Appendix G:

Useful tools for monitoring

Tools/examples included (in order):

- A sample of lab analytical costs
- Conversion factors
- Example monitoring checklist
- Example field data sheets for stream, lake and biological monitoring
- Example QAPP completed for a volunteer monitoring program (Southern Red River Basin Surface Water Nutrient Loading Assessment Project)
- Sample of Monitoring Program Evaluation Form

Lab analytical costs

The following table presents a sample of analytical costs for analyses performed by the Minnesota Department of Health’s Environmental Laboratory. Note that costs at other labs may be slightly higher or lower than those presented here, depending on a variety of factors. This is included merely as a general guidance as to what to expect for certified lab analysis costs.

Conversions

As you enter and assess your data, it is sometimes necessary to transform the data from one unit to another. For example, you may take Secchi disk measurements in feet and later find that you need to translate them to meters to match with the data someone else has collected. The table on the next page provides conversions for common units used in water quality monitoring and analysis.

Examples:

All summer, you record Secchi disk measurements in feet. You later learn that the county also has transparency data for your lake from previous years, but the measurements are in meters. To change your measurements from feet to meters, you use the following equation:

Measurement in feet x conversion factor = Measurement in meters

Conversion factor (from table) = 0.3048

Your laboratory reports results in mg/L (ppm), but you’d like to compare those results to ecoregion reference values, which are reported in µg/L (ppb). To change your measurements, you use the following equation:

Result in mg/L x conversion factor = Result in µg/L

Conversion factor (from table) = 1000

---

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>PRICE OF ANALYSIS, PER SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkalinity, Total</td>
<td>$17.00</td>
</tr>
<tr>
<td>Ammonia Nitrogen, Total</td>
<td>$13.00</td>
</tr>
<tr>
<td>BOD, 5-day</td>
<td>$50.00</td>
</tr>
<tr>
<td>Chloride, Total</td>
<td>$11.00</td>
</tr>
<tr>
<td>Chlorophyll-α (phaeophytin corrected)</td>
<td>$35.00 (field filtered)</td>
</tr>
<tr>
<td></td>
<td>$55.00 (lab filtered)</td>
</tr>
<tr>
<td>Fecal Coliform, MF</td>
<td>$33.00</td>
</tr>
<tr>
<td>Kjeldahl Nitrogen, Total</td>
<td>$27.00</td>
</tr>
<tr>
<td>Nitrate+Nitrite Nitrogen, Total</td>
<td>$10.00</td>
</tr>
<tr>
<td>Orthophosphate, Total</td>
<td>$16.00</td>
</tr>
<tr>
<td>Phosphorus, Total</td>
<td>$27.00 (0.01 mg/L detection limit)</td>
</tr>
<tr>
<td></td>
<td>$33.00 (0.002 mg/L detection limit)</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>$15.00</td>
</tr>
<tr>
<td>Turbidity</td>
<td>$13.00</td>
</tr>
</tbody>
</table>

*from 2003 MDH Environ. Lab Handbook
Conversions

<table>
<thead>
<tr>
<th>TO CONVERT “UNIT X”</th>
<th>TO “UNIT Y”</th>
<th>MULTIPLY VALUE IN UNIT X BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>acres</td>
<td>hectares</td>
<td>0.4047</td>
</tr>
<tr>
<td>acre-feet</td>
<td>gallons</td>
<td>3.259 x 10⁵</td>
</tr>
<tr>
<td>cubic feet/second (cfs)</td>
<td>gallons/minute</td>
<td>448.831</td>
</tr>
<tr>
<td>feet</td>
<td>meters</td>
<td>0.3048</td>
</tr>
<tr>
<td>gallons</td>
<td>liters</td>
<td>3.785</td>
</tr>
<tr>
<td>inches</td>
<td>centimeters</td>
<td>2.54</td>
</tr>
<tr>
<td>pounds</td>
<td>grams</td>
<td>453.5924</td>
</tr>
<tr>
<td>temperature in degrees F (°F)</td>
<td>temperature in degrees C (°C)</td>
<td>First subtract 32, then multiply by 5/9</td>
</tr>
<tr>
<td>milligrams/liter (mg/L or ppm – part per million)</td>
<td>micrograms per liter (µg/L or ppb – part per billion)</td>
<td>1000</td>
</tr>
</tbody>
</table>

Note: To perform the conversion in the reverse direction, multiply by (1/(the conversion factor)). For example, to convert from hectares to acres, multiply the value in hectares by (1/0.4047).

Note:

Keep in mind when converting between units that it is important not to report excess decimal places. Use the following rule of thumb: Look at all the values that were used in the calculation, and find the measured value with the fewest decimal places. The final answer should have that same number of decimal places. For example, if you measured Secchi disk transparency to the nearest tenth of a foot, after converting from feet to meters the final value should not have more than one decimal place (even though there are 4 decimal places in the conversion factor).

\[ 4.6 \text{ feet} \times 0.3048 \text{ (conversion factor)} = 1.40208, \] which should be recorded as 1.4 meters

Monitoring checklist

(example for lake monitoring)

The following example of a sampling checklist is from Training Manual for the CLMP+ Program, 2002.

Lake sampling equipment checklist

Below is a checklist of the equipment you’ll need to bring with you IN the boat for sampling.

1. Sample bottles (one each):
   A. Nutrient plastic bottle for TP
   B. 2-liter plastic bottle for Chlorophyll-a
2. Sulfuric acid vial for preserving TP sample
3. Cooler (with ice provided by volunteer)
4. Integrated sampler
5. Secchi disk
6. Temperature Digital Depth Counter (Fish Hawk)
7. Lake map showing site locations, Site ID #, and MN Lake ID #
8. Watch – for recording the time of sampling
9. Permanent marker for writing on bottles
10. Ink pen
11. Field observation forms
12. Life jackets (State Law requires 1 for each person in the boat)
13. Oar or paddle in case of motor problems
14. Anchor - with rope length at least 1 1/2 times the depth at the deepest sampling site. Pontoon boats should carry extra rope and a second anchor to prevent sway.
15. Depth finder - optional
16. A 14-foot or larger boat is recommended with a properly matched motor. Pontoon boats work well but can be difficult to anchor in windy conditions.

Field data sheets

The following five pages contain example data sheets used for field data collection. Feel free to duplicate any of these data sheet and use them if they fit with your monitoring effort, or revise as needed for your project goals and objectives.
### Example stream monitoring field sheet (p.1)

**MINNESOTA POLLUTION CONTROL AGENCY / STREAM FIELD SHEET**

<table>
<thead>
<tr>
<th>FIELD INFO</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT ID*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STORET ESTAB.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STATION NUMBER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIELD CODE OR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STREAM NAME*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATE (YMMDD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TIME (military)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SITE ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QA*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEMP °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 25 °C (umhos/cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DO (mg/l)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TURBIDITY, NTU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W.L. GAGE (ft.)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W.L. GAGE TYPE*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSPARENCY*</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>60 cm tube (to the nearest cm)</td>
<td></td>
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<tr>
<td>TRANSPARENCY*</td>
<td></td>
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<tr>
<td>100 cm tube (to the nearest cm)</td>
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<tr>
<td>APPEARANCE*</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RECREAT. SUIT.*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STREAM CONDITION*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STREAM FLOW (cfs)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAMPLING DEVICE*</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SAMPLE TYPE*</td>
<td></td>
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</tr>
</tbody>
</table>

* See back of sheet for additional instructions/information. Use codes listed on back to assure STORET entry.

