North Fork Mauvaise Terre Creek Watershed
Draft Stage 3 Report

Prepared for Illinois Environmental Protection Agency

April 2007

North Fork Mauvaise Terre Creek (IL_DDC): Manganese
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Attachment 2. Load Duration Curve Analysis for Manganese
INTRODUCTION

Section 303(d) of the 1972 Clean Water Act requires States to define impaired waters and identify them on a list, which is referred to as the 303(d) list. The State of Illinois recently issued the 2006 303(d) list, which is available on the web at: http://www.epa.state.il.us/water/tmdl/303d-list.html. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting designated uses under technology-based controls. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also takes into account a margin of safety, which reflects scientific uncertainty, as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of their water resources (USEPA, 1991).

North Fork Mauvaise Terre Creek (IL_DDC) is listed on the 2006 Illinois Section 303(d) List of Impaired Waters (IEPA, 2006) as a waterbody that is not meeting its designated use for support of aquatic life. This document presents a TMDL designed to allow this waterbody to fully support its designated uses. The report covers each step of the TMDL process and is organized as follows:

- Problem Identification
- Required TMDL Elements
- Watershed Characterization
- Description of Applicable Standards and Numeric Targets
- Development of Water Quality Model
- TMDL Development
- Public Participation and Involvement
- Adaptive Implementation Process
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1 PROBLEM IDENTIFICATION

North Fork Mauvaise Terre Creek has been identified in the 303 (d) list (ILEPA, 2006) as not supporting the aquatic life use due to manganese, dissolved oxygen deficits, total nitrogen and total suspended solids (IEPA, 2006). This report presents the manganese TMDL for this creek. Dissolved oxygen will be delisted as an impairment based on monitoring that was conducted in 2006.

While TMDLs are currently only being developed for pollutants that have numerical water quality standards, many controls that are implemented to address TMDLs for these pollutants will reduce other pollutants as well. For example, any controls to reduce manganese loads from watershed sources such as stream bank erosion would also serve to reduce total suspended solids loads to the river.

<table>
<thead>
<tr>
<th>North Fork Mauvaise Terre Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment Unit ID</td>
</tr>
<tr>
<td>Size (length)</td>
</tr>
<tr>
<td>Listed For</td>
</tr>
<tr>
<td>Use Support(^1)</td>
</tr>
</tbody>
</table>

\(^1\) F = fully supporting, N=not supporting, X = not assessed

\(^2\) Dissolved oxygen will be delisted.
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2 REQUIRED TMDL ELEMENTS

USEPA Region 5 guidance for TMDL development requires TMDLs to contain eleven specific components. Each of those components is summarized below.

1. **Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking:** North Fork Mauvaise Terre Creek, HUC 0713001104. The pollutant of concern addressed in this TMDL is manganese. Additional pollutants causing impairments include total nitrogen and total suspended solids; however, these pollutants will not be addressed at this time, as they do not have numerical water quality criteria. Soils naturally enriched in manganese are a potential source contributing to the listing of North Fork Mauvaise Terre Creek. North Fork Mauvaise Terre Creek is reported on the 2006 303(d) list as being in category 5, meaning available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed (IEPA, 2006).

2. **Description of Applicable Water Quality Standards and Numeric Water Quality Target:** The IEPA guidelines (IEPA, 2006) for identifying manganese as a cause of impairment in streams state that manganese is a potential cause of impairment of the aquatic life use if there is a single exceedance of the applicable numeric criteria for manganese. Public and food processing water supply is not listed as a designated use for the North Fork Mauvaise Terre Creek, thus the target is based on the water quality criterion for aquatic life. The TMDL target is a total manganese concentration of 1,000 µg/l.

3. **Loading Capacity – Linking Water Quality and Pollutant Sources:**

A load capacity calculation was completed to determine the maximum manganese loads that will maintain compliance with the total manganese standard under a range of flow conditions:

<table>
<thead>
<tr>
<th>North Fork Mauvaise Terre Creek (IL_DDC) Flow (cfs)</th>
<th>Manganese load capacity (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.4</td>
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<tr>
<td>3</td>
<td>16.2</td>
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<td>5</td>
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<td>53.9</td>
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<td>25</td>
<td>134.8</td>
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<tr>
<td>75</td>
<td>404.5</td>
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<tr>
<td>200</td>
<td>1078.7</td>
</tr>
<tr>
<td>500</td>
<td>2696.8</td>
</tr>
</tbody>
</table>

4. **Load Allocations (LA):** Load allocations designed to achieve compliance with the above TMDL are calculated by the following equation:

\[
\text{Load allocation} = \text{Load capacity} - \text{MOS} - \Sigma \text{WLAs}
\]
5. **Wasteload Allocations (WLA):** There are no permitted point source dischargers in the North Fork Mauvaise Terre Creek watershed, therefore the wasteload allocation does not need to be calculated.

6. **Margin of Safety:** The manganese TMDL contains an implicit and explicit Margin of Safety. An implicit Margin of Safety is provided via the use of a conservative model to define load capacity. The model assumes no loss of manganese that enters the creek, and therefore represents an upper bound of expected concentrations for a given pollutant load. The TMDL also contains an explicit Margin of Safety of 10%. This 10% MOS was included in addition to the implicit MOS to address potential uncertainty in the effectiveness of load reduction alternatives.

7. **Seasonal Variation:** The TMDL was conducted with an explicit consideration of seasonal variation. The manganese standard will be met regardless of flow conditions in any season because the load capacity calculations specify target loads for the entire range of flow conditions that are possible to occur in the creek.
8. **Reasonable Assurances:** There are no permitted point sources in the North Fork Mauvaise Terre Creek watershed, so reasonable assurances for point sources are not discussed.

In terms of reasonable assurances for nonpoint sources, Illinois EPA is committed to:

- Convene local experts familiar with nonpoint sources of pollution in the watershed
- Ensure that they define priority sources and identify restoration alternatives
- Develop a voluntary implementation plan that includes accountability.

