Turbidity TMDL Assessment for the Pomme de Terre River Draft Report

Submitted by:

Pomme de Terre River Watershed Association

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Acknowledgements

Submitted by:

Pomme de Terre River Association
12 Hwy 28 E. Ste. 2
Morris, MN 56267

Project Coordinator:
Shaun McNally

MPCA Project Manager:
Katherine Pekarek-Scott

Project Technical Team:
Ottertail County SWCD
Douglas County SWCD and Planning and Zoning
Grant County SWCD and Planning and Zoning
Stevens County SWCD and Environmental Services
Swift County NRCS and Planning and Zoning
Big Stone County SWCD and Planning and Zoning
WesMin RC&D
MN Board of Water and Soil Resources (BWSR)
MN DNR

MPCA TMDL Review Committee:
Mark Hanson, Minnesota Pollution Control Agency
Greg Johnson, Minnesota Pollution Control Agency
Jeff Jasperson, Minnesota Pollution Control Agency
Eileen Campbell, Minnesota Pollution Control Agency
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU</td>
<td>Animal Units</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>BWSR</td>
<td>Minnesota Board of Water and Soil Resources</td>
</tr>
<tr>
<td>CAFO</td>
<td>Confined Animal Feeding Operation</td>
</tr>
<tr>
<td>CCRP</td>
<td>Continuous Conservation Reserve Program</td>
</tr>
<tr>
<td>cf/L</td>
<td>Cubic Feet per Liter</td>
</tr>
<tr>
<td>cfs</td>
<td>Cubic Feet per Second</td>
</tr>
<tr>
<td>CREP</td>
<td>Conservation Reserve Enhancement Program</td>
</tr>
<tr>
<td>CRP</td>
<td>Conservation Reserve Program</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>DNR</td>
<td>Minnesota Department of Natural Resources</td>
</tr>
<tr>
<td>EQUIP</td>
<td>Environmental Quality Incentive Program</td>
</tr>
<tr>
<td>FNMU</td>
<td>Formazin Nephelometric Multibeam Units</td>
</tr>
<tr>
<td>HUC</td>
<td>Hydrologic Unit Code</td>
</tr>
<tr>
<td>JPB</td>
<td>Pomme de Terre River Association Joint Powers Board</td>
</tr>
<tr>
<td>LA</td>
<td>Load Allocation</td>
</tr>
<tr>
<td>LWMP</td>
<td>Local Water Management Plan</td>
</tr>
<tr>
<td>mg/L</td>
<td>Milligram per Liter</td>
</tr>
<tr>
<td>mg/ton</td>
<td>Milligram per Ton</td>
</tr>
<tr>
<td>MN</td>
<td>Minnesota</td>
</tr>
<tr>
<td>MOS</td>
<td>Margin of Safety</td>
</tr>
<tr>
<td>MPCA</td>
<td>Minnesota Pollution Control Agency</td>
</tr>
<tr>
<td>MS4</td>
<td>Municipal Separate Storm Sewer System</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Services</td>
</tr>
<tr>
<td>NTRU</td>
<td>Nephelometric Turbidity Ratio Units</td>
</tr>
<tr>
<td>NTU</td>
<td>Nephelometric Turbidity Units</td>
</tr>
<tr>
<td>PdT</td>
<td>Pomme de Terre River</td>
</tr>
<tr>
<td>RC</td>
<td>Reserve Capacity</td>
</tr>
<tr>
<td>RIM</td>
<td>Reinvest in MN conservation easement program</td>
</tr>
<tr>
<td>SWCD</td>
<td>Soil and Water Conservation District</td>
</tr>
<tr>
<td>SWPPP</td>
<td>Storm Water Pollution Prevention Plan</td>
</tr>
<tr>
<td>TAC</td>
<td>Technical Advisory Committee</td>
</tr>
<tr>
<td>TDLC</td>
<td>Total Daily Loading Capacity</td>
</tr>
<tr>
<td>TMRL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>US EPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>WLA</td>
<td>Waste Load Allocation</td>
</tr>
<tr>
<td>WRP</td>
<td>Wetlands Reserve Program</td>
</tr>
<tr>
<td>WWTF</td>
<td>Wastewater Treatment Facilities</td>
</tr>
</tbody>
</table>
# TMDL Summary Table