**FIELD OBSERVATIONS** (station name/location, weather, ice condition, stream width, picture #, GPS file name, etc.)

<table>
<thead>
<tr>
<th>A</th>
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<tbody>
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</tbody>
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<th>C</th>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
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</tr>
</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>E</th>
<th></th>
</tr>
</thead>
<tbody>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
### ADDITIONAL INSTRUCTIONS/INFORMATION (Stream Field Sheet p. 2)

**PROJECT ID**
Identify Project ID for sample collection (examples: MILE, UP_MISS, SWANTMDL). If project is not established, please fill out Project Establishment form.

**FIELD CODE OR STREAM NAME**
If this is an unestablished site and you want the site established and data entered in STORET, please supply us with GPS reading and station description/notation. Note these in the field observation section and fill out Station Establishment forms.

**QA:** FD = Field Dup, SB = Sampler Blank, TB = Trip Blank, BB = Bottle Blank, RB = Reagent Blank

**W.L. GAGE (L):**
Water level, also called “stage”, determined by reading a staff gage, recording gage, wire weight gage or by subtracting a tape down measurement to water level from a measuring point elevation. A description of the gage should be noted in “field observations”, as well as any unusual conditions that affect the measurement (debris around the staff, wind catching the tape, standing waves, etc...)

<table>
<thead>
<tr>
<th>W.L. GAGE TYPE</th>
<th>ABBREV.</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape Down</td>
<td>TD</td>
<td>Tape-down to water level subtracted from established measuring point elevation (describe in comments).</td>
</tr>
<tr>
<td>Staff Gage</td>
<td>S</td>
<td>Staff plate mounted vertically in stream.</td>
</tr>
<tr>
<td>Wire Weight</td>
<td>W</td>
<td>Weighted wire cable wound on a calibrated reel and attached to a box mounted on bridge.</td>
</tr>
<tr>
<td>Automated Stage Recorder</td>
<td>A</td>
<td>Automatic water level readout on an indoor instrument connected to water level sensor in or above stream.</td>
</tr>
<tr>
<td>Pool and/or Tailwater elev. (ie L&amp;D)</td>
<td>P/TW</td>
<td>Pool (above dam) and tailwater (below dam) elevations, recorded in L&amp;D station offices. (Record both; also record flow measurement if available).</td>
</tr>
<tr>
<td>Other</td>
<td>O</td>
<td>Describe in comments.</td>
</tr>
</tbody>
</table>

**TRANSPARENCY READINGS**

**INSTRUCTIONS:**
Make sure your back is to the sun when taking a measurement.
Fill your tube until the symbol disappears.
Release water until you can just make out the symbol. Note depth.
Release a bit more water until the symbol is clearly visible (can make out screw in middle of symbol). Note depth.
Record the average of the two depths to the nearest centimeter.
If the symbol is visible when the tube is full, record as p<60cm².

**APPEARANCE:**
1 = Clear – crystal, clear transparent water
2 = Milky – not quite clear, cloudy white or gray
3 = Foamy – natural from pollution
4 = Tea-colored – clear but tea-colored due to wetland or bog influences
5 = Muddy – cloudy brown due to high sediment levels
6 = Green – might indicate excess nutrients released into the stream
7 = Green or muddy & either extensive floating scum or strong foul odor

**RECREATIONAL SUITABILITY:**
1 = Beautiful, could not be better
2 = Very minor aesthetic problems: excellent for body-contact recreation.
3 = Body-contact recreation and aesthetic enjoyment slightly impaired
4 = Recreational potential and level of enjoyment of the stream substantially reduced (would not swim but boating/unocing is okay)
5 = Swimming and aesthetic enjoyment of the stream nearly impossible

**STREAM CONDITION**
N=Normal, L=Low, H=High / SW=Swift, S=Slow, MO=Moderate / C=Clear, M=Muddy, O=Other

**STREAM FLOW (cfs)**
Note in Field Observations if stream flow was determined by direct measurement, rating curve, L&D gate rating or other.

**SAMPLING DEVICE**

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>STORET CONFIG ID</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM</td>
<td>SIMPLE</td>
<td>Simple Open Plastic Bucket</td>
</tr>
<tr>
<td>ROD</td>
<td>ROD</td>
<td>Telescoping Rod with Bottle</td>
</tr>
<tr>
<td>IICE1</td>
<td>ICE 1</td>
<td>Ice Conditions Water Sampler (straight rod with bottle attached to lower through ice)</td>
</tr>
<tr>
<td>DI</td>
<td></td>
<td>Depth Integrating (USGS type)</td>
</tr>
<tr>
<td>WB</td>
<td>WEIGHTED</td>
<td>Weighted Bucket with Cover (aka triple sampler, &quot;subline&quot;)</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>Another type of sampler (describe in notes)</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td>Sample collected directly into sample bottle</td>
</tr>
<tr>
<td>AS</td>
<td></td>
<td>Automatic Sampler</td>
</tr>
</tbody>
</table>

**SAMPLE TYPE**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab</td>
<td>Sampling vessel or bottle filled at one point in water column and cross section of a waterbody</td>
</tr>
<tr>
<td>Composite-F</td>
<td>Flow-weighted with auto-sampler</td>
</tr>
<tr>
<td>Composite-M</td>
<td>Samples from multiple locations on a waterbody, combined w/churn splitter (describe in comments)</td>
</tr>
<tr>
<td>Composite-O</td>
<td>Composite O Other (describe in comments)</td>
</tr>
</tbody>
</table>
Example lake monitoring field sheet
Example habitat assessment field sheet (p. 1)

### Habitat Assessment Field Data Sheet

<table>
<thead>
<tr>
<th>Site (include county)</th>
<th>Site Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigator</td>
<td>Date Time</td>
</tr>
<tr>
<td>Local Coordinator/Organization</td>
<td>GPS Coordinates</td>
</tr>
<tr>
<td>Yes No</td>
<td></td>
</tr>
</tbody>
</table>

#### Weather
- In past 24 hours:
  - Storm (heavy rain)
  - Rain (steady)
  - Showers (intermittent)
  - Overcast
  - Clear/Sunny
- Now:
  - Storm (heavy rain)
  - Rain (steady)
  - Showers (intermittent)
  - Overcast
  - Clear/Sunny

#### Temperature Readings
- Water temperature:
- Air temperature:

#### Type of Sampling
- Rock bottom
- Muddy bottom

#### Water Appearance
- Clear
- Blue-green
- Green
- Brown
- Milky
- Yellow

#### Water Odor
- None
- Musty
- Septic
- Fishy
- Rotten eggs

#### Local Land Use
- Residential
- Paved roads or bridges
- Commercial
- Unpaved roads
- Agricultural
- Construction
- Natural/Preserve
- Recreational use
- Lawns
- Industry
- Wooded
- Land fill
- Crop land
- Waste treatment plant
- Grazing land
- Evidence of past alteration
- Feed lot

**Note:** Conduct all habitat assessments in the field. Complete all data sheets before leaving the site.
Habitat Assessment  Field Data Sheet

SKETCH OF SITE
On your sketch, note features that affect stream habitat, such as: riffles, runs, pools, ditches, wetlands, dams, riprap, outfalls, tributaries, landscape features, vegetation, and roads. Include all pipes draining directly into the stream and indicate direction of flow.

