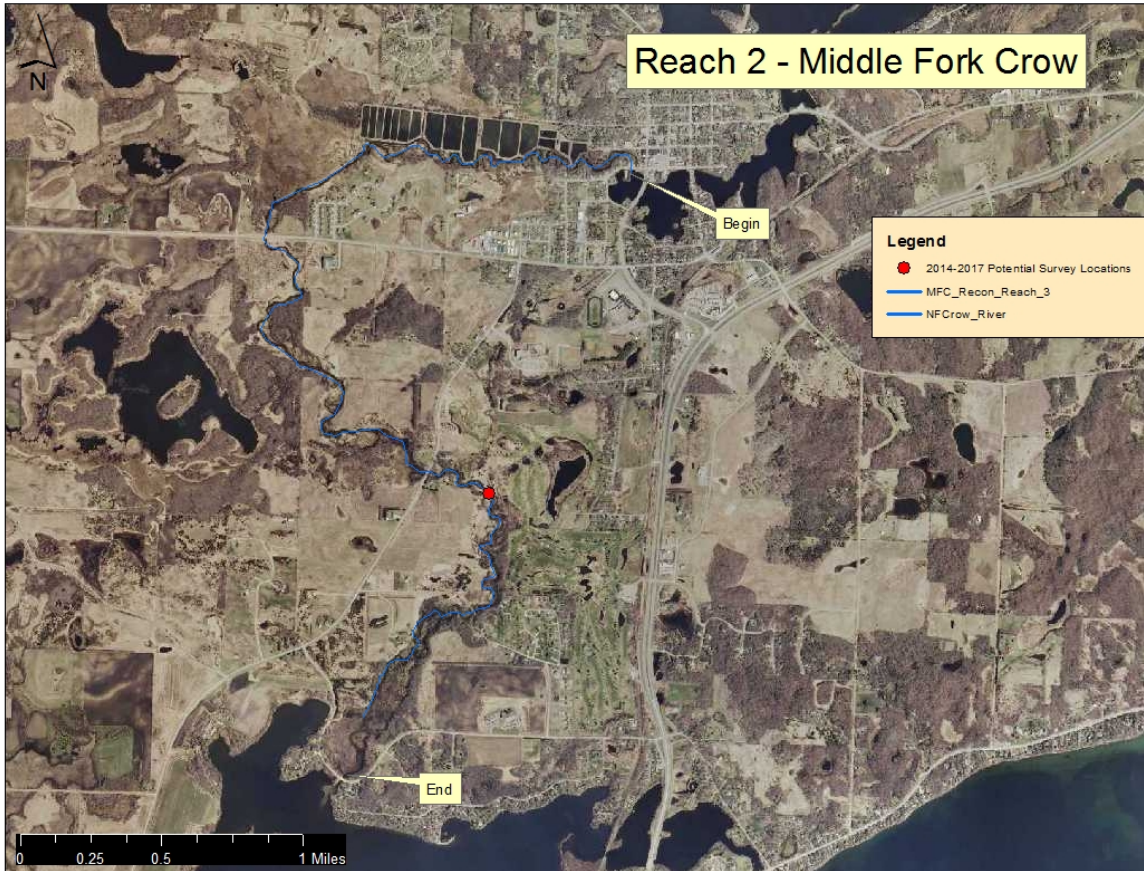
Figure 10: Middle Fork Crow River, Reach #1

This 3.5 mile reach was surveyed in September 2011. The reach displayed excellent riparian vegetation and floodplain connectivity throughout, indicating good channel stability. The majority of the reach is located within a number of large Type III/IV wetlands connected by short stretches of stream channel. Very little erosion was noted in this reach and, in cases where erosion was noted, it was only in proximity to road crossings, likely as the result of high flows or improperly sized culverts. As the majority of the reach was located within wetlands, bed features were difficult to note aside from a small portion of the streambed at the upstream end of the reach. Additional detailed survey information is planned to be collected at this site.

Qualitative analysis of the stream corridor detailed potential reference reach conditions, as very little erosion was noted, channel width, depth, water height to bankfull elevation appeared reasonable for this stream, and floodplain connectivity is very good. The channel does not appear at this time to be over-wide or entrenched due to excessive flows and good access to the floodplain, however, additional data will need to be collected to quantitatively determine these parameters. The reach visited was located immediately downstream of a lengthy channelized reach, and served as the transition from a channelized reach to a meandered stream reach. The primary reason for selection of this reach was to determine if there was a significant affect to the downstream meandered reach as a result of the upstream channelization.

Strategies in this reach would tend toward protection status, through preservation of the riparian vegetation and buffer/riparian corridor continuity. Additional study including a detailed channel analysis will be needed to properly classify this reach and make additional recommendations.

**Reach 2: Middle Fork Crow River, New London Dam crossing to Nest Lake.**



**Figure 11: Middle Fork Crow River, Reach #2**

This reach displayed significantly altered conditions from those noted upstream. The stream was much more incised in most areas, and limited floodplain accessibility was noted, both of which are indicative of instability throughout this reach. Significantly increased streambank erosion was noted in this reach, many moderately sized actively eroding banks ranging from 3-8 feet in height, and several banks exceeding 10 feet in height were noted. Riparian vegetation and buffers were present in most locations; however, there were several sites where the streambanks displayed erosion that likely could have benefitted from a larger buffer.

Qualitative analysis of the stream corridor detailed impaired reach conditions, as significant erosion was noted, channel width was beginning to increase throughout the reach, and mid channel bars were noted in several locations. BEHI and NBS information were not collected in this reach, but will be collected in the future as a portion of more intensive surveys. Access to the floodplain was becoming limited and floodplain connectivity is relatively poor. This portion of the stream is also likely impacted from stormwater runoff from the city of New London, and the effects of the New London Dam.

Strategies in this area would trend toward restoration activities, with buffer maintenance and installation as well as potential streambank restoration may be necessary. Systematic issues related to stormwater and potential retention will need to be addressed, however, it will be necessary to first identify the source of the instability in this reach. Additional study including a detailed channel analysis will be needed to properly classify this reach and make additional recommendations.

### Reach 3: Middle Fork Crow River, Calhoun Lake Outlet Structure to 520<sup>th</sup> Avenue

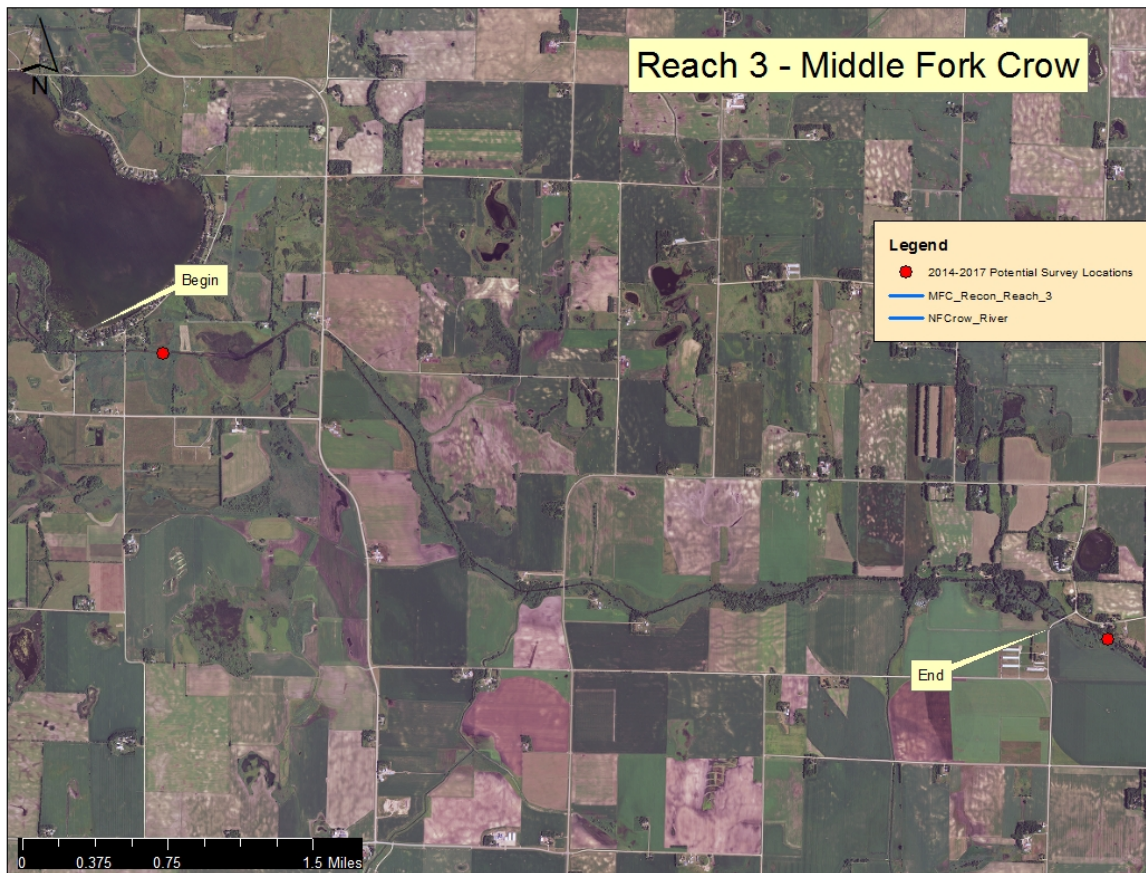


Figure 12: Middle Fork Crow River, Reach #3

The stream is channelized for the entirety of this reach, and displayed significantly higher instability than was seen in upstream reaches. Significant streambank erosion was noted in the portion of the reach downstream of Kandiyohi County Rd 2, and numerous trees had fallen into the river as a result of erosion at the toe of the slope and the resulting rotational failures. Sediment loading from the bank erosion sites was not estimated in this reach; however, several bank erosion sites were noted for future study.

In addition, this reach contains the confluence with Kandiyohi County Ditch 28. At the time of the survey, the water clarity in the Middle Fork was approximately 1.0 meters. Flow from the outlet of CD 28 into the Middle Fork had significantly lower water clarity, indicating much higher sediment loads. Downstream of this confluence, water clarity was significantly decreased. As a portion of future study, CD 28 will be assessed to determine the sources of sediment in this watershed in attempts to decrease sediment loads within the system as a whole.

This reach was also dominated by the presence of mid channel bars throughout the reach from the outlet of Lake Calhoun to Kandiyohi County Rd 2. These features are indicative of a stream that is over-widened and unable to transport sediment loads at low to moderate flows. It is likely that this reach is beginning to become over-wide, and access to the floodplain is becoming limited in many areas.

Strategies in this area would trend toward restoration activities, with implementation of targeted BMPs, including buffer maintenance and installation as well as potential streambank restoration. Additional study including a detailed channel analysis will be needed to properly classify this reach and make additional recommendations.