<table>
<thead>
<tr>
<th>EPA/MPCA Required Elements</th>
<th>Summary</th>
<th>TMDL Page #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Waterbody ID</strong></td>
<td>Pomme de Terre River, Muddy Creek to Marsh Lake: Turbidity 07020002-501</td>
<td>6</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>The Pomme de Terre River Watershed is located in the upper Minnesota River Basin in southwestern MN. The river starts in southern Otter Tail county, flows south through Grant, Stevens, and Swift counties. Parts of Douglas and Big Stone counties are included in the watershed also.</td>
<td>7, 8</td>
</tr>
<tr>
<td><strong>303(d) Listing information</strong></td>
<td>The impaired reach of the Pomme de Terre River from Muddy Creek to Marsh Lake was listed in 2002 for failure to meet turbidity standards. The MPCA’s projected schedule for the TMDL completions, as indicated on Minnesota’s 303(d) impaired waters list, implicitly reflects Minnesota’s priority ranking of this TMDL. This TMDL was prioritized to begin in 2008 and be completed in 2011.</td>
<td>6</td>
</tr>
<tr>
<td><strong>Impairment/TMDL Pollutants of Concern</strong></td>
<td>Turbidity</td>
<td>6</td>
</tr>
<tr>
<td><strong>Impaired Beneficial Uses</strong></td>
<td>The applicable water body classifications and water quality standards are specified in Minnesota rules Chapter 7050. Minnesota rules chapter 7050.0407 lists water body classifications and chapter 7050.0200 lists the beneficial uses. This water body is classified as impaired for aquatic life and aquatic recreation.</td>
<td>6, 12</td>
</tr>
<tr>
<td><strong>Applicable Water Quality Standards/Numeric Targets</strong></td>
<td>The Minn. R. ch. 7050.0222 subp. 4 and 5 sets the water quality standard for class 2B waters, which is the classification of the impaired reach in the Pomme de Terre River. If the standards in this part are exceeded, it is considered indicative of a polluted condition which is actually or potentially deleterious, harmful, or injurious with respect to designated uses or established classes of the waters of the state. The numeric criterion for turbidity, based on stream classification of a class 2B stream, is a standard of 25 NTU. Turbidity, however, is a dimensionless measurement and thus loading capacities cannot be calculated. A TSS surrogate is used to calculate loading capacity and to determine allocations. The TSS surrogate numeric target was determined to be 52 mg/L.</td>
<td>12</td>
</tr>
<tr>
<td><strong>Loading Capacity (expressed as daily loads)</strong></td>
<td>Flow regimes were determined for high, moist, mid-range, dry and low flow conditions. The mid-range flow value for each flow regime was then used to calculate the total daily loading capacity (TDLC). Thus, for the “high flow” regime, the TDLC is based on the daily flow value at the 5th percentile. How to convert flow and concentration to load: 1. Determine the median flow value for each regime. 2. Calculate the TSS surrogate equivalent of 25 NTU 3. For each flow regime, calculate the total liters per day Flow (cfs) x 28.31 (cubic feet per liter) x 86400 (sec. per day) 4. For each flow regime, calculate total mg of TSS: TSS surrogate (52 mg/L) x total liters 5. For each flow regime, calculate total tons TSS per day: Total mg TSS/907,184,740</td>
<td>20-21</td>
</tr>
</tbody>
</table>
Daily flows multiplied by the TSS surrogate value results in the load duration curve.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Loading capacity (tons/day)</th>
</tr>
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<tbody>
<tr>
<td>High</td>
<td>101</td>
</tr>
<tr>
<td>Moist</td>
<td>38.2</td>
</tr>
<tr>
<td>Mid</td>
<td>18.0</td>
</tr>
<tr>
<td>Dry</td>
<td>7.9</td>
</tr>
<tr>
<td>Low</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Turbidity levels are generally at their worst following significant storm events during the late spring and early summer months. See section 6.4 for a detailed description of seasonal variation of turbidity levels.