FIELD NOTES
Include notable observations such as any major landscape changes (including construction projects, bridge projects, etc.) upstream or adjacent to your site.
## Minnesota Citizen Wetland Vegetation Survey Field Sheet

### Observer:  
Site Name:  
Date:  

Local Survey Sponsor (a city, county, watershed etc.):  

**Relevé dimensions** (circle one):  
10m x 10m  
5m x 20m  
100 meters  

**Water depth in plot (meters):**  
Shallowest: ______ meters  
Deepest: ______ meters  

Is the relevé typical of the entire wetland plant community?  
(circle one; if no explain in Remarks)  
Remarks: yes  
no  

Describe any abrupt drop-offs or shelves on the wetland bottom in the Remarks section.  
Remarks:  

Sketch the location of your sample plot on the Site Sketch Sheet form or on the back of this sheet.  
Please note: Numbers in ( ) refer to the metric(s) where the respective data is used.  

### Useful Tools for Monitoring

#### FORBS (1, 5, 6, 7)

<table>
<thead>
<tr>
<th>CC</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergent/Erect (1, 7)</td>
<td></td>
</tr>
<tr>
<td>Submerged or Floating (1, 6)</td>
<td></td>
</tr>
<tr>
<td>Bladderwort (Utricularia) (1, 5, 6)</td>
<td></td>
</tr>
</tbody>
</table>

#### GRASSLIKE (1, 3, 4, 7)

<table>
<thead>
<tr>
<th>CC</th>
<th>Grasses &amp; Rushes (1, 3, 7)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedges (Carex) (1, 3, 4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### WOODY (1, 6)

<table>
<thead>
<tr>
<th>CC</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear-leaved Willow (include only those willows in water or right adjacent to water so they always have wet feet!) (6)</td>
<td></td>
</tr>
</tbody>
</table>

#### Cover Value  
Cover class (CC) estimate

<table>
<thead>
<tr>
<th>Cover Value</th>
<th>Cover class (CC) estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>75% – 100% complete or nearly complete cover</td>
</tr>
<tr>
<td>4</td>
<td>50% – 75% large group, definitely more than 50% cover</td>
</tr>
<tr>
<td>3</td>
<td>25% – 50% small group of plants, near 50% cover</td>
</tr>
<tr>
<td>2</td>
<td>5% – 25% plant is common in plot, more than 5% cover</td>
</tr>
<tr>
<td>1</td>
<td>1% – 5% plant is established well, but minimal cover</td>
</tr>
<tr>
<td>0.5</td>
<td>&lt; 1% plant is rare, insignificant cover</td>
</tr>
</tbody>
</table>

#### Selected Remarks Code

- DD: dead  
- DY: dying  
- SP: sprout/seedling  
- IN: insect damage  
- L: leaf spots  
- L:D: leaves discolored  

---

QUALITY ASSURANCE PROJECT PLAN
for
Southern Red River Basin Surface Water
Nutrient Loading Assessment Project

Prepared for:
Ms. Sarah Lehmann
EPA Monitoring Coordinator
USEPA, Region 5 Water Division
Water Quality Branch
77 W. Jackson Blvd. (WQ-16J)
Chicago, IL 60604-3590

Prepared by:
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August 2002
Example QAPP for project involving volunteer monitoring (p.2)

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<tr>
<th>Name</th>
<th>Title/Affiliation</th>
<th>Address</th>
<th>Phone/e-mail</th>
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<tbody>
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</tbody>
</table>
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GROUP A  PROJECT MANAGEMENT

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<tr>
<td>Goeken</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Vavricka</td>
<td>QA Officer</td>
</tr>
<tr>
<td>Goeken</td>
<td>Field Sampling Leader, water quality</td>
</tr>
<tr>
<td>S. Lehmann</td>
<td>Lab Manager Leader</td>
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</tbody>
</table>

A5  PROBLEM DEFINITION/BACKGROUND

This project establishes a flow-weighted assessment of the Bois de Sioux, Buffalo-Red and Wild Rice River watersheds of the upper Red River Basin. These watersheds represent the main sources of the Red River of the North and provide drinking water for the cities of Fargo, N.D. and Moorhead, MN. Seventeen river reaches in these watersheds have been identified as impaired according to Section 303(D) of the Clean Water Act. Moreover, water quality monitoring information is extremely limited. This project uses existing resources from local government, including watershed districts, soil and water conservation districts, county planning and schools, to establish a locally based water quality monitoring network. Locals will establish sites, evaluate conditions and collect field samples of dissolved oxygen, conductivity, temperature and pH. They will also collect samples for lab analysis. This information will be used by local and state resource managers to establish trends, design water resource management project and evaluate the performance of mitigation measures.

The Bois de Sioux - Mustinka Rivers Watersheds represent an area of about 1,420 square miles, including areas of Traverse County (38% of the watershed), Grant County (27%), Wilkin County (14%), Stevens County (10%), Big Stone County (7%), and Otter Tail County (4%). The watershed includes the drainage basins of Lake Traverse and the Bois de Sioux River. Where the Bois de Sioux River and the Otter Tail River join is considered the headwaters of the Red River Basin. The major tributaries of the watershed include: the Mustinka River, numerous creeks in the south and east portions of the watershed, and the Rabbit River in the northern portion of the watershed (described below).

Generally, the topography of the subbasin has little relief. A near-level glacial lake plain covers most of the western portion, and the eastern portion is characterized by gently rolling glaciated uplands. Between the rolling hills and the flat plain is the transition zone composed of a series of ridges with moderate slopes that are the former beach ridges of glacial Lake Agassiz.

Three different ecoregions are included in the watershed: The Red River Valley ecoregion, the Northern Glaciated Plains Ecoregion and the North Central Hardwood Forests ecoregion.

The Red River Valley ecoregion encompasses most of the watershed in the north, central and western portions of the watershed. The Northern Glaciated Plains ecoregion is found in the southern and eastern portion of the watershed. The northeastern portion of the watershed includes a small area of the North Central Hardwood Forests ecoregion.

The majority of glacial deposits in the watershed are till, made up of clay, silt, sand and gravel. Soils are predominantly black, loamy and clayey in the central portion of the watershed, with black, loamy soils in the southwest and eastern portions of the watershed.

Historically, prairie/grassland (78%) and wetland (17%) were the dominant landcover types. As a result of the fertile soils that are present, land use and cover in the watershed is now dominated by cropland (88%), while prairie/grassland and wetlands provide only 2% and 4% of the current land cover, respectively. Land cover in the riparian areas (1,000 feet on either side of rivers) of the
watershed are mainly cultivated land (78%) and wetland (12%). Primarily to accommodate agriculture, the central portion of the watershed has been extensively drained.