Local agencies and institutions with an interest in watershed management will be important for successful implementation of this TMDL. Detail on watershed activities is provided in Attachment 1 (see First Quarterly Progress Report, Watershed Characterization).

9. **Monitoring Plan to Track TMDL Effectiveness:** A monitoring plan will be prepared as part of the implementation plan.

10. **Transmittal Letter:** A transmittal letter will be prepared and included with the TMDL.

11. **Public Participation:** Numerous opportunities were provided for local watershed institutions and the general public to be involved. The Agency and its consultant met with local municipalities and agencies in summer 2004 to gather and share information and initiate the TMDL process. A number of phone calls were made to identify and acquire data and information (listed in Attachment 1; see First Quarterly Progress Report, Appendix A). As quarterly progress reports were produced, the Agency posted them to their website. In March 2005, a public meeting was conducted in Jacksonville, Illinois to present the results of the Stage 1 characterization work. Two additional meetings are planned to present the TMDL and implementation plan.
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3 WATERSHED CHARACTERIZATION

The Stage 1 Report (Attachment 1) presents and discusses information describing the North Fork Mauvaise Terre Creek watershed (as well as the Mauvaise Terre Creek watershed and Mauvaise Terre Lake) and supports the identification of sources contributing to the manganese impairment. Watershed characterization activities were focused on gaining an understanding of key features of the watershed, including geology and soils, climate, land cover, hydrology, urbanization and population growth, point source discharges and watershed activities.

North Fork Mauvaise Terre Creek lies within Morgan County and drains a 46.9-square mile area (Figure 1). The predominant land use in the watershed is agriculture, with croplands comprising 90.8% of the watershed. Only 2% of the watershed is forested, and 1.5% developed. Many of the soils in the Mauvaise Terre watershed contain manganese concretions or accumulations and are also somewhat acidic. This could result in manganese moving into solution and being transported in base flow and/or runoff, and contribute to the manganese impairment.
Figure 1. North Fork Mauvaise Terre Creek Watershed
4 DESCRIPTION OF APPLICABLE STANDARDS AND NUMERIC TARGETS

A water quality standard includes the designated uses of the waterbody, water quality criteria to protect designated uses, and an antidegradation policy to maintain and protect existing uses and high quality waters. Water quality criteria are sometimes in a form that are not directly amenable for use in TMDL development and may need to be translated into a target value for TMDLs. This section discusses the applicable designated uses, use support, criteria and TMDL targets for North Fork Mauvaise Terre Creek.

4.1 DESIGNATED USES AND USE SUPPORT

Water quality assessments in Illinois are based on a combination of chemical (water, sediment and fish tissue), physical (habitat and flow discharge), and biological (macroinvertebrate and fish) data. Illinois EPA conducts its assessment of water bodies using a set of seven designated uses: aquatic life, aesthetic quality, indigenous aquatic life (for specific Chicago-area waterbodies), primary contact (swimming), secondary contact, public and food processing water supply, and fish consumption (IEPA, 2006). For each water body, and for each designated use applicable to the water body, Illinois EPA’s assessment concludes one of two possible “use-support” levels:

- Fully Supporting (the water body attains the designated use); or
- Not Supporting (the water body does not attain the designated use).

Water bodies assessed as “Not Supporting” for any designated use are identified as impaired. Waters identified as impaired based on biological (macroinvertebrate, macrophyte, algal and fish), chemical (water, sediment and fish tissue), and/or physical (habitat and flow discharge) monitoring data are placed on the 303(d) list. Potential causes and sources of impairment are also identified for impaired waters (IEPA, 2006).

Following the U.S. EPA regulations at 40 CFR Part 130.7(b)(4), the Illinois Section 303(d) list was prioritized on a watershed basis. Illinois EPA watershed boundaries are based on the USGS ten-digit hydrologic units to provide the state with the ability to address watershed issues at a manageable level and document improvements to a watershed’s health (IEPA, 2006).

4.2 WATER QUALITY CRITERIA

Illinois has established water quality criteria and guidelines for allowable concentrations of manganese under its CWA Section 305(b) program, as summarized below.

4.2.1 Manganese

The IEPA guidelines (IEPA, 2006) for identifying manganese as a cause of impairment in streams state that one exceedance of an applicable Illinois water quality standard (related to the protection of aquatic life) results in identifying the parameter as a potential cause of impairment. In this case, manganese is identified as a potential cause of impairment of the aquatic life use if there is a single exceedance of the applicable total manganese criterion (1000 ug/l).
4.3 DEVELOPMENT OF TMDL TARGETS

The TMDL target is a numeric endpoint specified to represent the level of acceptable water quality that is to be achieved by implementing the TMDL. Where possible, the water quality criterion for the pollutant of concern is used as the numeric endpoint. When appropriate numeric standards do not exist, surrogate parameters must be selected to represent the designated use.

4.3.1 Manganese

For the North Fork Mauvaise Terre Creek manganese TMDL, the target is set at the water quality criterion for manganese of 1000 ug/l.
5 DEVELOPMENT OF WATER QUALITY MODELS

Water quality models are used to define the relationship between pollutant loading and resulting water quality. The TMDL for manganese utilizes a Load Duration Curve method in addition to a Load Capacity Calculation. The development of the Load Duration Curve Approach is described in this section.

5.1 LOAD DURATION CURVE APPROACH

A load duration curve approach was used in the manganese analysis for North Fork Mauvaise Terre Creek. A load duration curve is a graphical representation of observed pollutant load compared to maximum allowable load over a range of flow conditions. The load duration curve provides information to:

- Help identify the issues surrounding the problem and differentiate between point and nonpoint source problems, as discussed immediately below;
- Address frequency of deviations (how many samples lie above the curve vs. those that plot below); and
- Aid in establishing the level of implementation needed, by showing the magnitude by which existing loads exceed standards for different flow conditions.