#### Reach 4: Middle Fork Crow River, Meeker County Rd 30 to North Fork Crow River Confluence.

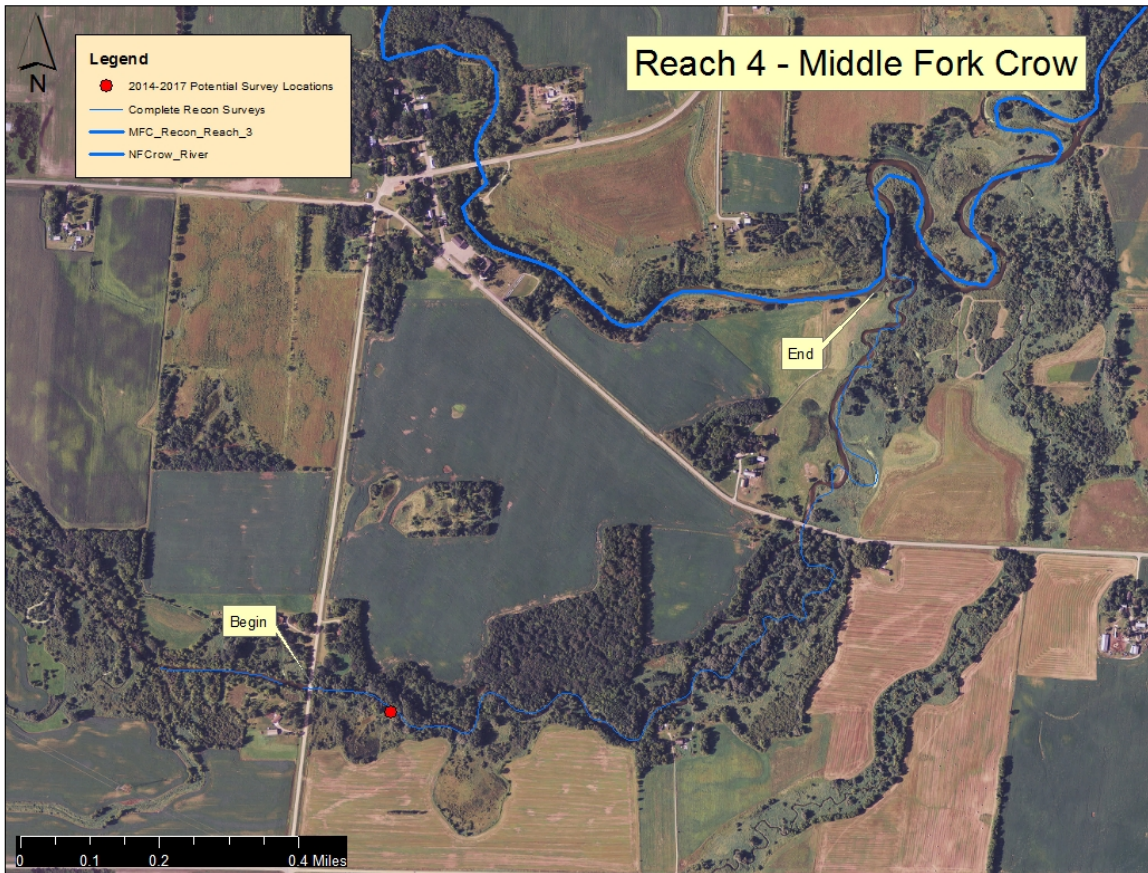


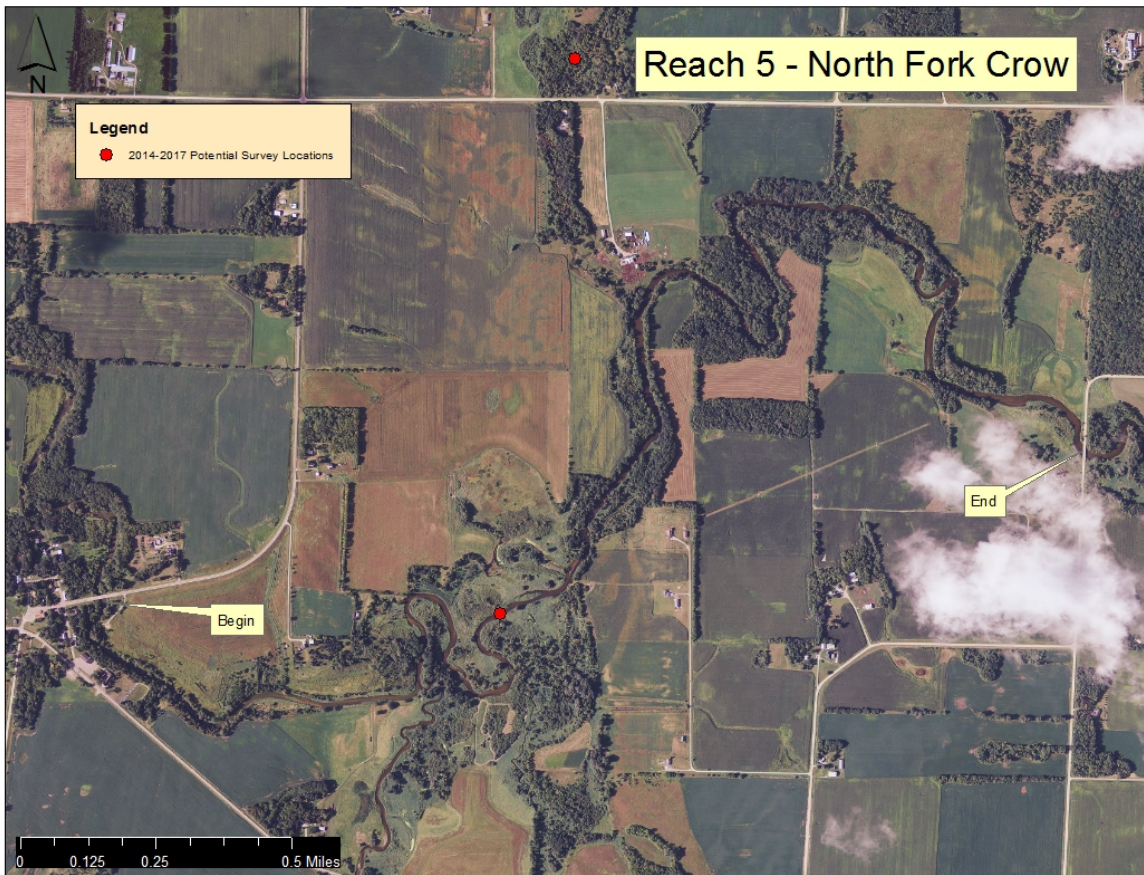
Figure 13: Middle Fork Crow River, Reach 4

This reach is located at the termination of the channelized portion of the Middle Fork, and includes a higher gradient portion as the stream descends into NFC River Valley. In spite of the location of this reach at the downstream end of a large channelized portion of the stream, and immediately downstream of a large cattle pasture, the streambanks are in relatively good condition. The riparian corridor is well vegetated and contiguous throughout this reach. Some instability was noted, but to a lesser extent than that noted immediately upstream. In addition, several riffles were noted in this section, and very few rotational failures were seen. Stability in this reach may be as a result of the riffles acting as grade controls and preventing additional erosion due to increased flows. In addition, several stable bankfull bench features were noted.

Qualitative analysis of the stream corridor downstream of Meeker CSAH 3 detailed some impaired reach conditions, as active erosion was noted, channel width was beginning to increase throughout the reach, and mid channel bars were noted in several locations. Access to the floodplain was becoming limited and floodplain connectivity is relatively poor in the downstream portion of this reach as well.

Strategies for this section would likely incorporate both restoration, through implementation of targeted BMP's, and protection through preservation of the riparian corridor. Additional study will be conducted within this reach.

**Reach 5: NFC Mainstem, Meeker County Rd 30 to 592<sup>nd</sup> Ave.**



**Figure 14: North Fork Crow River, Reach 5**

This reach contains the confluence with the Middle Fork Crow and Grove Creek. In addition, significant erosion is noted within this stream reach in several locations. The primary locations for significant streambank erosion are noted in reaches that intersect the stream valley wall. This reach also includes an active meander loop cutoff immediately downstream of the confluence with Grove Creek, which is indicative of active stream channel migration within the floodplain.

Analysis of elevation data in this area indicates that river valley is relatively narrow for the majority of this reach and does not extend outside of the meander belt width of the river, except for the area of the confluence with the NFC, MFC and Grove Creek. The channel migration is likely a significant source of sediment for this portion of the stream. Additional comparisons will be made using historical photographs to help estimate rate of migration.

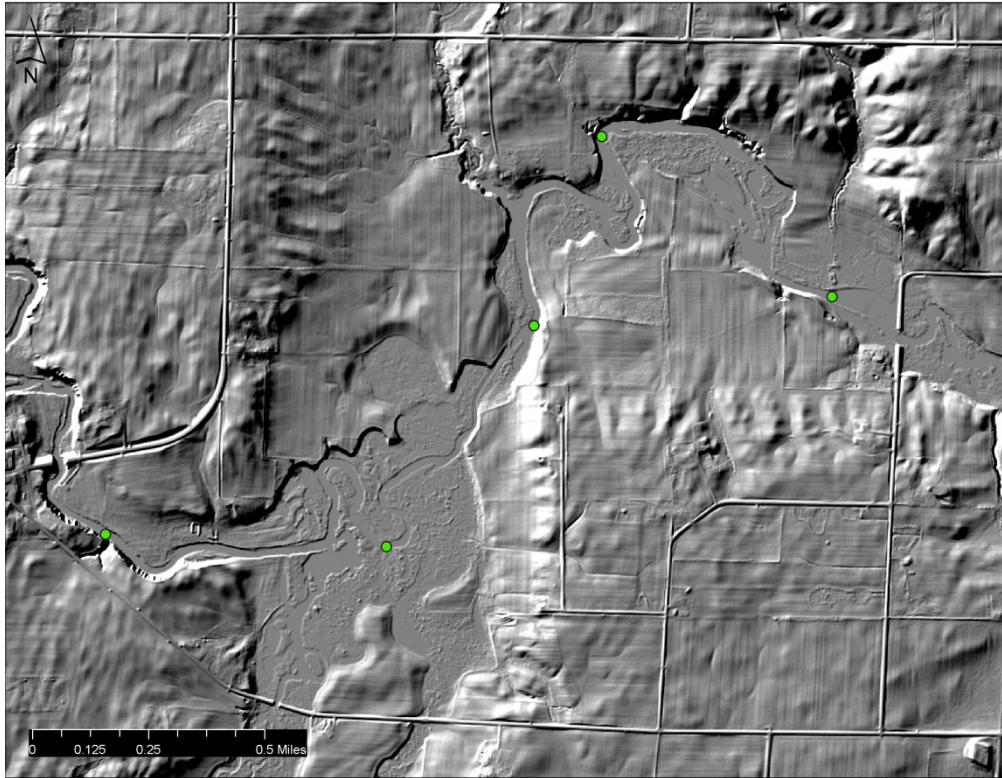


Figure 15: LIDAR Hillshade photo of Reach 5

Terrain analysis (Figure 15) shows that a portion of this reach may be confined within the river valley, and these valley constraints may have exacerbated bank erosion in the areas where the river channel nears the valley wall. This is the case for Bank #1 and Bank #4 referenced below.

| Bank # | Bank Height | BKF Height | Root Depth | Bank Angle | BKF Width | BEHI TOTAL | Ranking |
|--------|-------------|------------|------------|------------|-----------|------------|---------|
| 1      | 18          | 2.0        | 6.0        | 60         | 75        | 44.0       | V. High |
| 2      | 3.5         | 2.0        | 1.0        | 90         | 75        | 40.2       | V. High |
| 3      | 12          | 2.0        | 3.0        | 75         | 75        | 45.5       | V. High |
| 4      | 15          | 2.0        | 3.0        | 60         | 60        | 43.0       | V. High |

Table 1: Streambank characteristics and correlated BEHI adjective ratings for assessed banks in Reach 5.



Figures 16 & 17: Significant streambank erosion at Bank #1 and Bank #4 in this reach.

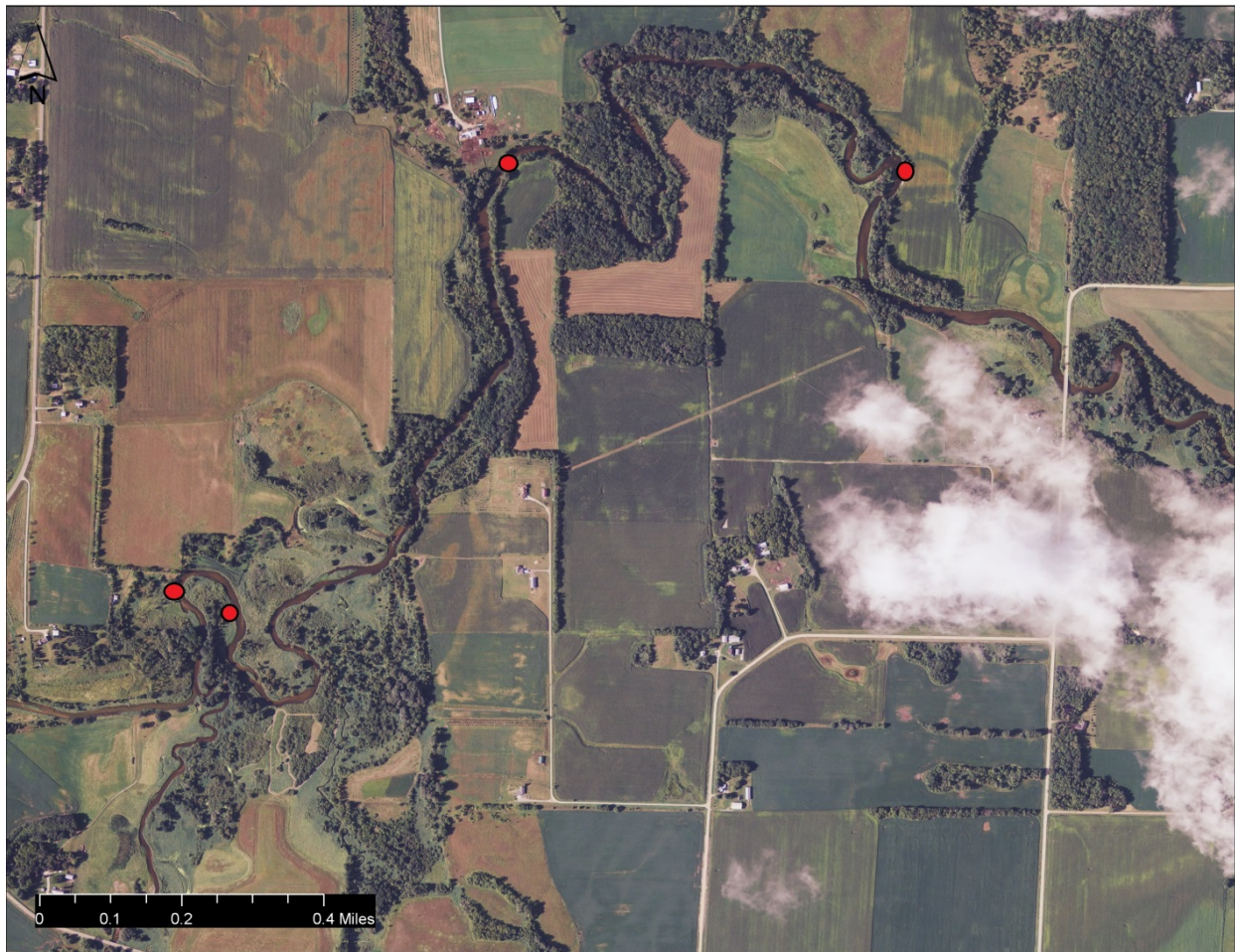


Figure 18: Recon bank locations, numbered 1-4 from upstream to downstream

| Stream: <b>North Fork Crow River</b>  |   | Location: <b>Meeker County</b>                   |   |                        |   |   |  |   |
|---|---|--|---|------------------------|---|---|--|---|
| Graph Used: <b>Colorado</b>   |   | Total Stream Length (ft):                        |   |                        |   | Date: <b>6/6/2012</b>   |  |   |
| Observers: <b>Ethan Jenzen</b>  |   | Valley Type: <b>VIII</b>                         |   |                        | Stream Type:                            |   |  |   |
| (1)   | (2)   | (3)  | (4)   | (5)                    | (6)                                     | (7)   | (8)  | (9)                                       |
| Station (ft)  | BEHI rating<br>(Worksheet<br>3-11)<br>(adjective) | NBS rating<br>(Worksheet<br>3-12)<br>(adjective) | Bank<br>erosion<br>rate<br>(Figure 3-9<br>or 3-10)<br>(ft/yr) | Length of<br>bank (ft) | Study bank<br>height (ft)               | Erosion<br>subtotal<br>[[4]x(5)x(6)]<br>(ft <sup>3</sup> /yr) | Erosion<br>Rate<br>(tons/yr/ft)<br>{[(7)/27] x<br>1.3 / (5)} | Erosion<br>total per<br>bank<br>(tons/yr) |
| 1. 1  | Very High   | High   | 0.573   | 300.0                  | 18.0                                    | 3094.20   | 0.49660  | 148.98                                    |
| 2. 2  | Very High   | Low  | 0.250   | 800.0                  | 3.5                                     | 700.00  | 0.04213  | 33.70                                     |
| 3. 3  | Very High   | Low  | 0.250   | 250.0                  | 12.0                                    | 750.00  | 0.14444  | 36.11                                     |
| 4. 4  | Very High   | Very High  | 0.872   | 300.0                  | 15.0                                    | 3924.00   | 0.62978  | 188.93                                    |
| 15.   |   |  |   |                        |   |   |  |   |
| Sum erosion subtotals in Column (7) for each BEHI/NBS combination   |   |  |   |                        | Total Erosion<br>(ft <sup>3</sup> /yr)  | 8468.20   |  |   |
| Convert erosion in ft <sup>3</sup> /yr to yds <sup>3</sup> /yr {divide Total Erosion (ft <sup>3</sup> /yr) by 27}     |   |  |   |                        | Total Erosion<br>(yds <sup>3</sup> /yr) | 313.64  |  |   |
| Convert erosion in yds <sup>3</sup> /yr to tons/yr {multiply Total Erosion (yds <sup>3</sup> /yr) by 1.3}             |   |  |   |                        | Total Erosion<br>(tons/yr)              | 407.73  |  |   |
| Calculate erosion per unit length of channel {divide Total Erosion (tons/yr) by total length of stream (ft) surveyed} |   |  |   |                        | Unit Erosion<br>Rate (tons/yr/ft)       | 0.2471  |  |   |

Table 2: Prediction of annual erosion rate using the BANCS method in Reach 5.