The Mustinka River is the largest tributary to the Bois de Sioux River. The Mustinka River sub-watershed comprises 850 square miles (over one-half of the total area of Bois de Sioux Watershed). The Mustinka River sub-watershed itself occupies the upper most portion of the Red River Basin. The Mustinka River sub-watershed is typified by extremely flat gradients (with the exception of the glacial moraine portion in the east) which seldom exceed 0.5 feet or drop per mile. The soils within the watershed are generally heavy clays that when tilled are subject to wind and water erosion. The land use within the subwatershed is predominately agricultural. The Mustinka River and its watershed provide the largest portion of the hydraulic budget for Lake Traverse. Lake Traverse is a large reservoir (12th largest lake in Minnesota) which is management by the Army Corps of Engineers for flood control purposes. Water Quality sampling data collected in the mid 1990’s as part of a Clean Water Partnership Phase I Diagnostic for the Lake study characterized Lake Traverse as a hyper-eutrophic lake with very high concentrations of total suspended solids and phosphorus. During that period inflows from the Mustinka River and its tributaries to the lake often exceeded concentrations of 250ug/l for phosphorus. Thus suggesting that inflows to Lake Traverse from the Mustinka River watershed system are leading contributors to the nutrification of the lake.

The main channel of the Bois de Sioux River was modified during the construction of the Reservation and White Rock Dams at Lake Traverse and Mud Lake to help improve the flow of water to the north. The Corps of Engineers built the Lake Traverse and Bois de Sioux River project from 1939 to 1941. It provided for use of Lake Traverse and Mud Lake as flood control and water conservation reservoirs and for channel modification in the river below the lakes (extending 24 miles below the main dam). In 1958, the Corps of Engineers completed a project on the Mustinka River near Wheaton, which consisted of 36.1 miles of straightening, clearing and enlarging of the Mustinka River and its tributaries.

The Bois de Sioux watershed contributes 58,200-acre feet to the Red River annually, less than 1 percent of the volume contributed from Minnesota tributaries. Flood damage is a major concern. Annual average flood damage (in 1996 dollars) in the watershed is estimated at $1,103,488 with 98% of the damages being rural. The Bois de Sioux watershed suffers 5.5% of flood damages occurring in the Red River Basin, outside of damages occurring along the main stem of the Red River.

The Bois de Sioux Watershed District oversees water management in the watershed, which has been in existence since 1988. Also, the U.S. Army Corps of Engineers oversees the operation of the outlet of Lake Traverse and is responsible for controlling lake levels.

The Rabbit River Watershed has a total drainage area of 320 square miles. It flows westerly from Upper Lightning Lake in SW Ottertail County, and Stony, Ash and Mud Lakes in NW Grant County. It has three major branches, from the northeast, from due east, a ditch from the Stony and Ash Lake area, and the South Fork which generally lies west of Highway 9; the northeast and east branches join just inside Wilkin County; the two main branches met west of Campbell. County Ditch Two flows north to the River east of Campbell and north of Tintah; Judicial Ditch 12 is a major tributary running parallel to Highway 9 and joining the main branch of the river, upstream of the South Fork, at Campbell. The drainage is very complex and it is difficult to discern the boundary between the Mustinka’s watershed to the south and the Otter Tail’s to the north.

The 1994 stream water quality assessment for the Bois de Sioux subbasin showed the Rabbit River to be impaired. Non-point sources adversely affecting dissolved oxygen, ammonia, nitrogen, high pH, fecal coliform suspended solids,
nutrient levels, biological oxygen demand and agricultural chemicals are causing eutrophication, sedimentation, toxicity and turbidity.

The survey reported the Mastinka River to be impaired. Local resource managers cited crop production, feedlots, livestock holding, agricultural chemicals, streambank modification, storm sewers, and urban runoff as causing oxygen depletion, eutrophication, bacterial contamination, sedimentation, and toxicity due to pesticides, turbidity, and habitat alteration.

The Buffalo River Watershed represents an area of about 1,189 square miles, including areas of Clay, Becker, Otter Tail and Wilkin Counties. It is the drainage basin of the headwaters of the Red River. The major tributaries of the watershed include the Buffalo River (and its tributaries, including the South Branch of the Buffalo River; and Whiskey, Deerhorn, Stoney and Hay Creeks) and Wolverton Creek -- both direct tributaries to the Red River. The Buffalo River originates in Tamarac Lake in Becker County.

The Whiskey Creek watershed drains an area of approximately 300 square miles lying exclusively in the lakebed region of the Red River Basin, characterized by level deposits of sediments up to 80 feet in thickness. This subwatershed is intensively drained by drainage ditches. The 1994 water quality assessment survey reported that crop production, livestock holding, and agricultural chemicals cause oxygen depletion, sedimentation and turbidity.

Two ecoregions comprise the watershed. The southern and western portion of the watershed lies in the Red River Valley ecoregion. The eastern portion of the basin lies in the North Central Hardwood Forest ecoregion.

Glacial deposits in the western portion of the watershed are glacial lake deposits of clay and silt from Glacial Lake Agassiz, and glacial lakeshore deposits of delta sand and gravel, along with areas of beach sand ridges separated by silty wetland depressions. The eastern portion of the watershed has primarily till glacial deposits made up of clay, silt, sand, gravel, cobble and boulders. Soils in the watershed vary moving from west to east from clayey soils of the lake plain at the mouth of the watershed, to black, limey, clayey soils; sandy soils; black, loamy soils; loamy soils and rolling wooded soils in the very uplands of the watershed.

Historic land cover in the watershed was primarily prairie/grassland (73%), wetland (14%), and forest (10%). Currently, the dominant land use is cropland (77%) with prairie/grassland having been reduced to 4% of land cover, wetlands having been reduced to 7%, and forests having been reduced to 6%. Land cover in the riparian areas (1,000 feet on either side of rivers) of the watershed is mainly cropland (67%) and wetland (15%). Primarily for agricultural purposes, wetlands have been extensively drained in the southern portion of the watershed.

A buried sand aquifer, the Buffalo aquifer, containing large amounts of ground water underlies the watershed near its mouth. Smaller quantities of ground water are available throughout the rest of the basin. An average of 2,700 acre-feet per year of ground water is pumped for municipal water supplies and crop irrigation. Ground water recharge occurs in the moraine area, while discharge occurs to the Red River, the Buffalo River and the glacial lake plain.

Nearly 300 streams miles assessed for aquatic life in 1996 found only 39 miles fully supporting aquatic life; 108 miles did not support aquatic life, and 120 miles were threatened or partially supported aquatic life. The MPCA assessed 152 stream miles for swimming in the same year and found that all monitored stream miles partially supported or did not support swimming.

Since much of the watershed lies in the Red River Valley, it is prone to flooding. Annual average flood damage (in 1996 dollars) in the watershed is estimated at $2,705,710 and is 99.5% rural damage. The watershed suffers 13.6% of flood damages occurring in the Red River Basin, outside of damages occurring along the main stem of the Red River.

The Buffalo River Watershed District oversees water management in the watershed, and has been in existence since 1960.