5.1.1 Model Selection

The load duration curve approach was selected for manganese because it is consistent with the selected level of TMDL implementation for this TMDL and it can be applied with the existing data. The load duration curve approach identifies broad categories of sources over the entire range of flows, and the extent of control required from these source categories to attain water quality standards.

5.1.2 Approach

The load duration curve approach uses stream flows for the period of record to gain insight into the flow conditions under which exceedances of the water quality standard occur. A load-duration curve is developed by: 1) ranking the daily flow data from lowest to highest, calculating the percent of days these flows were exceeded, and graphing the results; 2) translating the flow duration curve (produced in step 1) into a load duration curve by multiplying the flows by the TMDL target; and 3) plotting observed pollutant loads (measured concentrations times stream flow) on the same graph. Observed loads that fall above the load duration curve exceed the maximum allowable load, while those that fall on or below the line, do not exceed the maximum allowable load. An analysis of the observed loads relative to the load duration curve provides information on whether the pollutant source is point or nonpoint in nature. A more complete description of the load duration curve approach is provided in Attachment 1.

5.1.3 Data Inputs

The load duration curve approach requires a long-term flow record and concentration measurements that are paired to flows.
Manganese data collected during June-October 2001 by the Illinois EPA Ambient Water Quality Monitoring Program, as well as Stage 2 manganese data collected in June 2006 by LimnoTech were used in this analysis.

The load duration curve approach requires a matching of flows to water quality data for the recent period. Daily flows were not available for North Fork Mauvaise Terre Creek for recent years. Instead, daily average flows measured at the USGS gage on nearby Spring Creek at Springfield, Illinois (05577500) were used in the analysis. Flows are available for the period 1949-2006. The flows measured on Spring Creek were adjusted for the size of the drainage area (46.9 square miles versus 107 square miles).

### 5.1.4 Analysis

A load duration curve was developed for manganese to characterize pollutant problems over the entire flow regime and gain an understanding of manganese impairments in North Fork Mauvaise Terre Creek.

A flow duration curve was generated by ranking daily flow data from lowest to highest, calculating the percent of days these flows were exceeded, and graphing the results. A load duration curve for manganese was generated by multiplying the flows in the duration curve by the water quality standard of 1,000 ug/l. This is shown with a solid line in Figure 2. Observed pollutant loads (measured concentrations multiplied by corresponding stream flow), were plotted at triangles on the same graph. The worksheet for this analysis is provided in Attachment 2.

![Figure 2. Manganese Load Duration Curve for North Fork Mauvaise Terre Creek with Observed Loads (triangles)](image)

As shown in Figure 2, the single exceedance of the manganese target is observed at low flow. Instream dissolved oxygen measured 2.05 mg/l on the day of the manganese exceedance. Although this DO concentration is not low enough to cause manganese release from the bottom sediments, it is possible that DO concentrations were lower at other times of the day. If DO dropped to zero, then sediment release of manganese may
have occurred. Potential sources include groundwater or manganese release from the bottom sediments during anoxic conditions.
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6 TMDL DEVELOPMENT

This section presents the development of the Total Maximum Daily Load for the North Fork Mauvaise Terre Creek watershed. It begins with a description of how the total loading capacity was calculated, and then describes how the loading capacity is allocated among point sources, non-point sources, and the margin of safety. A discussion of critical conditions and seasonality considerations is also provided.

6.1 MANGANESE

A load capacity calculation approach was applied to support development of a manganese TMDL for North Fork Mauvaise Terre Creek.

6.1.1 Calculation of Loading Capacity

The loading capacity is defined as the maximum pollutant load that a waterbody can receive and still maintain compliance with water quality standards. The loading capacity was defined over a range of specified flows based on expected flows for North Fork Mauvaise Terre Creek. The allowable loading capacity was computed by multiplying flow by the water quality standard (1000 ug/l for manganese). The manganese loading capacity is presented in Table 1.

![Table 1. Manganese Loading Capacity](image)

<table>
<thead>
<tr>
<th>North Fork Mauvaise Terre Creek (IL_DDC) Flow (cfs)</th>
<th>Manganese load capacity (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.4</td>
</tr>
<tr>
<td>3</td>
<td>16.2</td>
</tr>
<tr>
<td>5</td>
<td>27.0</td>
</tr>
<tr>
<td>10</td>
<td>53.9</td>
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<td>25</td>
<td>134.8</td>
</tr>
<tr>
<td>75</td>
<td>404.5</td>
</tr>
<tr>
<td>200</td>
<td>1078.7</td>
</tr>
<tr>
<td>500</td>
<td>2696.8</td>
</tr>
</tbody>
</table>

The maximum concentrations of manganese for the expected flow ranges were examined to estimate the percent reduction in existing loads required to meet the 1000 ug/l target. As noted in Figure 1, the sole exceedance of the manganese water quality criterion occurred at low flow. Up to a 57% reduction in manganese is needed during very low flows, while no reductions are needed at higher flows.

6.1.2 Allocation

A TMDL consists of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

There are no permitted dischargers in the North Fork Mauvaise Terre watershed and the WLA does not need to be calculated. The remainder of the loading capacity is given to...
the load allocation for nonpoint sources and the margin of safety (Table 2). The load allocation is not divided into individual source categories for purposes of this TMDL, as it is the intent of the implementation plan to provide detail on the contributions of specific sources to the overall manganese load.