Erosion estimates using the BANCS method were 407.73 tons of sediment per year, or 0.2471 tons/yr/ft (Table 2). Specific reach cross-section and longitudinal profile information will be included in following additional study in this reach to validate these estimates.

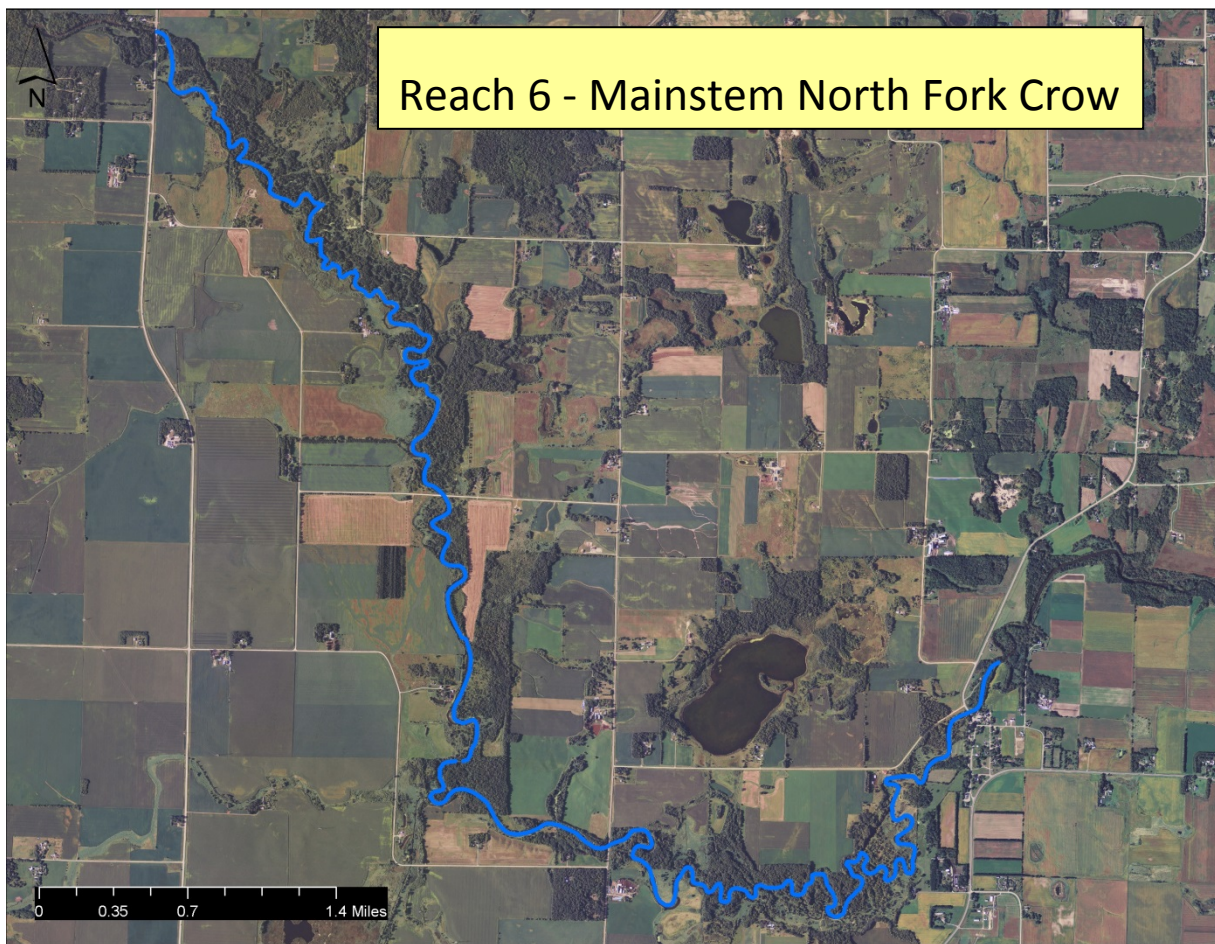
This reach was specifically selected due to the confluence of the Middle Fork Crow and Grove Creek with the mainstem NFC with interest in the potential effects on the streambank stability immediately adjacent to and downstream of the confluences. Instability was noted in the mainstem channel for approximately 1500' feet downstream of the Middle Fork outlet (Banks 1 and 2), and the erosion rates are estimated above. Bankfull width also appeared to marginally increase, however, this observation was not confirmed during this study, and will be analyzed in future study.

Changes of this nature were not observed at the confluence with Grove Creek; however, due to the presence of an existing meander cutoff resulting to channel migration, any influence at this location from flows emanating from Grove Creek may be difficult to distinguish.



The presence of significant eroding banks points toward instability within this reach. In addition, qualitative analysis indicates that this stream is widening. The presence of a large mid-channel bar at one point within the reach also indicates that the stream may be over widened, and is unable to transport the sediment bedload. All of this information indicates that this reach of the stream is trending towards instability. This is also supported by the apparent lack of significant riffle structures within this reach (additional survey will be needed to confirm this observation). The riparian corridor is relatively consistent throughout the reach with a mixture of forest and floodplain grasses, with reed-canary grass being the dominant grass present. Strategies in the reach should trend towards restoration, with implementation of targeted BMP's including buffers, selective streambank restorations, and similar practices.

**Reach 6: NFC Mainstem, MN Hwy 22 to MN Hwy 24.**



**Figure 19: Reach 6, Mainstem North Fork Crow River**

This reach is approximately 11 miles long, and is dominated by excellent riparian vegetation and excellent access to floodplain area throughout. While several unstable and eroding streambanks were noted, the vast majority of streambanks displayed were stable and significant vegetation was noted. Qualitative analysis of several more areas of this stream corridor detailed potential reference reach conditions, as very little erosion was noted, and floodplain connectivity is very good for the most part. Additional study will be needed to quantify and adequately characterize these reaches.

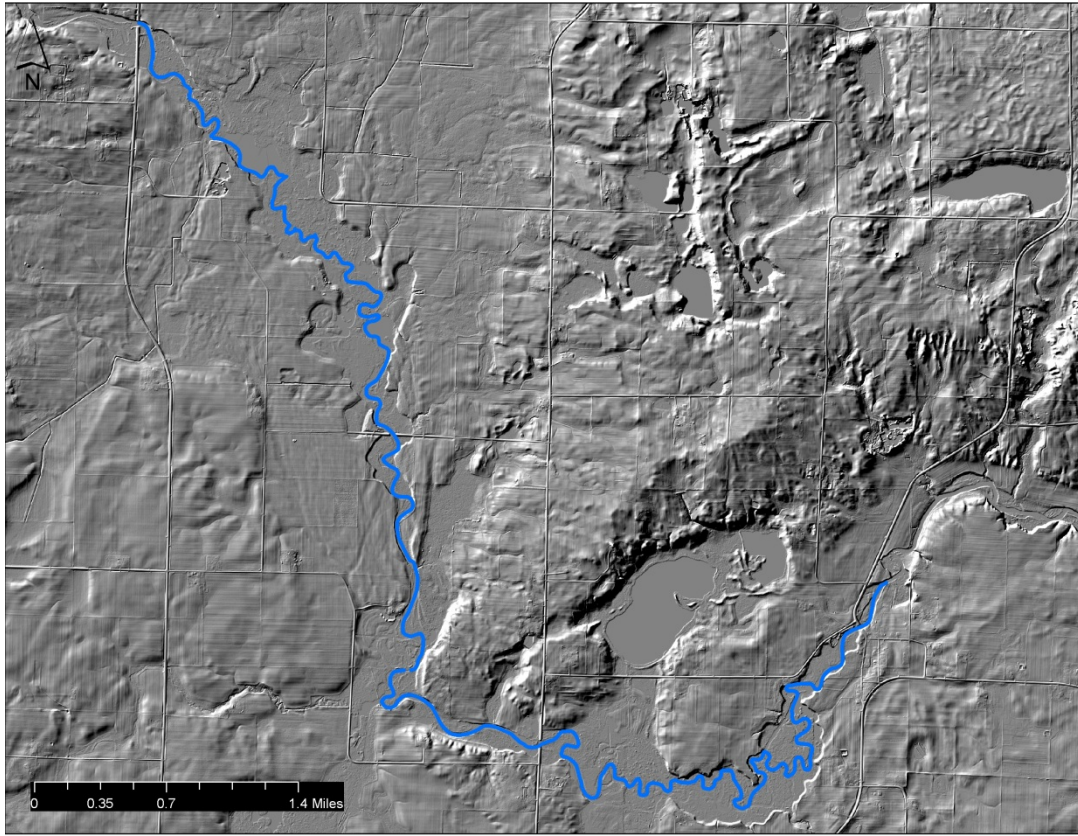


Figure 20: LIDAR Hillshade Map of Reach 6.

As with Reach 5, terrain analysis (Figure 20) indicates that there are several locations in the downstream portion of this reach where the stream channel approaches the valley wall. The only significant active erosion areas noted in this reach are located near the valley wall. In addition, analysis of elevation data noted a significantly wider floodplain in the upstream portions of this reach than what was observed in other areas, and is associated with the most sinuous portion of this stream. This portion of the stream is most likely to display reference conditions, and additional analysis will be completed to characterize and record these conditions.



Figure 21: Stream conditions within this reach.

In addition, analysis and comparison of recent aerial photos show several active meander loop cutoffs. In the upstream portion of this reach, several large mid-channel bars are noted, indicative an over-wide stream with reduced flow velocity, leading to sediment deposition during low to moderate flows within the channel itself. This may also be the result of an improperly sized bridge at the Minnesota Highway 22 crossing, which results in increased velocity and scour during moderate to high flow events, and additional sediment loads to the immediate downstream area.

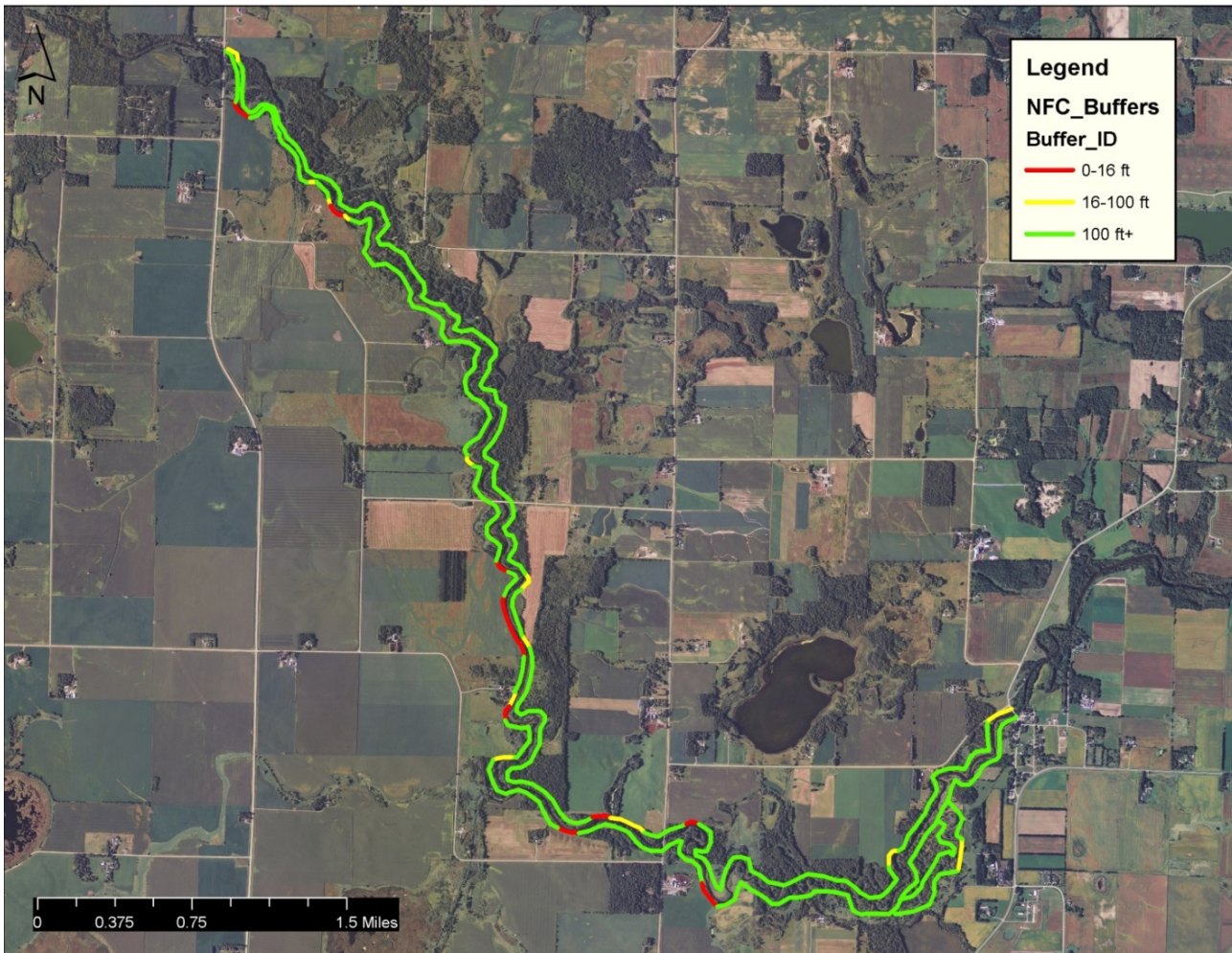


Figure 22: Buffer analysis of Reach 6.

This reach was specifically selected for survey due to the presence of a significant contiguous riparian corridor throughout the vast majority of the reach. In addition, aerial photo analysis indicates that the upstream portion of this reach has maintained higher channel sinuosity than the reaches immediately upstream, and is potentially more indicative of reference conditions. Channel migration within the river floodplain is also noted in many areas throughout this reach in comparative analysis of aerial photos.

The near channel corridor for this reach of the stream is dominated by a nearly contiguous buffer consisting of primarily floodplain forest with intermixed small grassy areas. The buffer analysis displayed in Figure 22 shows

that while the buffer exceeds 100 feet for the majority of the stream reach, there are several areas that would benefit from increased buffer width.

## **Additional Data and Considerations**

### **Lake Watersheds**

Several lakes in the mid to upper portions of this watershed that show water quality and water clarity in excess of the normal rates for this watershed, and as per information collected by DNR Fisheries, display much higher fish IBI scores than other area lakes. The lakes include Green (34-79P), Long Lake (34-66P), and George Lake (34-142P), and to some degree Lake Koronis. All of these basins display water quality and clarity characteristics more consistent with a moderate production trophic status consistent with a mesotrophic designation instead of the more commonly seen eutrophic status associated with highly productive turbid basins. Additional monitoring data will be necessary to further this designation.