The Wild Rice River subbasin occupies 2080 square miles in portions of Norman, Mahnomen, Polk, Clearwater, Clay, and Becker Counties in northwestern Minnesota. The upland areas in the east are gently undulating to rugged and are covered by forests, grasslands, agriculture, and fairly large lakes. The uplands give way to an extensive beach ridge area that is mainly agricultural, but contains grassland, some lightly forested areas, and small lakes. Below the beach
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The Wild Rice River begins at Mud Lake above Lower Rice Lake in a rugged, heavily forested area of Clearwater County. It flows west through a series of Lake Agassiz beach ridges where it drops in elevation quite rapidly and then flows across the flat Lake Agassiz lake plain before it joins with the Red River of the North. Channel gradients change from drops in elevation of 10 to 30 feet per mile in the eastern portion to 1 to 2 feet per mile in the western portion. The other major tributary in the subbasin is the Marsh River, which originates just east of Ada, Minnesota. Channel changes, ditch improvements, and a diversion structure constructed at various times since the late 1800s have diverted part of the flow of the Wild Rice River to the Marsh River north and west of Ada. Some of the tributaries of the Wild Rice River are the White Earth River, Marsh Creek, South Branch Wild Rice River, Felton Ditch, Moccasin Creek, Spring Creek, Mushaung Creek, and Coon Creek. The major tributary to the Marsh River is the Spring Creek drainage area.

The 1994 water quality assessment reported that monitoring of the Wild Rice River from the mouth of Marsh Creek down to the mouth of the South Branch revealed use impairment. Nonpoint sources adversely affecting high pH, fecal coliform, suspended solids, ammonia, and nutrient levels result in nonsupport of aquatic life and overall uses and partial support of agriculture, wildlife, and swimming. The assessment survey reported impairment of the segment downstream from the South Branch confluence, on a small segment downstream from Lower Rice Lake and on both Marsh Creek and the Marsh River. The survey judged the segment of the Wild Rice River above Lower Rice Lake and from the downstream end of the short impaired segment through the City of Mahnomen to be threatened. Local resource managers cited crop production, pasture land use, feedlots, agricultural chemicals, septic systems, storm sewers, channelization, and dredging as causing oxygen depletion, sedimentation, toxicity, and turbidity. The survey also reported the White Earth River to have threatened quality. Local resource managers cited crop production, pasture land use, feedlots, livestock holding, agricultural chemicals, land development, septic systems, removal of riparian vegetation, and streambank modification as causing oxygen depletion, sedimentation, toxicity, and turbidity.

In 1999, the Wild Rice Watershed District (WRWD) published its Water Quality Management Plan. This plan was developed by dividing the watershed into fourteen river reaches that corresponded with major tributaries. Each subwatershed was evaluated using metrics or measures of water quality, including:

- Potential sediment yield.
- Past exceedances of surface water quality standards.
- Past exceedances of fecal coliform bacteria standards for surface water.
- The presence of timber production.
- The percentage of land under cultivation.
- Estimated acreage with potential to be converted from permanent cover to cultivation.
- Index of biotic integrity.
- Stream stability and bank erosion.
- Feedlots.
- Presence of barriers to fish migration.
- Identified point sources.
- The condition of the stream riparian area.
- The condition of the drainage system riparian area.

Data were gathered for each metric and totaled for each river reach. “Weight” or ranking assignments of low, medium, and high were identified for each metric, and the data were used to rank each river reach for implementation priorities based on the ranking assignments. A number of
specific strategies were then recommended to address problems found in subwatersheds. Implementation goals of this plan are:

- Understanding and making accessible existing water quality data.
- Identifying specific regions and water resources within the basin that are of public concern.
- Analyzing and interpreting the existing data and applying the results to the identified regions and water resources.
- Prioritizing the regions and water resources based on existing data and levels of public concern.

The WRWD is now developing a program of ambient water quality monitoring to develop a baseline of water quality for the subwatersheds of the Wild Rice Watershed and to evaluate progress in implementing and achieving the goals of the water quality management plan.

A6 PROJECT AND TASK DESCRIPTION

Red River Basin Water Monitoring Program personnel in conjunction with staff from the Bois de Sioux and Buffalo-Red Watershed Districts, Clay County SWCD, and teachers and students from the participating schools based in Climax, Hawley, Barnesville, Breckenridge, Campbell, Herman, Wheaton, and Graceville, will collect water samples once a month at a total of 40 sites located throughout the southern portion of the Red River Basin. Water samples will begin to be sent to the EPA Region V lab analytical laboratory in Chicago during the third week of August 2002 and continue through November of 2002. The samples will be packaged and shipped according to EPA standards to the EPA Region V lab for analysis of total phosphorus, ammonia, nitrate, total suspended solids and total dissolved solids. In addition, sampling personnel will collect and record ambient water quality information, including temperature, pH, dissolved oxygen (DO), turbidity, and conductivity during the course of the sampling period. In order to develop loading estimates from the various sources that will be sampled, flow data will be collected from existing USGS gaging stations where available. Flow will be calculated at those sampling sites for which there is no gaging station using velocity measurements in conjunction with the cross-sectional area of the stream through a defined structure, e.g., a culvert. Data generated by the project will be reviewed by the MPCA prior to being input into the national EPA STORET database. Project results will be incorporated into the water quality database being established for the Red River Basin. Table 1 provides a general milestone chart for the assessment.

<table>
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<th>TABLE 1. Project/Task Organization</th>
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<td>x</td>
<td>x</td>
<td></td>
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A7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

This assessment is exploratory and will focus on evaluating baseline ambient water quality parameters and nutrient loads strategically by watershed and subwatershed in the Bois de Sioux, Otter Tail, Buffalo-Red, and Sand Hill watersheds with primary emphasis on sites in the Red River Valley ecoregion. Therefore, data quality objectives will be targeted as such. The data generated from this assessment will be treated as “screening” level data only. Data for all variables will be compared with historic data where available, to determine how well they agree with previous analytical techniques and results. One field duplicate sample and one field blank will be collected per 10 samples collected to evaluate field-sampling precision and quality control. For the 40 samples being collected this will equate into 4 sets of duplicate and field blanks collected per month which will be rotated equally among the eight schools involved in this monitoring program.

Water quality is an ongoing concern throughout the Red River Basin with special concerns in the southern portion of the basin due to a relative lack of current or historic water quality data from which to assess current conditions and base resource management decisions on. This nutrient assessment is intended to determine the relative contribution from subwatersheds of sediments and nutrients to the main stems of the Bois de Sioux, Otter Tail, Buffalo, and Sand Hill Rivers and, ultimately, these river’s like contributions to the Red River of the North. MPCA staff has established ecoregion expectations for water quality of the state (see Table 2 for ecoregion water quality expectations for northwest Minnesota). These expectations will be used, where they have been identified, to evaluate results of monitoring. One site in the southernmost portion of the project area being monitored by the Graceville school is in the Northern Glaciated Plains ecoregion with the other sites monitored by this school being on the border between the NGP ecoregion and the Red River Valley ecoregion. Otherwise all other sites being assessed by this monitoring program lie within the Red River Valley ecoregion. These two ecoregions are characterized as follows:

- Red River Valley (RRV) Relatively flat; fine or clay soils dominate. Low population density. Heavily cultivated in small grains. Land use changes have increased suspended sediments (turbidity). Located in the western portion of watersheds throughout the Red River Basin.
- Northern Glaciated Plains (NGP) Flat with silty soils; population density equals 19 people per square mile; agriculture is more than 83% of land use, predominately corn and soybeans; about 11% pasture and open land. Only found in the extreme southern tip of the Red River Basin.