Table 2. Manganese TMDL Allocation

<table>
<thead>
<tr>
<th>North Fork Mauvaise Terre Creek Flow (cfs)</th>
<th>Manganese Loading Capacity (lbs/day)</th>
<th>Manganese LA (lbs/day)</th>
<th>Manganese MOS (lbs/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.4</td>
<td>4.85</td>
<td>0.54</td>
</tr>
<tr>
<td>3</td>
<td>16.2</td>
<td>14.56</td>
<td>1.62</td>
</tr>
<tr>
<td>5</td>
<td>27.0</td>
<td>24.27</td>
<td>2.70</td>
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<tr>
<td>10</td>
<td>53.9</td>
<td>48.54</td>
<td>5.39</td>
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<tr>
<td>25</td>
<td>134.8</td>
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<td>13.48</td>
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<tr>
<td>75</td>
<td>404.5</td>
<td>364.07</td>
<td>40.45</td>
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<tr>
<td>200</td>
<td>1078.7</td>
<td>970.86</td>
<td>107.87</td>
</tr>
<tr>
<td>500</td>
<td>2696.8</td>
<td>2427.14</td>
<td>269.68</td>
</tr>
</tbody>
</table>

1 Due to rounding, numbers may not add up exactly.
6.1.3 Critical Condition
TMDLs must take into account critical environmental conditions to ensure that the water quality is protected during times when it is most vulnerable. Figure 2 provides a graphical depiction of the data compared to the load capacity, showing that exceedances of the TMDL target occur at low flow conditions. TMDL development utilizing the load-duration approach applies to the full range of flow conditions; therefore critical conditions were addressed during TMDL development.

6.1.4 Seasonality
This TMDL was conducted with an explicit consideration of seasonal variation. The manganese standard will be met regardless of flow conditions in any season because the load capacity calculations specify target loads for the entire range of flow conditions that are possible to occur in the river.

6.1.5 Margin of Safety
TMDLs are required to contain a Margin of Safety (MOS) to account for any uncertainty concerning the relationship between pollutant loading and receiving water quality. The MOS can be either implicit (e.g., incorporated into the TMDL analysis through conservative assumptions), or explicit (e.g., expressed in the TMDL as a portion of the loading), or expressed as a combination of both. The manganese TMDL contains a combination of both types. An implicit Margin of Safety is provided via the use of a conservative model to define load capacity. The model assumes no loss of manganese that enters the river, and therefore represents an upper bound of expected concentrations for a given pollutant load. The TMDL also contains an explicit margin of safety of 10%. This 10% margin of safety was included in addition to the implicit margin of safety to address potential uncertainty in the effectiveness of load reduction alternatives. This margin of safety can be reviewed in the future as new data are developed.
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7 PUBLIC PARTICIPATION AND INVOLVEMENT

The TMDL process included numerous opportunities for local watershed institutions and the general public to be involved. The Agency and its consultant met with local municipalities and agencies in Summer 2004 to notify stakeholders about the upcoming TMDLs for the Mauvaise Terre Creek watershed, including the North Fork Mauvaise Terre Creek. A number of phone calls were made to identify and acquire data and information (see Appendix A to the First Quarterly Progress Report, presented in Attachment 1). As quarterly progress reports were produced during the first stage of the TMDL process, the Agency posted them to their website for public review.

In January 2005 a public meeting was announced for presentation of the Stage 1 findings. This announcement was mailed to everyone on the previous TMDL mailing list and published in local newspapers. The public meeting was held at 6:30 pm on Tuesday, March 1, 2005 at the Jacksonville Municipal Building in Jacksonville, Illinois. In addition to the meeting’s sponsors, nine (9) individuals attended the meeting. Attendees registered and listened to an introduction to the TMDL Program from Illinois EPA and a presentation on the Stage 1 findings by LimnoTech. This was followed by a general question and answer session.

The results of the TMDL and implementation plan will be presented to the public at a future date.
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8 ADAPTIVE IMPLEMENTATION PROCESS

The approach to be taken for TMDL implementation is based upon discussions with Illinois EPA and its Scientific Advisory Committee. The approach consists of the following steps:

1. Use existing data to define overall existing pollutant loads, as opposed to developing a watershed model that might define individual loading sources.
2. Apply relatively simple models (e.g. load capacity calculations) to define the load-response relationship and define the maximum allowable pollutant load that the lake can assimilate and still attain water quality standards.
3. Compare the maximum allowable loading capacity to the existing load to define the extent to which existing loads must be reduced in order to meet water quality standards.
4. Develop a voluntary implementation plan that includes both accountability and the potential for adaptive management.
5. Carry out adaptive management through the implementation of a long-term monitoring plan designed to assess the effectiveness of pollution controls as they are implemented, as well as progress towards attaining water quality standards.

This approach is designed to accelerate the pace at which TMDLs are being developed for sites dominated by nonpoint sources, which will allow implementation activities (and water quality improvement) to begin sooner. The approach also places decisions on the types of nonpoint source controls to be implemented at the local level, which will allow those with the best local knowledge to prioritize sources and identify restoration alternatives. Finally, the adaptive management approach to be followed recognizes that models used for decision-making are approximations, and that there is never enough data to completely remove uncertainty. The adaptive process allows decision-makers to proceed with initial decisions based on modeling, and then to update these decisions as experience and knowledge improve.

Steps 1-3 correspond to TMDL development and have been completed, as described in Section 5 of this document. Steps 4 and 5 correspond to implementation.
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REFERENCES


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North Fork Mauvaise Terre Creek Watershed
TMDL Implementation Plan

Prepared for Illinois Environmental Protection Agency

April 2007

North Fork Mauvaise Terre Creek (IL_DDC): Manganese
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SUMMARY

A Total Maximum Daily Load (TMDL) has been developed for the North Fork Mauvaise Terre Creek (Morgan County, Illinois) to address manganese impairment. This TMDL determined that significant reductions in existing pollutant loadings were needed to meet water quality objectives. The next step in the TMDL process is to develop a voluntary implementation plan that includes both accountability and the potential for adaptive management. This document identifies a number of alternative actions to be considered by local stakeholders for TMDL implementation; these alternative actions are summarized, and recommendations are presented for implementation actions and additional monitoring.