### Wasteload allocation

#### WWTF with discharge limits

<table>
<thead>
<tr>
<th>Source</th>
<th>Permit#</th>
<th>Individual WLA</th>
<th>WLA with RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>MNG580002</td>
<td>0.050</td>
<td>0.075</td>
</tr>
<tr>
<td>Appleton</td>
<td>MN0021890</td>
<td>0.055</td>
<td>0.083</td>
</tr>
<tr>
<td>Ashby</td>
<td>MNG580087</td>
<td>0.147</td>
<td>0.221</td>
</tr>
<tr>
<td>Barrett</td>
<td>MN0022713</td>
<td>0.171</td>
<td>0.256</td>
</tr>
<tr>
<td>Chokio</td>
<td>MNG580007</td>
<td>0.147</td>
<td>0.221</td>
</tr>
<tr>
<td>Chokio WTP</td>
<td>MNG640022</td>
<td>0.0015</td>
<td>0.002</td>
</tr>
<tr>
<td>Morris</td>
<td>MN0021318</td>
<td>1.425</td>
<td>2.175</td>
</tr>
<tr>
<td>Denco LLC</td>
<td>MN0060232</td>
<td>0.031</td>
<td>0.045</td>
</tr>
<tr>
<td><strong>Total (tons/day)</strong></td>
<td></td>
<td><strong>2.027</strong></td>
<td><strong>3.041</strong></td>
</tr>
</tbody>
</table>

#### Construction Stormwater

<table>
<thead>
<tr>
<th>Flow condition</th>
<th>Individual WLA (tons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0.03</td>
</tr>
<tr>
<td>Moist</td>
<td>0.011</td>
</tr>
<tr>
<td>Mid</td>
<td>0.005</td>
</tr>
<tr>
<td>Dry</td>
<td>0.002</td>
</tr>
<tr>
<td>Low</td>
<td>*</td>
</tr>
</tbody>
</table>

#### Industrial Stormwater

<table>
<thead>
<tr>
<th>Flow condition</th>
<th>Individual WLA (tons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0.06</td>
</tr>
<tr>
<td>Moist</td>
<td>0.023</td>
</tr>
<tr>
<td>Mid</td>
<td>0.011</td>
</tr>
<tr>
<td>Dry</td>
<td>0.004</td>
</tr>
<tr>
<td>Low</td>
<td>*</td>
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</table>

#### Permitted MS4

<table>
<thead>
<tr>
<th>Flow condition</th>
<th>Individual WLA (tons/day)</th>
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<tbody>
<tr>
<td>High</td>
<td>1.01</td>
</tr>
<tr>
<td>Moist</td>
<td>0.382</td>
</tr>
<tr>
<td>Mid</td>
<td>0.18</td>
</tr>
<tr>
<td>Dry</td>
<td>0.079</td>
</tr>
<tr>
<td>Low</td>
<td>*</td>
</tr>
</tbody>
</table>

* See section 5.8 for allocations for this specific category in this flow zone.

### Load allocation

<table>
<thead>
<tr>
<th>Flow condition</th>
<th>Load Allocation (tons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>86.76</td>
</tr>
<tr>
<td>Moist</td>
<td>30.93</td>
</tr>
<tr>
<td>Mid</td>
<td>12.97</td>
</tr>
<tr>
<td>Dry</td>
<td>3.99</td>
</tr>
<tr>
<td>Low</td>
<td>*</td>
</tr>
</tbody>
</table>

* See section 5.8 for allocations for this specific category in this flow zone.
Margin of Safety

Because the allocations are a direct function of daily flow, accounting for potential flow variability is the appropriate way to address the MOS explicitly for the turbidity impairments. This is done within each of five flow zones. An explicit 10% MOS was applied.