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<th>Turbidity, NTU1</th>
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<th>Conductivity, mS/cm</th>
<th>pH</th>
<th>Dissolved Oxygen mg/L</th>
<th>Ammonia N mg/L</th>
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<td>5</td>
<td>0.2</td>
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1. Nephelometric turbidity unit.
Although there are no anticipated legal issues or requirements at stake concerning this nutrient assessment, the data collected will be used to establish baseline water quality conditions for the principal surface water courses. The parameters identified in the project task and description will be consistently sampled for the period of performance defined above. The completeness of this data set is expected to range from 80% to 90%. Laboratory precision and accuracy are addressed below, along with data acceptability levels.

A8 DOCUMENTATION AND RECORDS

This monitoring plan will be retained in the Red River Watershed Management Board’s Monitoring Coordinator’s office (RRWMB) and at the Detroit Lakes Regional MPCA Environmental Outcomes office. Water quality data will be transmitted to MPCA for review and entry into the national STORET database.

GROUP B – MEASUREMENT/DATA ACQUISITION

B1 SAMPLING PROCESS DESIGN

All samples to be collected for the Red River Mid-Basin surface water nutrient assessment will follow the EPA Region V Minimum Requirements for Field Sampling Activities (September 1996). Water samples will be collected for lab analysis of total phosphorus, ammonia N, nitrate N, TSS, and TDS. Field measurements will be taken for temperature, pH, DO, turbidity, and conductivity. Transparency tube and general site observations will also be recorded at all sites along with GPS coordinates if not already collected. Locations to be sampled and gaging status are identified in Table 3. Flow data will be collected from existing gaging stations where available. Flow will be calculated at those sampling sites for which there is no gaging station using velocity measurements in conjunction with the cross-sectional area of the stream through a defined structure, e.g., a culvert. These sampling sites were selected because of representativeness of the watershed or subwatershed and ease of access via bridges. Samples will be collected and velocity measurements taken at 60% of the depth below the surface at each sampling site to obtain a representative sample. Water depth and 60% depth will be determined by use of a weighted tape measure.

TABLE 3. Southern Red River Basin Sampling Site Locations and Descriptions

<table>
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<tr>
<th>Site Name</th>
<th>Water Body</th>
<th>School</th>
<th>Site Location Description</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Gaging</th>
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<td>Graceville</td>
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<td>SG</td>
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<td>SG</td>
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<tr>
<td>BdS 15</td>
<td>12 Mile Cr.-W,Fk</td>
<td>Graceville</td>
<td>3 miles S. of Dumont; 4.7 miles E</td>
<td></td>
<td></td>
<td>SG</td>
</tr>
<tr>
<td>BdS 16</td>
<td>12 Mile Cr.-E,Br</td>
<td>Wheaton</td>
<td>Approx. 3.4 miles E. of Dumont on CR 6</td>
<td></td>
<td></td>
<td>SG</td>
</tr>
<tr>
<td>BdS 5</td>
<td>12 Mile Cr-M</td>
<td>Wheaton</td>
<td>Approx. 7.4 miles NE of Wheaton on CR 14</td>
<td></td>
<td></td>
<td>SG</td>
</tr>
<tr>
<td>BdS 34</td>
<td>12 Mile Cr.-W,Br</td>
<td>Wheaton</td>
<td>Approx. 0.25 mile E. of Dumont on CR 6</td>
<td></td>
<td></td>
<td>SG</td>
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<tr>
<td>BdS 23</td>
<td>5 Mile Cr</td>
<td>Herman</td>
<td>Approx. 5.7 miles W. of Herman on MN 27</td>
<td></td>
<td></td>
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</tbody>
</table>
### USEFUL TOOLS FOR MONITORING

**Example QAPP for project involving volunteer monitoring (p.10)**

<table>
<thead>
<tr>
<th>Site</th>
<th>Location Description</th>
<th>Coordinates</th>
<th>Map Code</th>
</tr>
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<tr>
<td>Tyler</td>
<td>Bois de Sioux R, Breckenridge</td>
<td>46.15194, -96.57930</td>
<td>MD</td>
</tr>
<tr>
<td>BdS26</td>
<td>Bois de Sioux R, Campbell</td>
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<tr>
<td>BdS LkTr</td>
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<td>45.76908, -96.63915</td>
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<td>BdS5W</td>
<td>Bois de Sioux R, Wheaton</td>
<td></td>
<td>SG &amp; USGS</td>
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<tr>
<td>RockN</td>
<td>8 miles N of Wheaton and 4 miles W on CR 16</td>
<td></td>
<td>MD</td>
</tr>
<tr>
<td>BuffMN9</td>
<td>Buffalo R, Hawley</td>
<td>46.87956, -96.50530</td>
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</tr>
<tr>
<td>Cederberg</td>
<td>Buffalo R, Hawley</td>
<td></td>
<td>USGS</td>
</tr>
<tr>
<td>Hsw31</td>
<td>Buffalo R, Hawley</td>
<td>46.85590, -96.32318</td>
<td>MD</td>
</tr>
<tr>
<td>ManJct</td>
<td>Buffalo R, Hawley</td>
<td>46.90472, -96.24523</td>
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</tr>
<tr>
<td>Muskoda</td>
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<tr>
<td>DeerHW</td>
<td>Deer Horn Cr, Barnesville</td>
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<td>BdS 11</td>
<td>Grant CD 8, Herman</td>
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<td>BdS 30</td>
<td>Judicial Ditch 12, Campbell</td>
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<td>BdS 31</td>
<td>Judicial Ditch 2, Campbell</td>
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<td>SG</td>
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<tr>
<td>BdS 33 P</td>
<td>Mustinka R, Herman</td>
<td></td>
<td>SG</td>
</tr>
<tr>
<td>BdS 28</td>
<td>Rabbit R, Campbell</td>
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<td>SG</td>
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<tr>
<td>Brushwa</td>
<td>Red R, Breckenridge</td>
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<tr>
<td>Red 210By</td>
<td>Red R, Breckenridge</td>
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<td>MD</td>
</tr>
<tr>
<td>Climax</td>
<td>Red R, Sand Hill R, Climax</td>
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<td>MD</td>
</tr>
<tr>
<td>CL1</td>
<td></td>
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<tr>
<td>Climax</td>
<td>Sand Hill R, Climax</td>
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<td>CL5</td>
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<tr>
<td>WhiskyE</td>
<td>Red R, Whisky Cr, Barnesville</td>
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<tr>
<td>BuTrout</td>
<td>Red R, BuTrout</td>
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</tr>
<tr>
<td>Wilco CD</td>
<td>Red R, Wilco CD</td>
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<td>MD</td>
</tr>
</tbody>
</table>