Long Lake and George Lake have small watersheds (Less than 1000 acres) that are dominated by perennial vegetation and are located within largely undeveloped areas, outside of the immediate riparian area. Green Lake has a large watershed (~80000 acres) and lies on the mainstem of the Middle Fork Crow River, however, there is a large number of wetlands and depressional storage areas upstream of the lake that reduce sediment inputs to the lake itself. In addition, much of the direct watershed to Green Lake is dominated by perennial vegetation and smaller near-channel or directly connected wetlands that buffer flows and reduce sediment inputs to the lake itself. The direct contributing watersheds of these basins (and other basins with similar water quality) should be prioritized for protection status to maintain the water quality within these basins.

### **DNR Prioritization Tools**

The recently developed DNR “Watershed Health Assessment Framework Tool” (WHAF) was also used to assess watershed health based on a number of additional criteria on a 12-digit HUC scale, including impervious surface, perennial cover, and aquatic connectivity. These tools should help to prioritize both restoration and protection strategies based on the scores received in the subwatersheds.

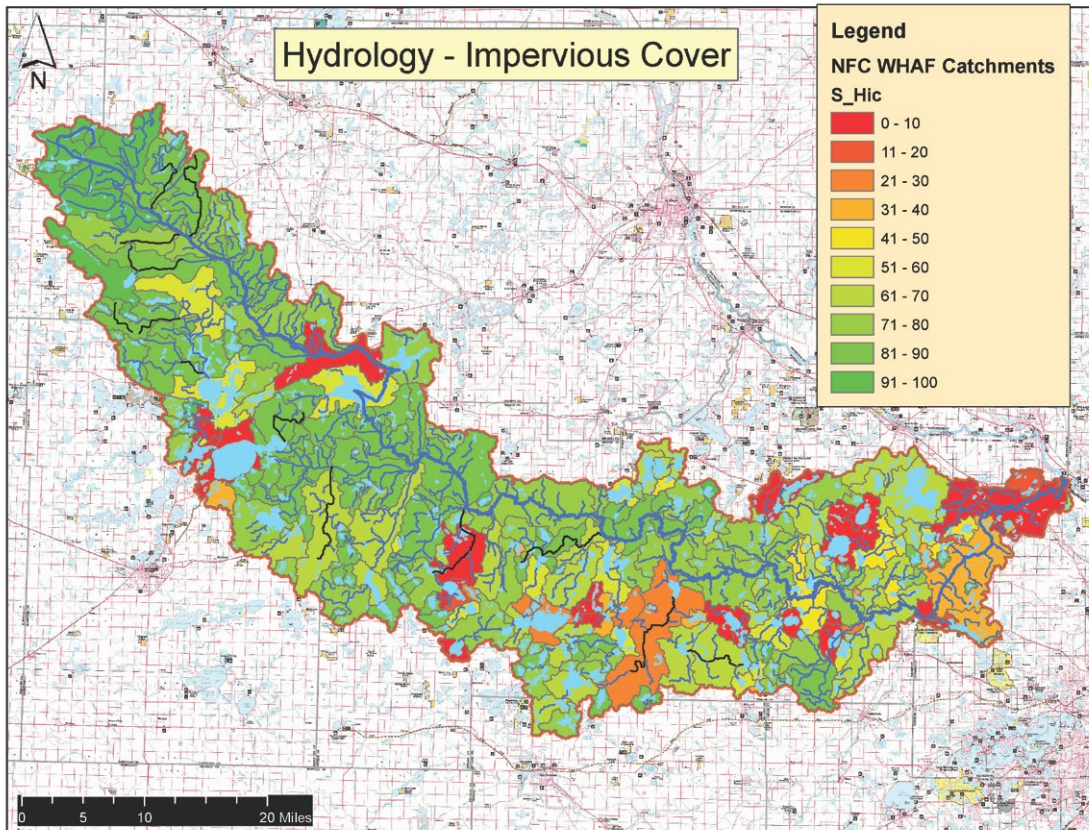


Figure 23: Impervious surface coverage

Figure 23 displays areas with significant impervious surface coverage in the NFC watershed. Areas with high impervious surface have significantly lower scores than areas with natural cover or agricultural land. Nearly all areas that score poorly using this index are associated with municipalities, and therefore the greatest potential for the use of this data is through implementation of protection strategies based on better stormwater policies and enforcement of ordinances that require stormwater treatment before delivery to downstream areas.

### Riparian Connectivity

Data has also been collected and compiled in the WHAF in regards to riparian connectivity (Figure 24). Riparian connectivity in this tool is defined as the number of crossings, dams, and/or culverts within a watershed area. Using this tool, the areas that display good riparian connectivity should be prioritized for maintenance of the riparian areas, and subwatersheds with low scores can be targeted for removal of unnecessary crossings, installation/placement of buffers or for enrollment of riparian land into conservation programs.

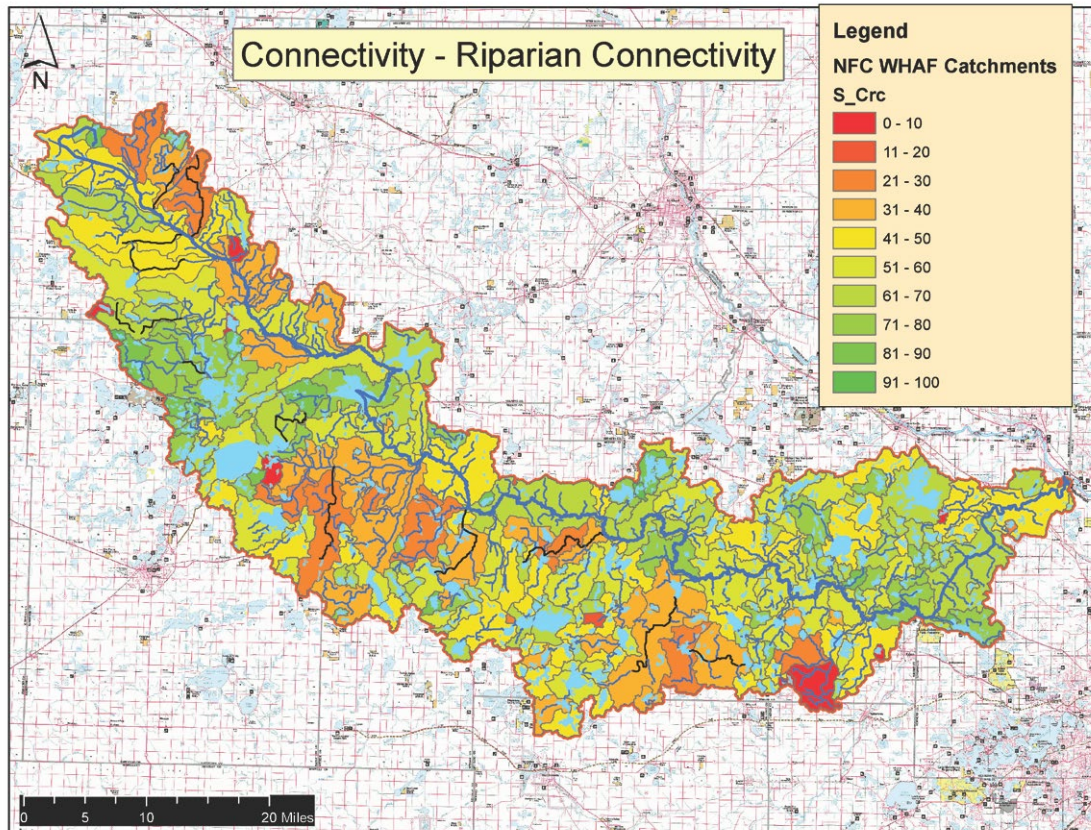


Figure 24: Riparian Connectivity

### Riparian Vegetation - Perennial Cover

Several stream reaches throughout the watershed were noted for good riparian vegetation, and for the presence of buffers in excess of 50 feet for the length of certain reaches. Similarly, PMZ development should also be considered in areas with intact riparian corridors and wide riparian buffers. Several areas with intact riparian corridors and significant buffers have been identified during a desktop analysis using ArcGIS tools, which will be field verified as a portion of the next WRAPS study. These reaches include:

- Grove Creek, from Hwy 12 north to the confluence with NFC Mainstem – predominantly wetland/pasture/grassland vegetation
- The Middle Fork Crow River, from 560<sup>th</sup> Street to the NFC Mainstem – predominantly floodplain forest.
- The NFC Mainstem, from Minnesota Highway 22 to Meeker County Road #2 – predominantly floodplain forest.
- Stag Creek, from the confluence with the NFC upstream approximately 3 miles – predominantly upland forest

These reaches should be prioritized for protection based on the presence of the intact riparian corridors.

In addition, it was noted that several of the riparian corridors were used for pasture ground for livestock. Specifically, portions of the Grove Creek, the Middle Fork Crow, and Stag Brook are known to have potential impacts from livestock activity within the riparian corridor that may affect stream stability and water quality. These areas should be prioritized for restoration through targeted implementation of projects such as cattle exclusion or riparian buffer programs.

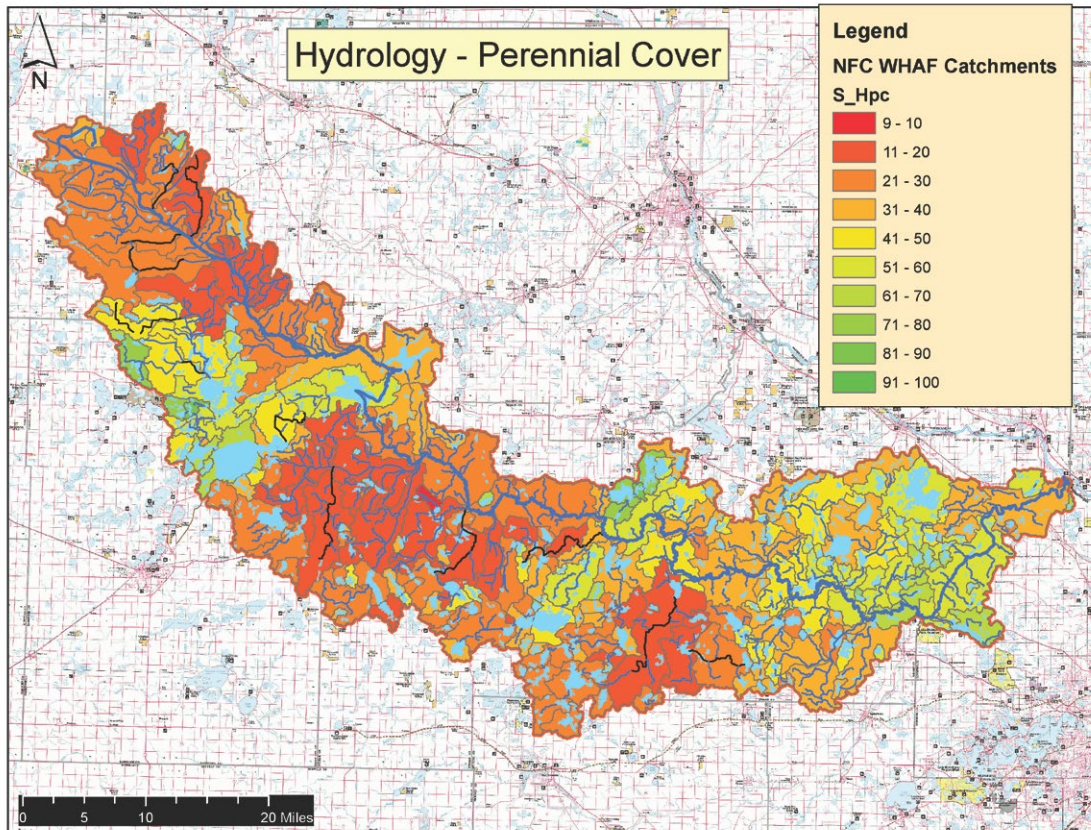


Figure 25: Perennial Cover

Another parameter calculated by the WHAF is perennial cover. Figure 25 indicates the presence of perennial vegetation and is represented as a percentage of total land area within the watershed. While it is difficult to determine from this graphic how much of the vegetation is in the near channel area, the presence of a significant portion of the watershed in perennial vegetation will have significant water quality benefits ranging from reduced runoff and increased infiltration of precipitation to decreased nutrient delivery to receiving waters. The areas with higher percentages of land in perennial vegetation should be prioritized for protection through preservation efforts and set-aside programs for land not currently enrolled. Areas with lower perennial vegetation coverage, which in this area are dominated by land in agricultural production, should be prioritized for restoration strategies involving buffer installation, conservation tillage, cover crops, and enrollment into conservation projects and land retirement programs.

### Aquatic Connectivity

Aquatic connectivity was assessed as a portion of the WHAF, and specifically denotes the presence of structures in the stream corridor, including bridges, culverts, and dams that affect the lateral and longitudinal hydrologic connectivity of this system (Figure 26). Higher scores denote areas with few structures or crossings in the stream channel, and lower scores indicate proportionately more structures. The areas in which scores are lower in this index in particular should be prioritized for a culvert/structure analysis to indicate the potential effects of these structures on the channel, including proper sizing to limit hydraulic restriction, limit scour, allow for fish migration, and proper construction on multiple barrel systems.

In addition, the data that is displayed in the Figure 26 is the best estimate of crossings present via MNDOT and local highway department records. Several crossings not included in this collection have been located in other watershed studies, and therefore may affect the WHAF scores if present in this watershed. Additional data was not collected in regards to horizontal connectivity, which assesses floodplain/river channel connectivity.