INTRODUCTION

Section 303(d) of the 1972 Clean Water Act requires States to define waters that are not meeting designated uses under technology-based controls and identify them on a list of impaired waters, which is referred to as the 303(d) list. Section 303(d) of the Clean Water Act and EPA’s Water Quality Planning and Management Regulations (40 CFR Part 130) requires states to develop Total Maximum Daily Loads (TMDLs) for these impaired water bodies. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and conditions in the water body. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also takes into account a margin of safety, which reflects scientific uncertainty, as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of their water resources (U.S. EPA, 1991).

North Fork Mauvaise Terre Creek (IL_DDC) is listed on the 2006 Illinois Section 303(d) List of Impaired Waters (IEPA, 2006) as a waterbody that is not meeting its designated use for support of aquatic life. As such, it was targeted as a high priority waterbody for TMDL development, and a TMDL for this waterbody was developed in 2007 (LTI, 2007). The next step in the TMDL process is to develop a voluntary implementation plan that includes both accountability and the potential for adaptive management. Adaptive management recognizes that proceeding with some initial improvement efforts is better than waiting to find a “perfect” solution. In an adaptive management approach, the TMDL and the watershed to which it applies are revisited over time to assess progress and make adjustments that continue to move toward achieving the TMDL’s goals. Adaptive management may be conducted through the implementation of a long-term monitoring plan designed to assess the effectiveness of pollution controls as they are implemented, as well as progress towards attaining water quality standards.

This document presents the implementation plan for the North Fork Mauvaise Terre Creek TMDL. It is divided into sections describing the watershed, summarizing the TMDL, describing existing controls within the watershed for the pollutants of interest, outlining the implementation approach, presenting a variety of implementation alternatives, recommending particular control alternatives, describing areas for targeting controls, presenting reasonable assurances that the measures will be implemented, and outlining future monitoring and adaptive management.
WATERSHED DESCRIPTION

North Fork Mauvaise Terre Creek lies within Morgan County and drains a 46.9-square mile area. The predominant land use in the watershed is agriculture, with croplands comprising almost 91% of the watershed. Only 2% of the watershed is forested, and less than 2% is developed. Many of the soils in the North Fork Mauvaise Terre Creek watershed contain manganese concretions or accumulations and are also somewhat acidic. This could result in manganese moving into solution and being transported in base flow and/or runoff, and contribute to the manganese impairment. Figure 1 shows a map of the watershed.
Figure 1. North Fork Mauvaise Terre Creek Watershed

North Fork Mauvaise Terre Creek Watershed Study Area

- Study watershed
- Landfill
- Public water intake
- Permitted discharge site
- Oil well – one or more

Legend:

North Fork Mauvaise Terre Creek
Watershed
Study Area

0 3 mi
0 5 km
TMDL SUMMARY

The impairments in waters of the North Fork Mauvaise Terre Creek watershed addressed in this report are summarized in Table 1, with the parameters (causes) that they are listed for, and the impairment status of each designated use, as identified in the 303(d) list (IEPA, 2006). While a TMDL has only been developed for pollutants that have numerical water quality standards (in this case, manganese, which is indicated below with bold font), controls that are implemented to address manganese will reduce other pollutants as well. For example, any controls to reduce manganese loads from watershed sources (stream bank erosion, runoff, etc.) would serve to reduce not only manganese, but also sediment loads to the creek, as manganese Best Management Practices (BMPs) are often the same or similar to sediment BMPs.

Table 1. Summary of Impairments

<table>
<thead>
<tr>
<th>North Fork Mauvaise Terre Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment Unit ID</td>
</tr>
<tr>
<td>Size (length)</td>
</tr>
<tr>
<td>Listed For</td>
</tr>
<tr>
<td>Use Support(^1)</td>
</tr>
</tbody>
</table>

\(^1\) F = fully supporting, N=not supporting, X = not assessed

\(^2\) Dissolved oxygen will be delisted.

Potential sources contributing to the manganese listing of this waterbody are summarized in Table 2.

Table 2. Potential Manganese Sources

<table>
<thead>
<tr>
<th>Cause of Impairment</th>
<th>Potential Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manganese</td>
<td>Natural background sources including groundwater, surface runoff and soil erosion</td>
</tr>
</tbody>
</table>

EXISTING CONTROLS

The local Natural Resource Conservation Service (NRCS), Farm Service Agency (FSA), and Soil and Water Conservation District (SWCD) offices have information on existing best management practices within the watershed, and can be contacted to understand what efforts have been made or are planned to control nonpoint sources. Recent discussions with local NRCS staff indicated that no large-scale BMPs have been implemented in the watershed within the last several years, and no streambank stabilization or restoration projects have been undertaken. The NRCS has been working with individual landowners to implement small-scale BMPs (e.g., filter strips) on individual properties. However, the NRCS indicated that it is difficult to quantify the impact of these individual property BMPs over the entire watershed (NRCS, 2007).
IMPLEMENTATION APPROACH

The approach to be taken for TMDL development and implementation is based upon discussions with Illinois EPA and its Scientific Advisory Committee. The approach consists of the following steps, with the first three steps corresponding to TMDL development and the latter two steps corresponding to implementation:

1. Use existing data to define overall existing pollutant loads, as opposed to developing a watershed model that might define individual loading sources.
2. Apply relatively simple tools (e.g., load duration curve) to define the load-response relationship and define the maximum allowable pollutant load that the creek can assimilate and still attain water quality standards.
3. Compare the maximum allowable load to the existing load to define the extent to which existing loads must be reduced in order to meet water quality standards.
4. Develop a voluntary implementation plan that includes both accountability and the potential for adaptive management.
5. Carry out adaptive management through the implementation of a long-term monitoring plan designed to assess the effectiveness of pollution controls as they are implemented, as well as progress towards attaining water quality standards.