*Gaging: SG=staff gage, USGS=U.S. Geological Survey; MD=Measure Down*
B2 SAMPLING METHODS REQUIREMENTS

Water quality samples will be collected using a Kemmerer or beta-bottle sampler. The sampler will be rinsed three times with the given source water before samples are taken. Clean 1-liter polyethylene bottles will be used as sample containers for shipment to the analytical laboratory. All samples will be preserved as necessary, tagged, and logged on EPA chain-of-custody forms. Table 4 outlines the necessary preservation techniques for each sample and also includes container types, analytical methods, reporting limits, and holding times. Field measurements, including water depth, pH, DO, temperature, conductivity, transparency tube, and site observations will be taken at each sampling location. The water temperature, pH, conductivity, and dissolved oxygen will be measured by use of a YSI 600QS multi-parameter probe. Turbidity will be measured by use of a Hach 2100P turbidimeter. When necessary, stream velocity will be measured by a USGS Type AA current meter. Field measurements will be recorded on data sheets and placed in a field notebook, and probes will be rinsed with deionized water between sampling locations. Table 5 describes the quality control (QC) checks maintained for nutrient sampling.

### TABLE 4. Parameters Analyzed from Wild Rice River Surface Nutrient Assessment Project

<table>
<thead>
<tr>
<th>Parameter, units</th>
<th>Method</th>
<th>Container and Preservative</th>
<th>Holding Time</th>
<th>Required Reporting Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH₃-N, mg N/L</td>
<td>EPA 350.1</td>
<td>1 L HDPE, H₂SO₄ to pH 2, 4°C</td>
<td>28 days</td>
<td>0.1 mg N/L</td>
</tr>
<tr>
<td>NO₃-N, mg N/L</td>
<td>EPA 353.2DNS</td>
<td>1 L HDPE, H₂SO₄ to pH 2, 4°C</td>
<td>28 days</td>
<td>0.05 mg N/L</td>
</tr>
<tr>
<td>P, mg/L</td>
<td>EPA 365.4</td>
<td>1 L HDPE, H₂SO₄ to pH 2, 4°C</td>
<td>28 days</td>
<td>0.05 mg P/L</td>
</tr>
<tr>
<td>TSS, mg/L</td>
<td>EPA 160.2NS</td>
<td>1 L HDPE, Unpreserved, 4°C</td>
<td>7 days</td>
<td>5 mg/L</td>
</tr>
<tr>
<td>TDS, mg/L</td>
<td>EPA 160.1</td>
<td>1 L HDPE, Unpreserved, 4°C</td>
<td>7 days</td>
<td>5 mg/L</td>
</tr>
</tbody>
</table>

### TABLE 5. Quality Control Checks for Nutrient Samples

<table>
<thead>
<tr>
<th>QC Check (Symbol)</th>
<th>Explanation</th>
<th>Run Frequency</th>
<th>Acceptance Criteria</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Control Sample (ICV)¹</td>
<td>Preferably out-of-house, critiqued standard or else a standard from different lot than calibration standards</td>
<td>Beginning of run to verify calibration</td>
<td>Historical data or 90%–110% of &quot;true&quot; value</td>
<td>Restandardize and rerun ICV</td>
</tr>
<tr>
<td>Continuing Calibration Verification (CCV)</td>
<td>Approximate midrange standard made from working standards stock</td>
<td>Every 20 samples and at end of run</td>
<td>Historical data or 90%–110% of &quot;true&quot; value</td>
<td>Restandardize and rerun all samples from last &quot;acceptable&quot; QC or check sample</td>
</tr>
</tbody>
</table>
### B3 SAMPLE-HANDLING AND CUSTODY REQUIREMENTS

Chain-of-custody procedures will follow those listed in the EPA Region V Central Research Laboratory (CRL) SOP. Wayne Goeken and/or a trained designee will be the field sample custodian and will keep records of all samples taken by field personnel. Sample bottles will be labeled with bottle number, site identification, date, and time; preservative added as needed; sealed tightly; and packed in ice at the sampling location. A chain-of-custody record including project name, sampler's signature, unique field station identification sample numbers, parameters for analysis, matrix, number and size of containers, date/time, and appropriate signatures will accompany all samples. All laboratory samples will be shipped to the EPA Region V CRL custodian within 48 hours of collection. Coolers containing samples that require ice preservation will be checked daily before shipping to ensure temperatures do not exceed 4°C.

### B4 ANALYTICAL METHODS REQUIREMENTS

Analytical methods for water samples are listed in Table 4. Methods for field measurement of pH, conductivity, temperature, turbidity, and DO will follow the EPA Chemistry Methods Manual, 1983; Standard Methods for the Examination of Water and Wastewater, 19th edition; or the EPA Region V Minimum Requirements for Field Sampling Activities, 1996.

### B5 QUALITY CONTROL REQUIREMENTS

One field QC sample set for laboratory analyses, including a field blank for each sample type (unpreserved and H2SO4 preserved) and a grab sample duplicate, will be collected for every ten locations sampled following the grab sample collection protocol described in A7. The field blanks will be used to determine whether sampling procedures introduce contaminants in the field. Field duplicates for laboratory analyses will also be collected to determine whether duplicate grab samples produce consistent results.
Acceptance criteria for field QC samples will follow those for laboratory blanks (PQL) and duplicates (20% RSD). Laboratory personnel will notify the field sample custodian as soon as possible if field QC samples do not meet acceptance criteria. If QC samples reveal a sampling or analytical problem, field and laboratory personnel will troubleshoot the problem and attempt to identify the source of contamination or cause of failure. Upon working out a plausible solution, personnel will take necessary steps to ensure that similar problems do not arise during future sampling events. Data may need to be flagged and qualified depending upon the nature and extent of the contamination. Sarah Lehmanna, EPA Region V, will assist in the review of QC data and implementing corrective measures if deemed necessary.

**B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS**

All equipment will be inspected and tested each day prior to use in the field. All pH probes will be checked prior to calibration for breaks or low fluid levels. Membranes on DO probes will also be inspected routinely for air bubbles. Steps will be taken to fix any problems that are noted. If any probes are beyond repair, replacement probes will be conditioned for use. Expired pH buffer solutions will be replaced with new solutions prior to the initiation of the field-sampling trip. Batteries on all meters will be replaced when meters show power-related problems. Every meter will have at least one backup available for use at all times if major problems should occur. All upkeep procedures will be documented in the meter maintenance logs or the field notebook. Global positioning system (GPS) readings will not be taken at sampling locations until signals from at least four satellites are received.

**B7 INSTRUMENT CALIBRATION AND FREQUENCY**

Instruments used in this project are those commonly used in most water quality studies and are widely available. Calibration of the instruments will follow manufacturers’ instructions, and the calibration results will be recorded in the project log book. Electrodes for pH determinations will be calibrated with pH buffers bracketing the expected range of pH values of the ambient samples each day before tests are conducted. Thermometers used in the field will be checked with a standard calibrated thermometer that has been registered with the National Institute of Standards and Technology. Calibration of the multi-parameter YSI 600QS for pH, conductivity, and dissolved oxygen will be completed according to the manufacturer’s recommended procedures prior to sample collection. The flow velocity meter consists of mechanical parts that do not require calibration. An initial calibration check will be performed prior to the first sampling event following manufacturer recommendations. If a National Geodetic Survey (NGS) benchmark is available, GPS readings will be taken at the benchmark and will be compared to the surveyed values documented on the benchmark disc.