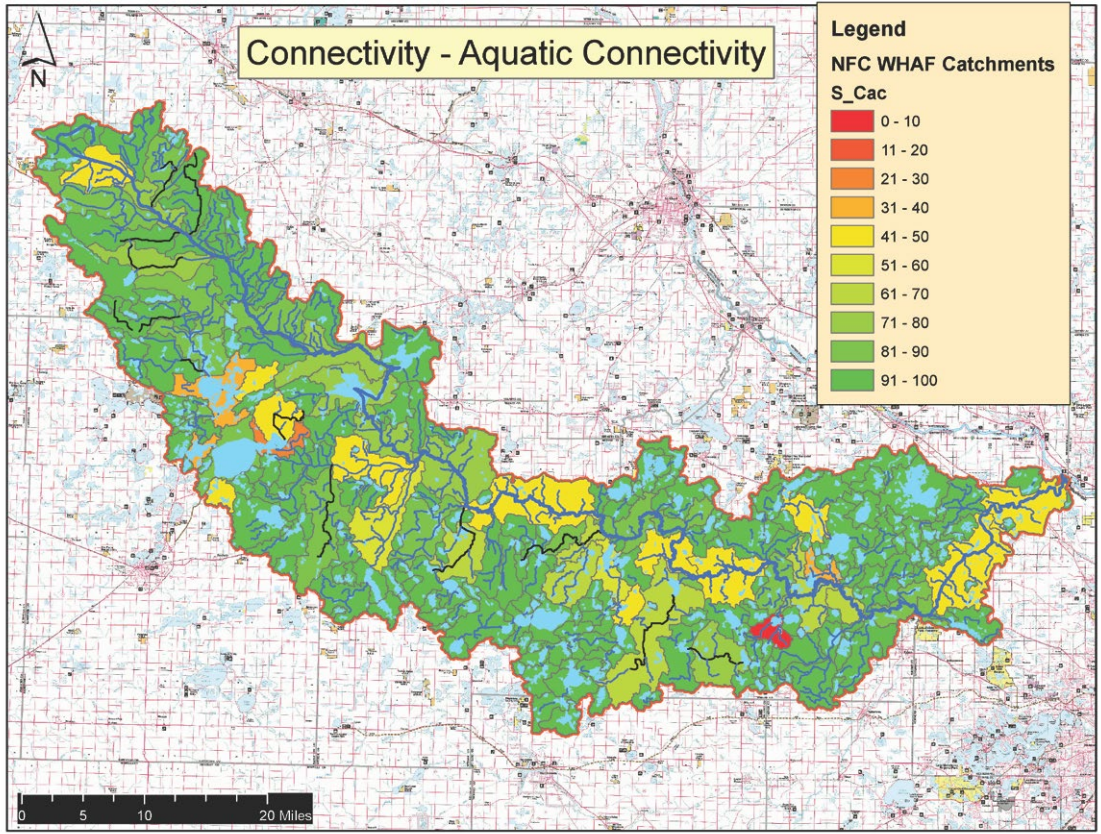


Figure 26: Aquatic Connectivity (WHAF)

### Fisheries Lake IBI information

In addition, DNR Fisheries has developed an assessment using the IBI for area lakes. While these scores are based on a range of fish present in the basin, the overall scores will allow for some prioritization of the habitat present within the basin. A number of lakes within the area score very high on the IBI scale (Figure 27). Specifically, the development of strategies for either protection or restoration in the watershed for a basin would benefit from the use of this information. The basins with higher IBI scores would likely display better water quality and benefit more from protection activities, whereas basins with lower IBI scores will likely display lower water quality and benefit more from restoration activities.



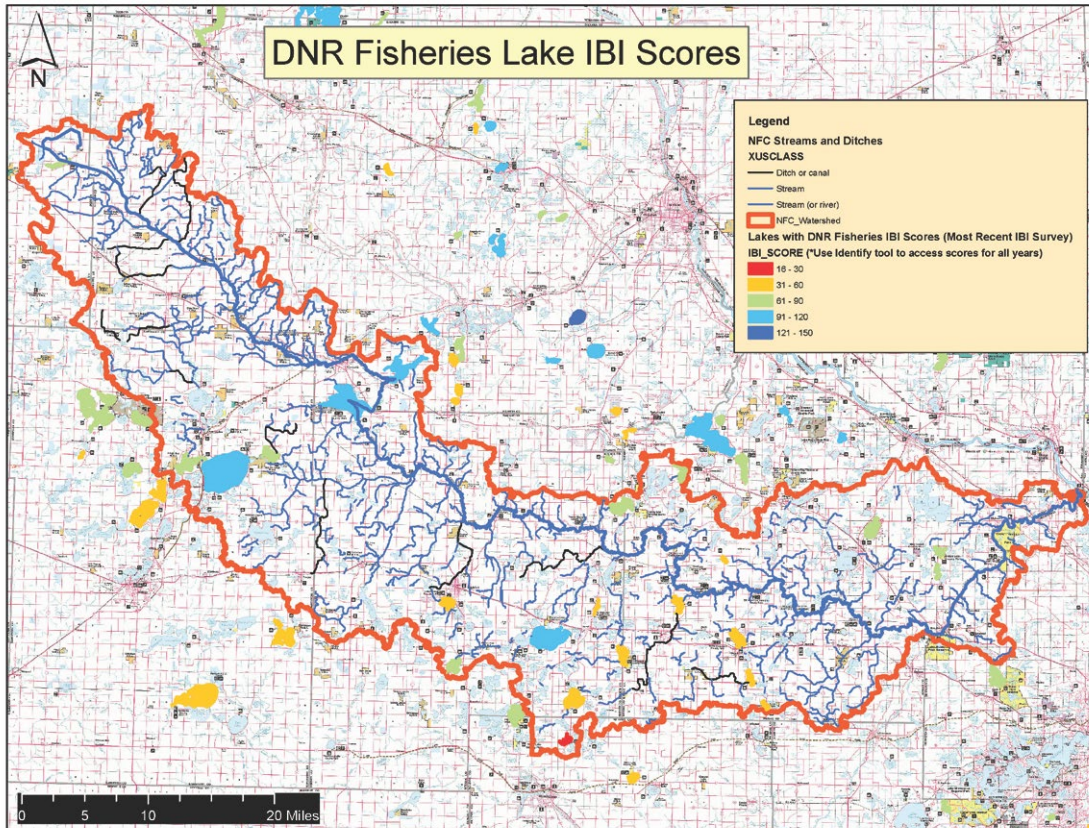


Figure 27: Lake IBI Scores determined by DNR Fisheries

### Future Studies

As previously stated, additional geomorphology data relating the pattern and profile of the mainstem NFC and many of the major tributaries is planned to be collected prior to and during the upcoming WRAP study commencing in 2017. The preliminary plan includes data collection on at least five reaches of the mainstem NFC, and data collection on the following major tributaries:

- Sedan Brook
- Skunk River
- Middle Fork Crow River
- Stag Brook
- Grove Creek
- Jewitts Creek
- Battle Creek
- Washington Creek
- Collinwood Creek
- Sucker Creek

These reaches were selected based on the following criteria:

- PCA AUID
- Confluence portion of tributaries to a mainstem creek
- Significant identified resource value (intact riparian corridor, potential reference conditions, etc.)
- Stability or reference condition noted
- Significant hydrologic impact noted (channelized reach, confluence between channelized and meandered reaches, impact noted on hillshade/LIDAR/aerial photos)
- Noted significant bed feature (riffles, etc.)
- Lack of presence of other hydrologic controls (crossings, culverts, etc.)
- Geographic coverage of headwaters reaches

Participation in core teams will also affect the nature of reach selection and sampling, and the sampling plan will be adjusted as needed to meet the specific needs of the core team goals.

#### Data needed

- Buffer analysis of the mainstem river and major tributaries.

## References

Minnesota Department of Natural Resources, Shallow Lakes Program, *Statewide Shallow Lakes Plan* (MNDNR, 2010).

<http://files.dnr.state.mn.us/recreation/hunting/waterfowl/shallowlakesplan.pdf>

Minnesota Department of Natural Resources, 2005. *Field Guide to Native Plant Communities of Minnesota: The Prairie Parkland and Tallgrass Aspen Parklands Provinces*. Ecological Land Classification Program, Minnesota Bounty Biological Survey, and Natural Heritage and Nongame Research Program, MNDNR, St. Paul.

## Appendix C. North Fork Crow Lake Prioritization

Table C.1 below identifies the implementation focus for each HUC-11 listed in Appendix C.

Table C.1

| HUC-11                         | ABBREVIATION |
|--------------------------------|--------------|
| Upper North Fork Crow River    | UNF          |
| Upper Middle Fork Crow River   | UMF          |
| Central Middle Fork Crow River | CMF          |
| Lower Middle Fork Crow River   | LMF          |
| Long Lake Outlet               | LGLO         |
| Jewitts Creek                  | JC           |
| Litchfield                     | L            |
| Washington Creek               | WC           |
| Collinwood Creek               | CC           |
| Sucker Creek                   | SC           |
| Twelvemile Creek               | TMC          |
| Mill Creek                     | MC           |
| Louzers Creek Outlet           | LZCO         |
| Lower North Fork Crow River    | LNF          |
| Sarah Creek                    | SRC          |
| St Michael                     | STM          |
| Crow River                     | CR           |
| <b>ACTION</b>                  | <b>KEY</b>   |
| Restore                        |              |
| Protect                        |              |
| Threatened                     |              |

Table C.2 below identifies the Trophic Status Index ranges for Appendix C

Table C.2. Trophic Status Ranges

| TROPHIC STATUS | RANGE |
|----------------|-------|
| Oligotrophic   | < 40  |
| Mesotrophic    | 40-50 |
| Eutrophic      | 50-70 |
| Hypereutrophic | >70   |

| MGMT FOCUS | LAKE                 | BAY              | ID         | COUNTY    | SURFACE AREA (hectares) | MAX DEPTH (feet) | % AG | INVASIVE SPECIES | Sanitary Sewer Hook-Up   | WILD RICE LAKES | DNR PRIORITY SHALLOW LAKES | HSPF | LAKE ASSOC. | TROPIC INDEX | NUTRIENTS (TP) (ug/L) | CHL-a (ug/L) | CLARITY (m) | LAKE ASSESS. | LAKE STATUS  | HUC-11 ACTION | WSHED SURFACE | % LITTORAL | DRAIN AREA | FISH SURVEY, STOCK, AQ PLANT SURVEY |
|------------|----------------------|------------------|------------|-----------|-------------------------|------------------|------|------------------|--|-----------------|----------------------------|------|-------------|--------------|-----------------------|--------------|-------------|--------------|--------------|---------------|---------------|------------|------------|-------------------------------------|
|            | Laura                |                  | 27-0123-00 | Hennepin  | 14                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Cowley               |                  | 27-0169-00 | Hennepin  | 19                      | 2                |      |                  | Older lots on south & west not, new development on east is hooked up |                 |                            |      |             | 79           | 744                   | 75           | 1           | •            | Impaired     | CR            |               |            |            |                                     |
|            | Unnamed              |                  | 27-0170-00 | Hennepin  | 16                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Sylvan               |                  | 27-0171-00 | Hennepin  | 44                      | 10               |      |                  | no   |                 |                            |      |             | 69           | 447                   | 28           | 2↑          |              |              | CR            |               |            |            |                                     |
|            | Prairie              |                  | 27-0177-00 | Hennepin  | 11                      |                  |      |                  | no   |                 |                            |      |             | 53           | 27                    | 13           | 2→          |              |              | CR            |               |            |            |                                     |
|            | Sarah                | West             | 27-0191-01 | Hennepin  | 138                     | 59               |      |                  | 1-2 holdouts, otherwise 100%   |                 |                            |      | •           | 67           | 102                   | 58           | 1→          | •            | Impaired     | SRC           | 2,227         |            |            |                                     |
|            | Sarah                | East             | 27-0191-02 | Hennepin  | 80                      | 59               |      |                  | 1-2 holdouts, otherwise 100%   |                 |                            |      | •           | 66           | 87                    | 48           | 1↓          | •            | Impaired     | SRC           | 2,227         |            |            |                                     |
|            | Schwappauf           |                  | 27-0194-00 | Hennepin  | 16                      |                  |      |                  | no   |                 |                            |      |             | 56           | 49                    | 9            | 1           |              |              | CR            |               |            |            |                                     |
|            | Schandell            |                  | 27-0196-00 | Hennepin  | 16                      | 29               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | CR            |               | 71         |            |                                     |
| Mixed      | Hafften              |                  | 27-0199-00 | Hennepin  | 16                      | 44               | 66   |                  | no   |                 |                            |      | •           | 61           | 53                    | 27           | 1           | •            | Impaired     | CR            |               | 61         | 1,561      | F survey                            |
|            | Rattail              |                  | 27-0200-00 | Hennepin  | 5                       | 63               |      |                  | no   |                 |                            |      |             | 58           | 52                    | 16           | 1↓          |              |              | CR            |               | 32         |            |                                     |
|            | Unnamed              |                  | 27-0379-00 | Hennepin  | 4                       | 8                |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Unnamed              |                  | 34-0019-00 | Kandiyohi | 27.6                    |                  |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Pay                  |                  | 34-0023-00 | Kandiyohi | 13                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Summit               |                  | 34-0027-00 | Kandiyohi | 55                      | 6                |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Unnamed              |                  | 34-0028-00 | Kandiyohi | 9                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Sperry               |                  | 34-0040-00 | Kandiyohi | 53                      |                  |      |                  | no   |                 |                            |      |             | 84           |                       |              |             |              |              |               |               |            |            |                                     |
|            | Diamond              |                  | 34-0044-00 | Kandiyohi | 628                     | 27               |      |                  | 100%   |                 |                            | •    | •           | 61           | 71                    | 40           | 2↓          | •            | Impaired     | LMF           | 7,280         | 41         |            | FSS                                 |
|            | Taits                |                  | 34-0046-00 | Kandiyohi | 5                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Schultz              |                  | 34-0049-00 | Kandiyohi | 63                      |                  |      |                  | no   |                 |                            |      |             | 80           | 216                   | 154          | 0           |              |              |               |               |            |            |                                     |
|            | Wheeler              | SW               | 34-0051-01 | Kandiyohi | 104                     |                  |      |                  | no   |                 |                            |      |             | 71           | 149                   | 55           | 1           |              |              |               |               |            |            |                                     |
|            | Wheeler              | NE               | 34-0051-02 | Kandiyohi |                         |                  |      |                  | no   |                 |                            |      |             | 81           | 381                   | 163          | 0           |              |              |               |               |            |            |                                     |
|            | Unnamed              |                  | 34-0056-00 | Kandiyohi | 9                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Jesse                |                  | 34-0060-00 | Kandiyohi | 31                      |                  |      |                  | no   |                 |                            |      |             | 87           | 312                   |              | 0           |              |              |               |               |            |            |                                     |
|            | Calhoun              |                  | 34-0062-00 | Kandiyohi | 251                     | 13               |      |                  | no   |                 | •                          |      | •           | 54           | 32                    | 11           | 1.3↓        | •            | Full Support | CMF           | 3,066         | 100        |            | FSS                                 |
|            | Long                 |                  | 34-0066-00 | Kandiyohi | 127                     | 45               |      |                  | no   |                 |                            | •    |             | 44           | 19                    | 5            | 4↑          | •            | Full Support | UMF           | 982           | 44         |            | FSS                                 |
|            | Bass                 |                  | 34-0078-00 | Kandiyohi | 20                      | 30.5             |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            | F survey                            |
|            | Green                |                  | 34-0079-00 | Kandiyohi | 2,239                   | 110              |      |                  | 100%   |                 |                            | •    | •           | 43           | 16                    | 5            | 3.7↑        | •            | Full Support | CMF           | 37,716        | 38         |            | FSS                                 |
|            | Woodcock             |                  | 34-0112-00 | Kandiyohi | 46                      |                  |      |                  | no   |                 |                            |      |             | 74           | 125                   |              | 0           |              |              |               |               |            |            |                                     |
|            | Unnamed              |                  | 34-0113-00 | Kandiyohi | 5                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Carlson              |                  | 34-0114-00 | Kandiyohi | 11                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Henderson            |                  | 34-0116-00 | Kandiyohi | 28                      | 57               |      |                  | 100%   |                 |                            |      |             | 42           | 15                    | 4            | 4→          |              | Insufficient | CMF           |               | 37         |            | FSS                                 |
|            | Elkhorn              |                  | 34-0119-00 | Kandiyohi | 28                      | 40               |      |                  | no   |                 |                            |      |             | 42           | 13                    | 3            | 4           | •            | Full Support | CMF           | 622           | 35         |            | FSS                                 |
|            | Alvig                |                  | 34-0120-00 | Kandiyohi | 29                      |                  |      |                  | no   |                 |                            |      |             | 82           | 152                   |              | 0           |              |              |               |               |            |            |                                     |
|            | Gina                 |                  | 34-0126-00 | Kandiyohi | 20                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Woodcock             |                  | 34-0141-00 | Kandiyohi | 69                      | 8                |      |                  | no   |                 |                            |      |             | 74           | 140                   |              | 0           |              | Insufficient | CMF           |               |            |            |                                     |
|            | George               |                  | 34-0142-00 | Kandiyohi | 90                      | 32               |      |                  | 100%   |                 |                            |      | •           | 42           | 15                    | 3            | 4↑          | •            | Full Support |               | 193           |            |            | FSS                                 |
|            | Unnamed              |                  | 34-0144-00 | Kandiyohi | 5                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Eight                |                  | 34-0146-00 | Kandiyohi | 22                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Bear                 |                  | 34-0148-00 | Kandiyohi | 56                      | 18               |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            | 85         | F survey                            |
|            | Unnamed              |                  | 34-0151-00 | Kandiyohi | 6                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
| Mixed      | Nest                 |                  | 34-0154-00 | Kandiyohi | 396                     | 40               | 69   |                  | 100%   |                 |                            | •    | •           | 56           | 41                    | 19           | 2→          | •            | Impaired     | CMF           | 31,842        | 56         | 74,139     | FSS                                 |
|            | Unnamed              |                  | 34-0156-00 | Kandiyohi | 8                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Unnamed              |                  | 34-0157-00 | Kandiyohi | 15                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Monongalia           | Main             | 34-0158-01 | Kandiyohi | 360                     | 7.8              |      |                  | not 100%   | •               | •                          | •    |             | 60           | 52                    | 8            | 0.6         | •            | Full Support | UMF           | 25,922        |            |            | FSS, AP                             |
|            | Monongalia           | Mid Frk Crow Rvr | 34-0158-02 | Kandiyohi | 329                     | 7.8              |      |                  | not 100%   |                 |                            |      |             | 53           | 36                    | 8            | 1.7         | •            | Full Support | UMF           | 25,922        |            |            |                                     |
|            | Crow River Mill Pond | East             | 34-0158-03 | Kandiyohi | 13                      | 7.8              |      |                  | not 100%   |                 |                            |      |             | 52           | 36                    | 8            | 1.8         | •            | Full Support | UMF           | 25,922        |            |            |                                     |