This approach is designed to accelerate the pace at which TMDLs are being developed for sites dominated by nonpoint sources, which will allow implementation activities (and water quality improvement) to begin sooner. The approach also places decisions on the types of nonpoint source controls to be implemented at the local level, which will allow those with the best local knowledge to prioritize sources and identify restoration alternatives. The Association of Illinois Soil and Water Conservation Districts (SWCDs), using Section 319 grant funding, have made available a Watershed Liaison to provide educational, informational, and technical assistance to local agencies and communities. The liaison can assist in establishing local watershed planning groups, as well as acting as an overall facilitator for coordination between local, state, and Federal agencies.

The adaptive management approach to be followed recognizes that models used for decision-making are approximations, and that there is never enough data to completely remove uncertainty. The adaptive process allows decision-makers to proceed with initial decisions based on modeling, and then to update these decisions as experience and knowledge improve.

Steps One through Three described above have been completed, as described in the TMDL report (LTI, 2007). This plan represents Step Four of the process. Step Five is briefly described in the last section of this document, and will be conducted as implementation proceeds.

IMPLEMENTATION ALTERNATIVES

For manganese, the primary sources are natural sources, including soils and groundwater. Manganese reductions are needed during low flow conditions. Soils naturally enriched in manganese can settle in the river and contribute to manganese exceedances during low flow, anoxic conditions, as the metals are released into the water column. The extent to which this mechanism contributes to the low flow exceedances of manganese is not known; however, controls targeted at reducing wet weather loads of sediment and manganese may also reduce sedimentation and subsequent release of the manganese during low flow periods. Because it is
difficult to control groundwater sources, implementation alternatives were focused on measures to reduce erosion, including:

- Conservation Tillage
- Conservation Buffers
- Sediment Control Structures
- Streambank Enhancement and Protection
- Grassed Waterways
- Dredging

Each of these alternatives is described briefly in this section, including information about their costs and effectiveness in reducing manganese loadings. Costs have been updated from their original sources, based on literature citations, to 2007 costs using the Engineering News Record Construction Cost Index, as provided by the Natural Resource Conservation Service (NRCS) (http://www.economics.nrcs.usda.gov/cost/priceindexes/index.html). Table 3 summarizes the implementation alternatives.

It should be noted that there is usually a wide range in the effectiveness of the various practices; this is largely due to variations in climate, soils, topography, design, construction, and maintenance of the practices (NRCS, 2006).
Table 3. Implementation Alternatives for Manganese

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Applicability for Addressing Manganese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation Tillage</td>
<td>*</td>
</tr>
<tr>
<td>Conservation Buffers</td>
<td>*</td>
</tr>
<tr>
<td>Sediment Control Structures</td>
<td>*</td>
</tr>
<tr>
<td>Streambank Enhancement and Protection</td>
<td>*</td>
</tr>
<tr>
<td>Grassed Waterways</td>
<td>*</td>
</tr>
<tr>
<td>Dredging</td>
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</tbody>
</table>

* While not directly tied to primary sources of manganese, BMPs designed to reduce erosion are expected to provide secondary benefits in reducing manganese

**Conservation Tillage**

The objective of conservation tillage is to provide profitable crop production while minimizing soil erosion (UIUC, 2005). The NRCS has replaced the term conservation tillage with the term crop residue management, or the year-round management of residue to maintain the level of cover needed for adequate control of erosion. This often requires more than 30% residue cover after planting (UIUC, 2005). Conservation tillage/crop residue management systems are recognized as cost-effective means of significantly reducing soil erosion and maintaining productivity. The most recent Illinois Soil Transect Survey (IDOIA, 2006) suggests that 73% of the land under soybean production in Morgan County is farmed using reduced till, mulch till, or no till, 100% of the land in small grain production is farmed using no-till and 60% of the corn fields are farmed with conventional methods. Additional conservation tillage measures should be considered as part of this implementation plan, particularly for cornfields.

Conservation tillage practices have been reported to reduce sediment loads by 75%. A wide range of costs has been reported for conservation tillage practices, ranging from $12/acre to $83/acre in capital costs (U.S. EPA, 2003). For no-till, costs per acre provided in the Illinois Agronomy Handbook for machinery and labor range from $36 to $66 per acre, depending on the farm size and planting methods used (UIUC, 2005). In general, the total cost per acre for machinery and labor decreases as the amount of tillage decreases and farm size increases (UIUC, 2005).

**Conservation Buffers**

Conservation buffers are areas or strips of land maintained in permanent vegetation to help control pollutants (NRCS, 1999), generally by slowing the rate of runoff, while filtering sediment, bacteria, and nutrients. Additional benefits may include the creation of wildlife habitat, improved aesthetics, and potential economic benefits from marketing specialty forest crops (Trees Forever, 2005). This category of controls includes buffer strips, field borders, filter strips, vegetative barriers, riparian buffers, etc. (NRCS, 1999).

Filter strips and similar vegetative control methods can be very effective in reducing nutrient transport. The relative gross effectiveness of filter strips in reducing total phosphorus has been reported as 75% (U.S. EPA, 2003). Reduction of particulate phosphorus is moderate to high, while effectiveness for dissolved phosphorus is low to negative (NRCS, 2006). Vegetated filter
strips and riparian buffers can also be used to reduce bacteria; riparian buffer zones have bacteria removal efficiencies of 43-57% (Commonwealth of Virginia, 2003).

Conservation buffers can help stabilize a stream and reduce its water temperature (NRCS, undated). Riparian buffers can work to improve instream dissolved oxygen concentrations by promoting increased infiltration and baseflow and lowering stream temperature.

Costs of conservation buffers vary from about $200/acre for filter strips of introduced grasses or direct seeding of riparian buffers, to approximately $360/acre for filter strips of native grasses or planting bare root riparian buffers, to more than $1,030/acre for riparian buffers using bare root stock shrubs (NRCS, 2005).