The precision and accuracy for each laboratory parameter produced by the analytical laboratory will be determined according to the laboratory’s SOPs and the EPA methods for chemical analysis of water and wastes. Precision for field measurements of pH, DO, conductivity, and temperature will be determined from statistical analysis of replicate data collection. Accuracy expressed as maximum error by instrument manufacturers is 0.2 for pH, 0.2 mg/L DO, 0.5% for conductivity, and 0.15 C for temperature. Precision will be determined from statistical analysis of replicate data collection.

Calibration procedures for nutrient analyses will be conducted according to manufacturer’s specifications and SOPs developed by the EPA Region V laboratory. Tables 4 and 5 list the QC protocols to be followed for all laboratory analyses.
GROUP C – ASSESSMENT/OVERSIGHT

C1 ASSESSMENT AND RESPONSE ACTIONS

Wayne Goeken, RRWMB, will be responsible for all field activities, reviewing the data, reporting to the group on findings, and forwarding all data to the appropriate state regulatory agency for inspection and input into STORET. He will oversee and assess field sampling and data collection activities a minimum of two times during the project duration to make sure that the samplers are following the QAPP and all standard procedures and quality control activities. Expected oversight dates are the initial sampling event and another event four to six weeks later. The EPA Project Officer and the EPA QA Staff are also authorized to oversee the field and laboratory activities during the period of this project.

C2 REPORTS

A draft report of the Southern Red River Basin (Minnesota) findings will be prepared for the RRWMB and shared with all involved watershed districts, local resource managers, and other involved parties.

GROUP D – DATA VALIDATION AND USABILITY

D1/D2 DATA VERIFICATION REQUIREMENTS AND USABILITY

All laboratory analytical results will be cross-checked against the field notebook, sample tags, and chain-of-custody documents to ensure that the raw, computer-generated summary of the laboratory analyses were correctly assigned to the corresponding sampling stations. All analytical results will be compared to the chain-of-custody documents to ensure that the data are complete. Laboratory QC data will be reviewed for all data to ensure that those data are usable. If any of the data are found outside of the QC limits identified in Tables 4 and 5, reanalysis of the samples may be requested.

Field data and field QC sample sets will be reviewed by Wayne Goeken, RRWMB, and Mike Vavricka, MPCA, to determine if data meet the QAPP objectives. In addition, Sarah Lehmann, EPA Region V, will assist in the data review. Data found outside of the QC limits identified in B5 may be flagged or rejected. Decisions to reject or qualify data will be made by Goeken and Vavricka.

D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Within 48 hours of receipt of results of each sampling event, calculations and determinations for precision, completeness, and accuracy will be made and corrective action implemented, if needed. If data quality indicators do not meet project specifications, data may be discarded and resampling may occur. The cause of failure will be evaluated. If the cause is found to be equipment failure, calibration/maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, team members will be retrained. Any limitations on data use will be detailed in any project-related reports and other documentation, as needed.
Sample Program Evaluation form

Please rate how well you feel your group is doing for each item by circling the appropriate number:

Organizational Health

Clear statement of purpose and objectives
poor - great
1 2 3 4 5

A written monitoring design to achieve the goals written down and agreed upon by all leaders
poor - great
1 2 3 4 5

A multiple year budget
poor - great
1 2 3 4 5

The monitoring component is related to the activities of the group or organization as a whole
poor - great
1 2 3 4 5

The program is evaluated annually and the work for the coming year adjusted accordingly
poor - great
1 2 3 4 5

A good mix of funding from various sources
poor - great
1 2 3 4 5

Clear financial management (clear, monthly financial statements, bookkeeper)
poor - great
1 2 3 4 5

Strong organizational leadership
poor - great
1 2 3 4 5
### USEFUL TOOLS FOR MONITORING

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Active board or advisory committee</td>
<td>great</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Clear staff and volunteer job descriptions</td>
<td>great</td>
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<tr>
<td>Overall organizational health</td>
<td>great</td>
<td></td>
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</tr>
<tr>
<td><strong>Community Support, Outreach, and Involvement</strong></td>
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<tr>
<td>Collaborative partnerships and networking (a broad base of groups, business, schools, agencies, individuals)</td>
<td>great</td>
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<tr>
<td>Good working relationship with local decision makers</td>
<td>great</td>
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<tr>
<td>Are visible in the community</td>
<td>great</td>
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<tr>
<td>Cultivates and receives media coverage</td>
<td>great</td>
<td></td>
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<tr>
<td>Have committed volunteers, with low turnover rates</td>
<td>great</td>
<td></td>
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<tr>
<td>Provides effective support and training for volunteers (recognition, training, opportunities for advancement, feedback)</td>
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<tr>
<td>Have a process for cultivating and training people for leadership roles</td>
<td>great</td>
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<tr>
<td>Overall effectiveness of community outreach</td>
<td>great</td>
<td></td>
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</tr>
</tbody>
</table>
Example QAPP for project involving volunteer monitoring (p.17)

Page 3

Monitoring Program

Do you have a technical advisory committee? (Y/N)_____ If so, how helpful has it been to your monitoring program?
poor ------------------ great
1---2---3---4---5

How well is the monitoring program integrated into other programs of your organization?
poor ------------------ great
1---2---3---4---5

Written study design that is used
poor ------------------ great
1---2---3---4---5

QA/QC plan approved by data users
poor ------------------ great
1---2---3---4---5

Clear, written manual for volunteers and training
poor ------------------ great
1---2---3---4---5

Clear data quality goals and users
poor ------------------ great
1---2---3---4---5

Good data management and reporting system
poor ------------------ great
1---2---3---4---5

Identified target users and uses for data
poor ------------------ great
1---2---3---4---5

Consistently meet data quality goals and requirements set forth in a QA Plan
poor ------------------ great
1---2---3---4---5

Involved local and regional resource people in data interpretation
poor ------------------ great
1---2---3---4---5

Presented data to interested parties and target users
poor ------------------ great
1---2---3---4---5

Target users accepted and used the data
poor ------------------ great
1---2---3---4---5

Page 4
Example QAPP for project involving volunteer monitoring (p.18)

Target users or your group used data to identify problems
poor ----------------------------- great
1---2---3---4---5

Target users or your group used data to identify actions or policy changes to solve problems
poor ----------------------------- great
1---2---3---4---5

Target users or your group used data to evaluate the effectiveness of actions or policy changes
poor ----------------------------- great
1---2---3---4---5

Made strides in achieving watershed improvement and program goals
poor ----------------------------- great
1---2---3---4---5

Impact on community
poor ----------------------------- great
1---2---3---4---5

Progress towards stated goals-vision
poor ----------------------------- great
1---2---3---4---5

Overall effectiveness of monitoring program
poor ----------------------------- great
1---2---3---4---5

Please describe any changes you are planning in your monitoring program within the next two years. For any areas above that you rated as a 3 or less, which ones would you like to address?