| MGMT FOCUS | LAKE                 | BAY  | ID         | COUNTY    | SURFACE AREA (hectares) | MAX DEPTH (feet) | % AG | INVASIVE SPECIES | Sanitary Sewer Hook-Up                     | WILD RICE LAKES | DNR PRIORITY SHALLOW LAKES | HSPF | LAKE ASSOC. | TROPHIC INDEX | NUTRIENTS (TP) (ug/L) | CHL-a (ug/L) | CLARITY (m) | LAKE ASSESS. | LAKE STATUS  | HUC-11 ACTION | WSHD SURFACE | % LITTORAL | DRAIN AREA | FISH SURVEY, STOCK, AQ PLANT SURVEY |
|------------|----------------------|------|------------|-----------|-------------------------|------------------|------|------------------|--|-----------------|----------------------------|------|-------------|---------------|-----------------------|--------------|-------------|--------------|--------------|---------------|--------------|------------|------------|-------------------------------------|
|            | Crow River Mill Pond | Mid  | 34-0158-04 | Kandiyohi | 8                       | 7.8              |      |                  | not 100%                                   |                 |                            |      |             | 50            | 31                    | 6            | 1.9         | •            |              | UMF           | 25,922       |            |            |                                     |
|            | Crow River Mill Pond | West | 34-0158-05 | Kandiyohi |                         | 7.8              |      |                  | not 100%                                   |                 |                            |      |             |               |                       |              |             |              |              |               |              |            |            |                                     |
|            | Unnamed              |      | 34-0161-00 | Kandiyohi | 10                      |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              | UNF           |              |            |            |                                     |
|            | Unnamed              |      | 34-0166-00 | Kandiyohi | 54                      |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              |               |              |            |            |                                     |
|            | Skull                |      | 34-0243-00 | Kandiyohi | 8                       |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | UMF           |              |            |            |                                     |
|            | Unnamed              |      | 34-0391-00 | Kandiyohi | 6                       |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CMF           |              |            |            | AP                                  |
|            | Unnamed              |      | 34-0510-00 | Kandiyohi | 7                       |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              | UNF           |              |            |            |                                     |
|            | Unnamed              |      | 34-0527-00 | Kandiyohi | 248.9                   |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              |               |              |            |            |                                     |
|            | Unnamed              |      | 34-0611-00 | Kandiyohi | 17                      |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              | CMF           |              |            |            |                                     |
|            | unnamed              |      | 34-0612-00 | Kandiyohi | 126.6                   |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              |               |              |            |            |                                     |
|            | Longanans            |      | 43-0070-00 | McLeod    | 26                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Todd                 |      | 43-0071-00 | McLeod    | 87                      | 6                |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
| In-lake    | Hook                 |      | 43-0073-00 | McLeod    | 131                     | 18               | 76   |                  | no   |                 |                            | •    |             | 71            | 124                   | 77           | 1↓          | •            | Impaired     | CC            |              | 99         | 3,014      | FSS                                 |
|            | Emily                |      | 43-0074-00 | McLeod    | 31                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Echo                 |      | 43-0081-00 | McLeod    | 34                      |                  |      |                  | no   |                 | •                          |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Dettmans             |      | 43-0102-00 | McLeod    | 6                       |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Campbells            |      | 43-0108-00 | McLeod    | 11                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Maple                |      | 47-0001-00 | Meeker    | 55                      | 6.5              |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              | 100        |            | F survey                            |
|            | Francis              |      | 47-0002-00 | Meeker    | 425                     | 17               |      |                  | no   |                 |                            | •    | •           | 50            | 21                    | 8            | 1.9→        | •            | Full Support | LNF           | 4,496        | 96         |            | FSS, AP                             |
|            | Byron                |      | 47-0004-00 | Meeker    | 137                     |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | SC            |              |            |            |                                     |
|            | Butternut            |      | 47-0005-00 | Meeker    | 31                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Unnamed              |      | 47-0007-00 | Meeker    | 8                       |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Pigeon               |      | 47-0008-00 | Meeker    | 101                     |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Unnamed              |      | 47-0009-00 | Meeker    | 31                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Spencer              |      | 47-0014-00 | Meeker    | 57                      |                  |      |                  | no   |                 | •                          |      |             | 65            | 87                    | 25           | 1           |              | Insufficient | CC            |              |            |            |                                     |
| Watershed  | Jennie               |      | 47-0015-00 | Meeker    | 428                     | 14               | 79   |                  | no   |                 | •                          | •    | •           | 61            | 61                    | 28           | 1.6↓        | •            | Impaired     | CC            | 5,001        | 100        | 10,664     | FSS                                 |
|            | Wolf                 |      | 47-0016-00 | Meeker    | 107                     | 11               |      |                  | no   |                 | •                          | •    | •           | 61            | 52                    | 20           | 1           |              | Insufficient | CC            |              |            |            | F survey                            |
|            | Collins Lake         |      | 47-0017-00 | Meeker    | 23                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Little Wolf          |      | 47-0019-00 | Meeker    | 25                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            | F survey                            |
|            | Arvilla              |      | 47-0023-00 | Meeker    | 53                      | 9                |      |                  | no   |                 | •                          | •    | •           | 66            | 86                    | 38           | 1           |              | Insufficient | WC            |              | 100        |            | FSS                                 |
|            | Little Swan          |      | 47-0025-00 | Meeker    | 20                      | 31               |      |                  | no   |                 |                            |      |             | 53            | 14                    | 4            | 4           |              | Full Support | CC            | 116          | 44         |            | F survey                            |
|            | Long                 |      | 47-0026-00 | Meeker    | 66                      | 28               |      |                  | no   |                 |                            |      |             | 51            | 37                    | 10           | 2↑          | •            | Full Support | CC            | 398          | 66         |            | FSS                                 |
|            | Hart                 |      | 47-0029-00 | Meeker    | 23                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | WC            |              |            |            | F survey                            |
|            | Mud                  |      | 47-0031-00 | Meeker    | 39                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
| In-lake    | Spring               |      | 47-0032-00 | Meeker    | 60                      | 30               | 57   |                  | 20 homeowners are hooked up, rest are not. |                 |                            | •    | •           | 61            | 59                    | 25           | 1↑          | •            | Impaired     | CC            |              | 76         | 1,036      | F survey                            |
|            | Unnamed              |      | 47-0033-00 | Meeker    | 4                       |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Sellards             |      | 47-0035-00 | Meeker    | 40                      | 9                |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | WC            |              | 100        |            |                                     |
|            | Little Spring        |      | 47-0036-00 | Meeker    | 28                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Boo                  |      | 47-0037-00 | Meeker    | 14                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
| Watershed  | Big Swan             |      | 47-0038-00 | Meeker    | 261                     | 32               | 80   |                  | no   |                 |                            | •    | •           | 67            | 91                    | 47           | 1.1↓        | •            | Impaired     | CC            | 20,363       | 54         | 45,478     | FSS                                 |
|            | Mud                  |      | 47-0040-00 | Meeker    | 27                      | 26               |      |                  | no   |                 |                            |      |             | 52            | 29                    | 10           | 2           |              | Insufficient | LNF           |              |            |            | F survey                            |
|            | Heenan Lake          |      | 47-0043-00 | Meeker    | 11                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Jewitt               |      | 47-0044-00 | Meeker    | 102                     | 5                |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Fallon               |      | 47-0045-00 | Meeker    | 89                      | 5                |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | CC            |              |            |            |                                     |
|            | Washington           |      | 47-0046-00 | Meeker    | 979                     | 17               |      | EWM              | no   |                 | •                          | •    | •           | 56            | 26                    | 10           | 1.1→        | •            | Full Support | WC            | 9,136        | 93         |            | FSS, AP                             |
|            | Unnamed              |      | 47-0047-00 | Meeker    | 16                      |                  |      |                  | no   |                 |                            |      |             |               |                       |              |             |              |              | WC            |              |            |            |                                     |
|            | Powers               |      | 47-0048-00 | Meeker    | 101                     |                  |      |                  | no   |                 |                            |      |             | 88            | 330                   |              | 0           |              |              | WC            |              |            |            |                                     |