The Conservation Practices Cost-Share Program (CPP), part of the Illinois Conservation 2000 Program, provides cost sharing for conservation practices including field borders and filter strips (http://www.agr.state.il.us/Environment/conserv/index.html). The Department of Agriculture distributes funding for the cost-share program to Illinois’ soil and water conservation districts (SWCDs), which prioritize and select projects. The Illinois Buffer Partnership offers cost sharing for installation of streamside buffer plantings at selected sites. An additional program that may be of interest is the Visual Investments to Enhance Watersheds (VIEW), which involves a landscape design consultant in the assessment and design of targeted BMPs within a watershed. Sponsored by Trees Forever (www.treesforever.org), VIEW guides a committee of local stakeholders through a watershed landscape planning process (Trees Forever, 2005). Additional funding for conservation buffers may be available through other sources such as the Conservation Reserve Program.

Sediment Control Basins

Sediment control basins trap sediments (and constituents bound to that sediment) before they reach surface waters (EPA, 2003). Because the manganese impairments have been attributed to natural contributions from local soils, sediment control basins could help reduce loadings of these sources. Costs for these basins can vary widely depending on location and size; estimates prepared for another Illinois watershed range from $1,200 to more than $200,000 per basin (Zahniser Institute, undated). This same study estimated a trapping efficiency for sediment of 75%. Siting considerations and costs are driven mainly by the size of the basin required, land availability, and land acquisition costs.

Streambank Enhancement and Protection

A recent aerial assessment report identified streambank incision and erosion within the Mauvaise Terre Creek watershed (Kinney, 2005). A number of erosion sites were identified along North Fork Mauvaise Terre Creek. The study recommended rock riffle grade control and stone toe protection to stabilize the banks of North Fork Mauvaise Terre Creek, with estimated costs of $4,375 per riffle (with riffles spaced 240 feet apart) and $2,500 per site for stone toe protection, based on a cost of $25 per ton of stone. Because of the potential cost of stabilizing streambanks throughout the watershed, additional study is recommended to prioritize sites for streambank stabilization. Such study should include direct observation of bank conditions, as well as an assessment of stream hydraulics and geomorphology to support identification and design of effective stabilization measures.
Grassed Waterways
Grassed waterways are another alternative to consider for this watershed. A grassed waterway is a natural or constructed channel that is planted with suitable vegetation to reduce erosion (NRCS, 2000). Grassed waterways are used to convey runoff without causing erosion or flooding, to reduce gully erosion, and to improve water quality. They may be used in combination with filter strips, and are effective at reducing soil loss, with typical reductions between 60 and 80 percent (Lin et al, 1999). Grassed waterways cost approximately $1,800/acre, not including costs for tile or seeding (MCSWCD, 2006).

Dredging
As noted in the TMDL report (LTI, 2007), manganese release from bottom sediments is a potential source of manganese. Control of this internal load would require removal of manganese from the creek bottom, such as through dredging. Dredging existing sediments is an expensive alternative and would be only a temporary solution. If manganese loads are not reduced in the watershed, it is likely that the flux of manganese from the sediments will continue to be a problem in the future.

IDENTIFYING PRIORITY AREAS FOR CONTROLS
Priority areas for locating controls were identified through a review of available information. Information reviewed included: tributary water quality data; an aerial assessment report; and GIS-based information. Based on this review, it is recommended that streambank stabilization be initiated in the North Fork Mauvaise Terre Lake Watershed to reduce bank erosion, and that this work occur concurrently with watershed controls in priority areas. Additional data collection is also recommended, to help focus control efforts.

Tributary Monitoring
Available water quality data obtained as part of the Stage 1 Watershed Characterization work were reviewed and no recent tributary monitoring data were identified. Since completion of the Stage 1 work, three additional samples of the North Fork Mauvaise Terre Creek (Lisbon Rd. [closed road south and off of Deornellas Road; approximately a 50 yard walk-in to old bridge]; Mobil Road [Hacker Road on Atlas]; and Illinois Route 123/Franklin-Alexander Road) and one unnamed tributary have been completed. Through this sampling it was observed that manganese concentrations did not exceed the water quality standard of 1 mg/L. The highest observed concentration in this sampling was the Illinois Route 123/Franklin-Alexander Road sample, which had a manganese concentration of 0.15 mg/L. Additional tributary monitoring data would help target particular areas for implementation efforts. Specific data collection recommendations are provided in the Monitoring and Adaptive Management Section later in this Implementation Plan.

Aerial Assessment Report
A recent aerial assessment report identified streambank incision and erosion within the North Fork Mauvaise Terre Creek watershed (Kinney, 2005). A number of erosion sites were identified along North Fork Mauvaise Terre Creek. The study recommended rock riffle grade control and stone toe protection to stabilize the banks of North Fork Mauvaise Terre Creek.
GIS Analysis

GIS soils, land use and topography data were analyzed to identify areas that are expected to generate the highest sediment and associated phosphorus loads. Within the GIS, maps were generated to show areas with steep slopes (Figure 2), highly erodible soils (Figure 3), and finally, priority areas for best management practices (BMPs). Priority areas are defined as agricultural areas that have both steep slopes and highly erodible soils (Figure 4). These maps serve as a good starting point for selecting areas to target for implementing control projects, to maximize the benefit of the controls.
Figure 2. Areas with Steep Slopes
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Figure 3. Areas of Highly Erodible Land
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Figure 4. Potential Priority Areas for BMPs
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REASONABLE ASSURANCE

The U.S. EPA requires states to provide reasonable assurance that the load reductions identified in the TMDL will be met. For nonpoint sources, which are the focus of this work, reasonable assurance means that nonpoint source controls are specific to the pollutant of concern, implemented according to an expeditious schedule and supported by reliable delivery mechanisms and adequate funding (U.S. EPA, 1999).

One of the most important aspects of implementing non-point source controls is obtaining adequate funding to implement voluntary or incentive-based programs. Funding is available from a variety of sources, including those listed below. It should be noted that the Federal programs listed are based on the 2002 Farm Bill, which expires on September 30, 2007. It is currently unknown what conservation programs will be included in a future farm bill.