| MGMT FOCUS | LAKE               | BAY  | ID         | COUNTY | SURFACE AREA (hectares) | MAX DEPTH (feet) | % AG | INVASIVE SPECIES | Sanitary Sewer Hook-Up                      | WILD RICE LAKES | DNR PRIORITY SHALLOW LAKES | HSPF | LAKE ASSOC. | TROPIC INDEX | NUTRIENTS (TP) (ug/L) | CHL-a (ug/L) | CLARITY (m) | LAKE ASSESS. | LAKE STATUS  | HUC-11 ACTION | WSHED SURFACE | % LITTORAL | DRAIN AREA | FISH SURVEY, STOCK, AQ PLANT SURVEY |
|------------|--------------------|------|------------|--------|-------------------------|------------------|------|------------------|---|-----------------|----------------------------|------|-------------|--------------|-----------------------|--------------|-------------|--------------|--------------|---------------|---------------|------------|------------|-------------------------------------|
|            | Manuella           |      | 47-0050-00 | Meeker | 117                     | 50               |      |                  | no  |                 |                            |      |             | 49           | 19                    | 7            | 2↓          | ●            | Full Support | WC            | 4,496         | 37         |            | FSS                                 |
|            | Birch              |      | 47-0055-00 | Meeker | 20                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | WC            |               |            |            |                                     |
|            | Porter             |      | 47-0057-00 | Meeker | 41                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | CC            |               |            |            |                                     |
|            | Erie               |      | 47-0064-00 | Meeker | 75                      | 34               |      |                  | no  |                 |                            |      |             | 54           | 30                    | 11           | 2           | ●            | Full Support | CC            | 239           | 46         |            | FSS                                 |
|            | Stella             |      | 47-0068-00 | Meeker | 241                     | 74               |      |                  | no  |                 |                            | ●    | ●           | 52           | 21                    | 10           | 2.1↑        | ●            | Full Support | WC            | 3,069         | 51         |            | FSS                                 |
|            | North Buckley      |      | 47-0069-00 | Meeker | 4                       |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | WC            |               |            |            |                                     |
|            | South Buckley      |      | 47-0070-00 | Meeker | 25                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | WC            |               |            |            |                                     |
|            | East Andrew Nelson |      | 47-0073-00 | Meeker | 16                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Turtle             |      | 47-0074-00 | Meeker | 19                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | WC            |               |            |            |                                     |
|            | Darwin             |      | 47-0076-00 | Meeker | 63                      |                  |      |                  | no  |                 |                            |      |             | 62           | 54                    |              |             |              |              | WC            |               |            |            | AP                                  |
|            | Stevens            |      | 47-0077-00 | Meeker | 11                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | WC            |               |            |            | AP                                  |
|            | Casey              |      | 47-0080-00 | Meeker | 34                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | WC            |               |            |            |                                     |
| In-lake    | Dunns              |      | 47-0082-00 | Meeker | 63                      | 20               | 85   |                  | no  |                 |                            | ●    | ●           | 69           | 106                   | 43           | 1           | ●            | Impaired     | L             | 2,260         | 61         | 5,426      | FSS                                 |
|            | Mud                |      | 47-0085-00 | Meeker | 50                      |                  |      |                  | no  |                 |                            |      |             | 69           | 90                    |              |             |              |              |               |               |            |            |                                     |
|            | Rice               |      | 47-0087-00 | Meeker | 28                      |                  |      |                  | no  |                 |                            |      |             | 93           | 697                   |              | 0           |              |              | L             |               |            |            |                                     |
| Watershed  | Richardson         |      | 47-0088-00 | Meeker | 48                      | 47               | 88   |                  | no  |                 |                            | ●    | ●           | 58           | 68                    | 32           | 1.1→        | ●            | Impaired     | L             | 2,057         | 41         |            | FSS                                 |
|            | Andrew Nelson      |      | 47-0101-00 | Meeker | 36                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Round              |      | 47-0102-00 | Meeker | 106                     | 8                |      |                  | no  |                 | ●                          |      |             | 53           | 27                    | 11           | 2           |              |              | JC            |               | 100        |            | F survey                            |
|            | Hoosier            |      | 47-0116-00 | Meeker | 42                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Minnie-Belle       |      | 47-0119-00 | Meeker | 240                     | 49               |      | EWM              | no  |                 |                            | ●    | ●           | 44           | 27                    | 5            | 3.5         | ●            | Full Support | WC            | 783           | 31         |            | FSS, AQ                             |
|            | Unnamed            |      | 47-0130-00 | Meeker | 12                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |
|            | Stone              |      | 47-0131-00 | Meeker | 65.8                    | 2                |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Unnamed            |      | 47-0132-00 | Meeker | 10                      |                  |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Chicken            |      | 47-0133-00 | Meeker | 41                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Ripley             | East | 47-0134-01 | Meeker | 54                      | 18               |      | EWM              | no  |                 |                            | ●    | ●           |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Ripley             | West | 47-0134-02 | Meeker | 241                     | 18               |      | EWM              | 3/4 covered, 1/4 (south side not hooked up) |                 |                            |      | ●           | 55           | 34                    | 9            | 2.1↑        | ●            | Full Support | JC            | 3,343         |            |            | FSS                                 |
|            | West Hanson        |      | 47-0136-00 | Meeker | 21                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Harold             |      | 47-0137-00 | Meeker | 49                      |                  |      |                  | no  |                 |                            |      |             | 81           | 124                   |              | 0           |              |              | JC            |               |            |            |                                     |
|            | Youngstrom         |      | 47-0138-00 | Meeker | 67                      | 5                |      |                  | no  |                 | ●                          |      |             | 56           | 38                    | 6            | 1           |              | Insufficient | JC            |               |            |            | F survey                            |
|            | Minnesota          |      | 47-0140-00 | Meeker | 47                      |                  |      |                  | no  |                 | ●                          |      |             | 56           | 28                    |              | 1           |              |              | JC            |               |            |            |                                     |
|            | Towers             |      | 47-0142-00 | Meeker | 21                      |                  |      |                  | no  |                 |                            |      |             | 68           | 82                    |              |             |              |              | JC            |               |            |            |                                     |
|            | Mary               |      | 47-0143-00 | Meeker | 37                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Half Moon          |      | 47-0144-00 | Meeker | 7                       |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Madsen             |      | 47-0146-00 | Meeker | 135.5                   |                  |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Schultz            |      | 47-0147-00 | Meeker | 18                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Unnamed            |      | 47-0148-00 | Meeker | 24                      |                  |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              | JC            |               |            |            |                                     |
|            | Horseshoe          |      | 47-0151-00 | Meeker | 8                       | 1                |      |                  | no  |                 | ●                          |      |             | 64           | 86                    |              | 1           |              |              |               |               |            |            |                                     |
|            | Thoen              |      | 47-0154-00 | Meeker | 85                      |                  |      |                  | no  |                 | ●                          |      |             | 77           | 119                   |              | 0           |              |              | JC            |               |            |            |                                     |
|            | Pigeon             |      | 47-0155-00 | Meeker | 11                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Popple             |      | 47-0173-00 | Meeker | 18                      |                  |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |
| Mixed      | Long               |      | 47-0177-00 | Meeker | 282                     | 3                | 72   |                  | no  |                 | ●                          |      |             | 82           | 323                   | 229          | 0↑          | ●            | Impaired     | LGLO          | 7,353         | 100        | 4,213      |                                     |
|            | Sather             |      | 47-0178-00 | Meeker | 27                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |
|            | Moe                |      | 47-0179-00 | Meeker | 16                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |
| Mixed      | Hope               |      | 47-0183-00 | Meeker | 118                     | 10               | 76   |                  | no  |                 | ●                          |      |             | 80           | 249                   | 238          | 0           | ●            | Impaired     | LGLO          | 1,856         | 100        | 16,927     |                                     |
|            | Unnamed            |      | 47-0187-00 | Meeker | 30.7                    |                  |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |
|            | Unnamed            |      | 47-0189-00 | Meeker | 12                      |                  |      |                  | no  |                 | ●                          |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |
|            | Unnamed (Grove)    |      | 47-0191-00 | Meeker | 13                      |                  |      |                  | no  |                 |                            |      |             |              |                       |              |             |              |              | LGLO          |               |            |            |                                     |

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|------------|------------------|----------|------------|---------|-------------------------|------------------|------|------------------|-----------------------------|-----------------|----------------------------|------|-------------|--------------|-----------------------|--------------|-------------|--------------|--------------|---------------|---------------|------------|------------|-------------------------------------|
|            | Lund             |          | 47-0192-00 | Meeker  | 45                      |                  |      |                  | no                          |                 | •                          |      |             | 53           | 24                    | 1            |             |              | LGLO         |               |               |            |            |                                     |
|            | Wilcox           |          | 47-0193-00 | Meeker  | 24                      |                  |      |                  | no                          |                 |                            |      |             | 65           | 59                    | 1            |             |              | LMF          |               |               |            |            |                                     |
|            | Miller           |          | 47-0194-00 | Meeker  | 32                      |                  |      |                  | no                          |                 | •                          |      |             |              |                       |              |             |              | LMF          |               |               |            |            |                                     |
|            | Peterson         |          | 47-0198-00 | Meeker  | 54                      | 15               |      |                  | no                          |                 | •                          |      |             | 73           | 116                   |              |             |              | LMF          |               |               | 96         |            |                                     |
|            | Helga            |          | 47-0199-00 | Meeker  | 47                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | LMF          |               |               |            |            |                                     |
|            | Emma             |          | 47-0201-00 | Meeker  | 24                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Whitney          |          | 47-0205-00 | Meeker  | 22                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | LMF          |               |               |            |            |                                     |
|            | Unnamed          |          | 47-0338-00 | Meeker  | 26                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | CC           |               |               |            |            |                                     |
|            | Unnamed          |          | 61-0017-00 | Pope    | 9                       |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Mud              |          | 61-0019-00 | Pope    | 13                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Lincoln          |          | 61-0020-00 | Pope    | 11                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Grove            |          | 61-0023-00 | Pope    | 144                     | 9                |      |                  | no                          |                 |                            | •    |             | 53           | 34                    | 12           | 2↑          | •            | Full Support | UNF           | 3,922         | 69         |            |                                     |
|            | McCloud          |          | 61-0024-00 | Pope    | 89.4                    | 10               |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Alice            |          | 61-0032-00 | Pope    | 90                      | 3                |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Unnamed          |          | 61-0310-00 | Pope    | 46                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Pirz             |          | 73-0144-00 | Stearns | 27                      |                  |      |                  | no                          |                 |                            |      | •           | 48           | 26                    | 7            | 3↑          | •            | Full Support | UNF           | 348           |            |            |                                     |
| Upstream   | Rice             |          | 73-0196-00 | Stearns | 27                      | 41               |      |                  | no                          |                 |                            | •    | •           | 60           | 60                    | 30           | 1.6→        | •            | Impaired     | UNF           | 70,075        | 58         |            |                                     |
|            | Koronis          | Mud Lake | 73-0200-01 | Stearns | 613                     | 13               |      |                  | no                          |                 |                            | •    | •           |              | 54                    | 10           | 0.6         | •            | Full Support | UNF           | 74,488        | 100        |            |                                     |
|            | Koronis          | Main     | 73-0200-02 | Stearns | 55                      | 13.2             |      |                  | no                          |                 |                            |      | •           | 54           | 40                    | 18           | 2.2↑        | •            | Full Support | UNF           | 74,542        |            |            |                                     |
|            | George           |          | 73-0258-00 | Stearns | 1191                    | 39               |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Unnamed          |          | 73-0268-00 | Stearns | 27                      |                  |      |                  | no                          |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Unnamed          |          | 73-0277-00 | Stearns | 127                     |                  |      |                  | no                          |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Tamarack         |          | 73-0278-00 | Stearns | 30                      | 3.5              |      |                  | no                          |                 | •                          |      |             |              |                       |              |             |              | UNF          |               |               |            |            |                                     |
|            | Crow             |          | 73-0279-00 | Stearns | 113                     | 1                |      |                  | no                          | •               |                            |      |             |              |                       |              |             |              | UMF          |               |               |            |            |                                     |
|            | Fish             |          | 73-0281-00 | Stearns | 91                      | 1                |      |                  | no                          | •               |                            |      |             |              |                       |              |             |              | UMF          |               |               |            |            |                                     |
|            | Raymond          |          | 73-0285-00 | Stearns | 70                      | 1                |      |                  | no                          |                 | •                          |      |             | 62           | 55                    |              | 1           |              |              |               |               |            |            |                                     |
| Mixed      | Foster           |          | 86-0001-00 | Wright  | 26                      | 10               | 63   |                  | no                          |                 |                            |      | •           | 76           | 262                   | 130          | 0.5↑        | •            | Impaired     | CR            |               | 100        | 2,850      |                                     |
|            | Rice             |          | 86-0002-00 | Wright  | 52                      | 3                |      |                  | no                          | •               | •                          |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Unnamed          |          | 86-0008-00 | Wright  | 20                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Martha           |          | 86-0009-00 |         |                         |                  |      |                  | particle - St. Michael WWTF |                 |                            |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Wagner           |          | 86-0010-00 | Wright  | 40                      | 22               |      |                  | no                          |                 |                            |      |             | 54           | 24                    | 8            | 2↑          | •            | Full Support | CR            | 177           | 74         |            |                                     |
|            | Charlotte        |          | 86-0011-00 | Wright  | 40                      | 7                |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Uhl              |          | 86-0017-00 | Wright  | 44                      | 46               |      |                  | particle - St. Michael WWTF |                 |                            |      |             | 41           | 15                    | 4            | 4.9↑        | •            | Full Support | CR            | 1,776         | 40         |            |                                     |
|            | Gonz             |          | 86-0019-00 | Wright  | 95                      | 14               |      |                  | no                          |                 |                            |      |             | 58           |                       | 1↓           |             |              |              | CR            |               |            |            |                                     |
|            | Gonz             |          | 86-0019-00 | Wright  | 35                      | 2.5              |      |                  | no                          | •               |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Wilhelm          |          | 86-0020-00 | Wright  | 10                      | 1                |      |                  | no                          |                 |                            |      |             | 69           | 128                   | 58           | 1→          |              |              | CR            |               |            |            |                                     |
|            | Mud              |          | 86-0021-00 | Wright  | 39                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | STM           |               |            |            |                                     |
|            | Steele           |          | 86-0022-00 | Wright  | 28                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
| Mixed      | Beebe            |          | 86-0023-00 | Wright  | 55                      | 23.5             | 74   |                  | no                          |                 |                            |      | •           | 62           | 59                    | 39           | 1.1↑        | •            | Impaired     | STM           | 389           | 61         | 655        |                                     |
|            | Moore            |          | 86-0028-00 | Wright  | 120                     | 8                |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | CR            |               |            |            |                                     |
|            | Schmidt          |          | 86-0029-00 | Wright  | 74                      |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | STM           |               |            |            |                                     |
| In-lake    | Pelican          |          | 86-0031-00 | Wright  | 71                      | 9                | 72   |                  | no                          | •               | •                          |      |             | 68           | 153                   | 60           | 0.4         | •            | Impaired     | STM           | 9,344         | 100        | 19,060     |                                     |
|            | Unnamed          |          | 86-0033-00 | Wright  | 945                     | 3                |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
|            | Unnamed          |          | 86-0035-00 | Wright  | 30                      |                  |      |                  | no                          |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Unnamed          |          | 86-0039-00 | Wright  | 4                       |                  |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
|            | Dean             |          | 86-0041-00 | Wright  | 4                       | 20               | 73   |                  | no                          |                 |                            |      |             | 73           | 217                   | 82           | 0.6↓        | •            | Impaired     | LNF           | 672           | 72         | 1,474      |                                     |
|            | Unnamed (Rooney) |          | 86-0043-00 | Wright  | 70                      | 7                |      |                  | no                          |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
|            | Mud              |          | 86-0044-00 | Wright  | 24                      |                  |      |                  | no                          |                 | •                          |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |

| MGMT FOCUS | LAKE             | BAY  | ID         | COUNTY | SURFACE AREA (hectares) | MAX DEPTH (feet) | % AG | INVASIVE SPECIES | Sanitary Sewer Hook-Up                           | WILD RICE LAKES | DNR PRIORITY SHALLOW LAKES | HSPF | LAKE ASSOC. | TROPIC INDEX | NUTRIENTS (TP) (ug/L) | CHL-a (ug/L) | CLARITY (m) | LAKE ASSESS. | LAKE STATUS  | HUC-11 ACTION | WSHED SURFACE | % LITTORAL | DRAIN AREA | FISH SURVEY, STOCK, AQ PLANT SURVEY |     |
|------------|------------------|------|------------|--------|-------------------------|------------------|------|------------------|--|-----------------|----------------------------|------|-------------|--------------|-----------------------|--------------|-------------|--------------|--------------|---------------|---------------|------------|------------|-------------------------------------|-----|
|            | Crawford         |      | 86-0046-00 | Wright | 43                      | 19               |      |                  | no   |                 |                            |      |             | 45           | 22                    | 4            | 4↑          | ●            | Full Support | LNF           | 184           | 98         |            |                                     |     |
|            | Mary             |      | 86-0049-00 | Wright | 43                      | 6                |      |                  | particle - Buffalo WWTF                          | ●               |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |     |
| In-lake    | Constance        |      | 86-0051-00 | Wright | 137                     | 23               | 70   |                  | no   |                 |                            |      |             | 66           | 91                    | 74           | 1.4→        | ●            | Impaired     | STM           | 375           | 54         | 753        | F survey                            |     |
|            | Little Pulaski   |      | 86-0053-01 | Wright | 67                      | 87               |      |                  | 100%   |                 |                            |      |             | 48           | 24                    | 6            | 3↑          |              |              | MC            |               |            |            |                                     |     |
|            | Pulaski          | Main | 86-0053-02 | Wright | 291                     | 27               |      | EWM              | 100%   |                 |                            |      |             | 47           | 19                    | 6            | 3.9→        | ●            | Full Support | MC            | 1,349         |            |            | FSS                                 |     |
|            | Washington       |      | 86-0056-00 | Wright | 50                      | 12               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | STM           |               | 100        |            |                                     |     |
|            | Pohl             |      | 86-0061-00 | Wright | 14                      | 9.5              |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | STM           |               | 100        |            |                                     |     |
|            | Green Mountain   |      | 86-0063-00 | Wright | 64                      |                  |      |                  | no   |                 | ●                          |      |             | 73           | 187                   | 98           | 1           |              | Insufficient | STM           |               |            |            | F stock                             |     |
|            | Gilchrist        |      | 86-0064-00 | Wright | 102                     | 9                |      |                  | no   | ●               |                            |      |             |              |                       |              |             |              |              | STM           |               |            |            |                                     |     |
|            | Slough           |      | 86-0078-00 | Wright | 11                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | STM           |               |            |            |                                     |     |
|            | Paradise         |      | 86-0082-00 | Wright | 13                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | STM           |               |            |            |                                     |     |
|            | Mud              |      | 86-0085-00 | Wright | 247.5                   |                  |      |                  | no   |                 | ●                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |     |
| In-lake    | Fountain         |      | 86-0086-00 | Wright | 171                     | 15               | 74   |                  | no   |                 | ●                          | ●    |             | 97           | 1221                  | 2892         | 0           | ●            | Impaired     | LNF           |               | 100        | 1,086      |                                     |     |
|            | Tamarack         |      | 86-0089-00 | Wright | 23                      | 26               |      |                  | no   |                 |                            |      |             | 74           | 128                   | 88           | 0           |              |              | MC            |               | 85         |            | F survey                            |     |
| In-lake    | Buffalo          |      | 86-0090-00 | Wright | 620                     | 33               | 63   |                  | 100%   |                 |                            |      |             | 67           | 78                    | 61           | 1↓          | ●            | Impaired     | MC            | 12,473        | 49         | 24,654     | FSS                                 |     |
|            | Varner           |      | 86-0091-00 | Wright | 40.5                    |                  |      |                  | no   |                 | ●                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |     |
|            | Carrigan         |      | 86-0097-00 | Wright | 54                      |                  |      |                  | particle - Montrose/Waverly WWTF                 | ●               |                            |      |             | 80           | 633                   | 170          | 1           |              |              | LZLO          |               |            |            |                                     |     |
|            | Lauzers          |      | 86-0100-00 | Wright | 29                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LZLO          |               |            |            |                                     |     |
|            | Pooles           |      | 86-0102-00 | Wright | 30                      | 5.5              |      |                  | no   | ●               |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |     |
|            | Ida              |      | 86-0103-00 | Wright | 33                      | 26               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LZLO          |               | 76         |            | F survey                            |     |
| Watershed  | Little Waverly   |      | 86-0106-00 | Wright | 135                     | 12               | 74   | EWM              | no   |                 | ●                          | ●    |             | 76           | 431                   | 72           | 1↓          | ●            | Impaired     | TMC           |               | 100        | 10,995     | FSS                                 |     |
| US lakes   | Deer             |      | 86-0107-00 | Wright | 69                      | 27               | 63   | EWM              | no   |                 |                            | ●    |             | 66           | 81                    | 54           | 1           | ●            | Impaired     | MC            | 25,403        | 77         | 25,403     | F survey                            |     |
|            | Goose            |      | 86-0108-00 | Wright | 20                      | 14               |      | EWM              | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               | 100        |            | F survey                            |     |
|            | Fadden           |      | 86-0109-00 | Wright | 7                       | 48               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               | 57         |            | F survey                            |     |
| In-lake    | Malardi          |      | 86-0112-00 | Wright | 39                      | 2.9              | 76   |                  | no   | ●               | ●                          | ●    |             | 86           | 446                   | 297          | 0           | ●            | Impaired     | LNF           |               | 100        | 700        |                                     |     |
| Mixed      | Waverly          |      | 86-0114-00 | Wright | 197                     | 70.5             | 61   | EWM              | particle - Montrose/Waverly WWTF                 |                 |                            | ●    |             | 54           | 37                    | 16           | 2↑          | ●            | Impaired     | TMC           |               |            | 29         | 1,674                               | FSS |
|            | Birch            |      | 86-0116-00 | Wright | 41                      | 31               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               | 76         |            | F survey                            |     |
|            | Sullivan         |      | 86-0119-00 | Wright | 28.3                    | 58               |      |                  | no   |                 |                            |      |             | 57           | 42                    | 28           | 2↑          |              |              |               |               |            |            | F survey                            |     |
| Watershed  | Ramsey           |      | 86-0120-00 | Wright | 124                     | 82               | 86   |                  | no   |                 |                            |      |             | 60           | 52                    | 29           | 1↑          | ●            | Impaired     | MC            |               | 49         | 1,000      | FSS                                 |     |
| Mixed      | Light Foot       |      | 86-0122-00 | Wright | 25                      | 22               | 79   |                  | no   |                 |                            | ●    |             | 74           | 196                   | 113          | 1           | ●            | Impaired     | MC            |               | 87         | 10,995     | F survey                            |     |
|            | North Twin       |      | 86-0123-00 | Wright | 18                      | 58               |      | EWM              | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               | 47         |            | F survey                            |     |
|            | Unnamed (Pauman) |      | 86-0124-00 | Wright | 8                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               |            |            |                                     |     |
|            | South Twin       |      | 86-0126-00 | Wright | 15                      | 19               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               | 83         |            | F survey                            |     |
| In-lake    | Albert           |      | 86-0127-00 | Wright | 22.6                    | 47               | 85   |                  | no   |                 |                            |      |             | 68           | 109                   | 83           | 1↓          | ●            | Impaired     |               |               | 49         | 304        |                                     |     |
|            | Abbie            |      | 86-0132-00 | Wright | 45                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               |            |            |                                     |     |
|            | Upper Maple      |      | 86-0134-01 | Wright | 293                     | 10               |      | EWM              | no   |                 |                            |      |             | 47           | 21                    | 8            | 3↑          | ●            | Full Support | MC            | 1,192         |            |            | FSS                                 |     |
|            | Upper Maple      |      | 86-0134-02 | Wright | 46                      | 3                |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               |            |            |                                     |     |
|            | Maple            | NE   | 86-0134-03 | Wright | 0                       | 9                |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | MC            |               | 51         |            |                                     |     |
|            | Yaeger           |      | 86-0177-00 | Wright | 39                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | TMC           |               |            |            | F survey                            |     |
|            | Dog              |      | 86-0178-00 | Wright | 41                      | 25               |      |                  | no   |                 |                            |      |             | 58           | 37                    | 23           | 1→          |              |              | LZLO          |               | 78         |            | F survey                            |     |
|            | Mains            |      | 86-0179-00 | Wright | 5                       |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |     |
|            | School Section   |      | 86-0180-00 | Wright | 14                      | 2                |      |                  | no   | ●               | ●                          |      |             |              |                       |              |             |              |              | TMC           |               |            |            |                                     |     |
|            | Little Rock      |      | 86-0181-00 | Wright | 17                      | 51               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               | 58         |            | FSS                                 |     |
| In-lake    | Rock             |      | 86-0182-00 | Wright | 73                      | 37               | 69   | EWM              | no   |                 |                            | ●    |             | 60           | 55                    | 52           | 1↑          | ●            | Impaired     | LNF           |               | 57         | 943        | FSS                                 |     |
| Mixed      | Dutch            |      | 86-0184-00 | Wright | 63                      | 20.5             | 73   |                  | particle - Annandale/Maple Lake/Howard Lake WWTF |                 |                            | ●    |             | 73           | 168                   | 63           | 1↑          | ●            | Impaired     | TMC           |               | 100        | 4,422      | FSS                                 |     |
|            | Emma             |      | 86-0188-00 | Wright | 73                      | 14               |      | EWM              | no   |                 |                            |      |             | 68           | 118                   | 53           | 1           | ●            | Impaired     | TMC           |               | 73         |            | F survey                            |     |
|            | Ann              |      | 86-0190-00 | Wright | 151                     | 18.5             |      |                  | no   |                 |                            | ●    |             | 71           | 190                   | 62           | 1↓          | ●            | Impaired     | TMC           |               | 29         |            | FSS                                 |     |



| MGMT FOCUS | LAKE             | BAY | ID         | COUNTY | SURFACE AREA (hectares) | MAX DEPTH (feet) | % AG | INVASIVE SPECIES | Sanitary Sewer Hook-Up                           | WILD RICE LAKES | DNR PRIORITY SHALLOW LAKES | HSPF | LAKE ASSOC. | TROPIC INDEX | NUTRIENTS (TP) (ug/L) | CHL-a (ug/L) | CLARITY (m) | LAKE ASSESS. | LAKE STATUS  | HUC-11 ACTION | WSHED SURFACE | % LITTORAL | DRAIN AREA | FISH SURVEY, STOCK, AQ PLANT SURVEY |
|------------|------------------|-----|------------|--------|-------------------------|------------------|------|------------------|--|-----------------|----------------------------|------|-------------|--------------|-----------------------|--------------|-------------|--------------|--------------|---------------|---------------|------------|------------|-------------------------------------|
|            | Unnamed          |     | 86-0191-00 | Wright | 62                      |                  |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Round            |     | 86-0192-00 | Wright | 17                      | 29               |      | EWM              | no   |                 |                            |      |             |              |                       |              |             |              |              | TMC           |               | 71         |            | F survey                            |
|            | Mary             |     | 86-0193-00 | Wright | 74                      | 46               |      |                  | no   |                 |                            |      |             | 50           | 26                    | 10           | 2.4↑        | •            | Full Support | LZLO          | 195           | 47         |            |                                     |
|            | Long             |     | 86-0194-00 | Wright | 20                      | 3                |      |                  | no   | •               |                            |      |             |              |                       |              |             |              |              | TMC           |               |            |            |                                     |
| In-lake    | Howard           |     | 86-0199-00 | Wright | 295                     | 36               | 79   | EWM              | particle - annandale/Maple Lake/Howard Lake WWTF |                 |                            |      | •           | 63           | 82                    | 33           | 1.3↑        | •            | Impaired     | TMC           | 1726          | 100        | 3,535      | FSS                                 |
|            | Spring           |     | 86-0200-00 | Wright |                         |                  |      |                  | no   | •               |                            |      |             |              |                       |              |             |              |              | TMC           |               |            |            |                                     |
|            | Unnamed          |     | 86-0203-00 | Wright | 45                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
|            | Taylor           |     | 86-0204-00 | Wright | 20                      |                  |      |                  | no   | •               |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
|            | Doefler          |     | 86-0206-00 | Wright | 36                      |                  |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | TMC           |               | 44         |            |                                     |
|            | Willima          |     | 86-0209-00 | Wright | 105                     |                  |      |                  | no   | •               | •                          |      |             | 73           | 255                   |              | 1           |              |              | LNF           |               |            |            |                                     |
|            | White            |     | 86-0214-00 | Wright | 47                      |                  |      |                  | no   | •               | •                          |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
| Mixed      | Granite          |     | 86-0217-00 | Wright | 143                     | 34               | 73   | EWM              | no   |                 |                            | •    | •           | 60           | 59                    | 32           | 2↑          | •            | Impaired     | LNF           |               | 32         | 2,054      | FSS                                 |
|            | Maxim            |     | 86-0218-00 | Wright | 19                      | 18               |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               | 89         |            | F survey                            |
| Mixed      | Camp             |     | 86-0221-00 | Wright | 48                      | 52               | 78   | EWM              | no   | •               |                            | •    | •           | 63           | 108                   | 41           | 2↑          | •            | Impaired     | LNF           |               | 38         | 476        | FSS                                 |
| In-lake    | Smith            |     | 86-0250-00 | Wright | 74                      | 5                | 85   |                  | no   | •               | •                          | •    |             | 84           | 236                   | 227          | 0           | •            | Impaired     | SC            |               | 100        | 1,105      | F survey                            |
|            | Shakopee         |     | 86-0255-00 | Wright | 46                      | 1.5              |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              | SC            |               |            |            |                                     |
|            | Grass            |     | 86-0257-00 | Wright | 171.7                   |                  |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
| Watershed  | Cokato           |     | 86-0263-00 | Wright | 221                     | 52               | 86   |                  | no   |                 |                            | •    | •           | 58           | 54                    | 22           | 1.9→        | •            | Impaired     | SC            | 11,855        | 34         | 29,535     | FSS                                 |
| In-lake    | Brooks           |     | 86-0264-00 | Wright | 39                      | 21               | 54   |                  | particle - Cokato WWTF                           |                 |                            |      |             | 64           | 63                    | 43           | 1→          | •            | Impaired     | SC            |               | 62         | 114        | F survey                            |
|            | Moose            |     | 86-0271-00 | Wright | 32                      | 43               |      |                  | no   |                 |                            |      |             | 42           | 14                    | 4            | 4           |              |              | LNF           |               | 72         |            | F survey                            |
| Watershed  | French           |     | 86-0273-00 | Wright | 137                     | 50               | 73   | EWM              | no   |                 |                            | •    |             | 57           | 38                    | 16           | 1↑          | •            | Impaired     | LNF           |               | 47         | 5,055      | FSS                                 |
|            | Dans             |     | 86-0274-00 | Wright | 30                      | 27               |      |                  | no   |                 |                            |      |             | 77           | 352                   | 105          | 1           |              |              | LNF           |               | 70         |            | F survey                            |
|            | Unnamed          |     | 86-0277-00 | Wright | 32                      |                  |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |
|            | Goose            |     | 86-0278-00 | Wright | 36                      | 6                |      |                  | no   |                 |                            |      |             |              |                       |              |             |              |              | LNF           |               |            |            |                                     |
|            | West Lake Sylvia |     | 86-0279-00 | Wright | 360                     | 88               |      | EWM              | no   |                 |                            | •    | •           | 37           | 10                    | 3            | 5.4↑        | •            | Full Support | LNF           | 3,241         | 33         |            | FSS                                 |
|            | John             |     | 86-0288-00 | Wright | 160                     | 28               |      | EWM              | no   |                 |                            |      | •           | 50           | 26                    | 9            | 2.4↑        | •            | Full Support | LNF           | 1,452         | 86         |            | FSS                                 |
|            | East Lake Sylvia |     | 86-0289-00 | Wright | 271                     | 78               |      | EWM              | no   |                 |                            |      | •           | 39           | 10                    | 4            | 5.2↑        | •            | Full Support | LNF           | 2,051         | 26         |            | FSS                                 |
| Watershed  | Collinwood       |     | 86-0293-00 | Wright | 253                     | 28               | 79   |                  | no   |                 |                            | •    | •           | 65           | 99                    | 47           | 1.6↓        | •            | Impaired     | CC            | 13,185        | 60         | 28,967     | FSS                                 |
|            | Swan             |     | 86-0295-00 | Wright | 25                      | 2                |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              | CC            |               |            |            |                                     |
|            | Beaver Dam       |     | 86-0296-00 | Wright | 8                       |                  |      |                  | no   | •               | •                          |      |             |              |                       |              |             |              |              | CC            |               |            |            |                                     |
|            | Unnamed          |     | 86-0442-00 | Wright | 31                      |                  |      |                  | no   |                 | •                          |      |             |              |                       |              |             |              |              |               |               |            |            |                                     |