- **Illinois Nutrient Management Planning Program**, cosponsored by the Illinois Department of Agriculture (IDOA) and IEPA [http://www.agr.state.il.us/Environment/LandWater/tmdl.html](http://www.agr.state.il.us/Environment/LandWater/tmdl.html). This program targets funding to Soil and Water Conservation Districts (SWCDs) for use in impaired waters. The nutrient management plan practice cost share is only available to landowners/operators with land in TMDL watersheds. The dollar amount allocated to each eligible SWCD is based on their portion of the total number of cropland acres in eligible watersheds.

- **Clean Water Act Section 319 grants** to address nonpoint source pollution [http://www.epa.state.il.us/water/financial-assistance/non-point.html](http://www.epa.state.il.us/water/financial-assistance/non-point.html). Section 319 of the Clean Water Act provides Federal funding for states for the implementation of approved nonpoint source (NPS) management programs. Funding under these grants has been used in Illinois to finance projects that demonstrate cost-effective solutions to NPS problems. Projects must address water quality issues relating directly to NPS pollution. Funds can be used for the implementation of watershed management plans, including the development of information/education programs, and for the installation of best management practices.

- **Conservation 2000** [http://www.epa.state.il.us/water/conservation-2000/](http://www.epa.state.il.us/water/conservation-2000/), which funds nine programs across three state natural resource agencies (IEPA, IDOA, and the Department of Natural Resources). Conservation 2000 is a six-year, $100 million initiative designed to take a broad-based, long-term ecosystem approach to conserving, restoring, and managing Illinois' natural lands, soils, and water resources while providing additional high-quality opportunities for outdoor recreation.

- **Conservation Practices Cost-Share Program** [http://www.agr.state.il.us/Environment/conserv/index.html](http://www.agr.state.il.us/Environment/conserv/index.html). Another component of Conservation 2000, the Conservation Practices Program (CPP) focuses on conservation practices, such as terraces, filter strips and grass waterways, which are aimed at reducing soil loss on Illinois cropland. IDOA distributes funding for the cost-share program to Illinois' SWCDs, which prioritize and select projects. Construction costs are divided between the state and landowners.

provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. CRP participants may enroll in 10 and 15-year contracts. CRP is administered by the Farm Service Agency, with NRCS providing technical land eligibility determinations, conservation planning and practice implementation.

- *Wetlands Reserve Program* ([http://www.nrcs.usda.gov/programs/wrp/](http://www.nrcs.usda.gov/programs/wrp/)). NRCS’s Wetlands Reserve Program (WRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection. Figure 5 shows potential wetland restoration areas. These are areas with hydric soils that are not currently developed, covered by water or forested.

- *Environmental Quality Incentive Program* sponsored by NRCS ([general information at http://www.nrcs.usda.gov/PROGRAMS/EQIP/](http://www.nrcs.usda.gov/PROGRAMS/EQIP/); [Illinois information and materials at http://www.il.nrcs.usda.gov/programs/eqip/](http://www.il.nrcs.usda.gov/programs/eqip/)). The Environmental Quality Incentives Program (EQIP) provides a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical assistance to eligible participants to install or implement structural and management practices on eligible agricultural land. EQIP may cost-share up to 75 percent of the costs of certain conservation practices (e.g., grassed waterways, nutrient management, riparian buffers, and wetland restoration). Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive.

- *Wildlife Habitat Incentives Program* ([WHIP](http://www.il.nrcs.usda.gov/programs/whip/index.html)). WHIP is a NRCS program for developing and improving wildlife habitat, primarily on private lands. It provides both technical assistance and cost-share payments to help establish and improve fish and wildlife habitat.

In terms of reasonable assurances for nonpoint sources, Illinois EPA is committed to:

- Convene local experts familiar with nonpoint sources of pollution in the watershed
- Ensure that they define priority sources and identify restoration alternatives
- Develop a voluntary implementation plan that includes accountability
- Using the results of future monitoring to conduct adaptive management

**MONITORING AND ADAPTIVE MANAGEMENT**

Future monitoring is needed to assess the effectiveness of the various restoration alternatives and conduct adaptive management. The Illinois EPA conducts a variety of water quality monitoring programs (IEPA, 2002). Ongoing stream monitoring programs include: a statewide 213-station Ambient Water Quality Monitoring Network (AWQMN); an Intensive Basin Survey Program that covers all major watersheds on a five-year rotation basis; and a Facility-Related Stream
Survey Program that conducts approximately 20-30 stream surveys each year. North Fork Mauvaise Terre Creek is not monitored regularly as part of any of these programs. Local agencies and watershed organizations are therefore encouraged to conduct additional monitoring to assess sources of pollutants and evaluate changes in water quality in the creek.

In particular, the following monitoring is recommended:

- Dry weather monitoring for manganese in the North Fork Mauvaise Terre Creek. Limited water quality data suggest that groundwater may be the primary source of manganese to the creek. Manganese concentrations measured in community water supply wells within Morgan County indicate elevated levels of manganese. Sampling North Fork Mauvaise Terre Creek under low flow conditions at a location that has been previously sampled (such as the Illinois Route 123/Franklin-Alexander Road site) will allow confirmation of groundwater as the source of the manganese.

Monitoring will provide additional information to identify or confirm potential sources of manganese, and assist in targeting implementation efforts.

Continued monitoring efforts will provide the basis for assessment of the effectiveness of the TMDL, as well as future adaptive management decisions. As various alternatives are implemented, the monitoring will determine their effectiveness and identify which alternatives should be expanded, and which require adjustments to meet the TMDL goals.
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REFERENCES


Zahniser Institute for Environmental Studies (undated; believed 2004). *Clean Lakes Program Phase I Diagnostic Feasibility Study, Glenn Shoals Lake, City of Hillsboro, Montgomery County, Illinois.* Prepared for the City of Hillsboro in cooperation with the Illinois Environmental Protection Agency.