In the very lowest flow zone, the total daily loading capacity is very small due to the occurrence of very low flows in the long-term flow record. Consequently the MOS and WLA would exceed the allocation. To account for this unique situation, the WLA and LA are expressed as an equation rather than an absolute number. That equation is:

\[ \text{Allocation} = (\text{flow contribution from a given source}) \times (45 \text{ mg/L TSS}) \]

In essence, this amounts to assigning a concentration-based limit to the sources in the low flow zone, with the concentration limit being 45 mg/L TSS from the MN Rules, Chapter 7050.

<table>
<thead>
<tr>
<th>Flow Condition</th>
<th>MOS (tons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>10.1</td>
</tr>
<tr>
<td>Moist</td>
<td>3.8</td>
</tr>
<tr>
<td>Mid</td>
<td>1.8</td>
</tr>
<tr>
<td>Dry</td>
<td>.79</td>
</tr>
<tr>
<td>Low</td>
<td>*</td>
</tr>
</tbody>
</table>

* See section 5.8 for allocations for this specific category in this flow zone.

Seasonal Variation

While the highest river flows occur in April, the highest turbidity and TSS levels occur in June, as this is the month with the highest average rainfall. During an average June, 3,000 tons of suspended solids are carried down the river. Combined, April, May and June account for 73% of the sediment load carried by the river during the April through September monitoring season.

Reasonable Assurance

The source reduction strategies detailed in the implementation plan section have been shown to be effective in reducing turbidity. Many of the goals outlined in this TMDL study run parallel to objectives outlined in the local Water Plans. Various programs and funding sources will be used to implement measures that will be detailed in an implementation plan to be completed.

Monitoring

A detailed monitoring plan will be included in the Implementation Plan to be completed. Currently there are monitoring efforts in the watershed.

Implementation

A summary of potential management measures was included. More detail will be provided in the implementation plan that will be completed following approval of the TMDL.

Public Participation

The PdT Watershed Project submitted monthly newspaper articles to watershed newspapers updating people on the TMDL process and progress. Public meetings were held in Sept. of 2008 to inform citizens of the impact of the turbidity TMDL on the PdT River. Invitations were mailed out to agricultural organizations and township board members and meeting notices were placed in watershed newspapers. The PdT Watershed Project developed a display board to be taken to county fairs, home and garden shows, and University Extension events. During the summer of 2008, this display was viewed by over 3,000 people.
Executive Summary

The Minnesota Pollution Control Agency (MPCA) listed one stream reach on the Pomme de Terre River, from Muddy Creek to Marsh Lake (HUC: 07020002-501), as impaired for the designated use of supporting aquatic life under Section 303(d) of the Clean Water Act. The pollutant of concern contributing to the impairment is excessive turbidity. This Total Maximum Daily Load (TMDL) report describes the magnitude of the problem and provides direction for improving water quality for the listed reach.

The Pomme de Terre River Watershed is located in the upper Minnesota River Basin. The Pomme de Terre (PdT) River originates in southern Otter Tail County and flows 105.9 miles to the south where it discharges into Marsh Lake on the Minnesota River. Land use in this area is dominated by agricultural cropping and animal production. Beef and swine production represent nearly half of the approximately 64,000 animal units (AUs) in the watershed.

This report uses a load duration curve approach to determine the loading capacity in the impaired reach under varying flow regimes. A total suspended solids (TSS) surrogate was calculated at a 52 mg/L and used to calculate each loading capacity. The report focuses on TSS loading capacity and general allocations necessary to meet water quality standards at the impaired reach, rather than on precise loading reductions that may be required from specific sources.

TSS loading capacities were calculated for the impaired reach and those capacities are allocated among point sources (wasteload allocation), nonpoint sources (load allocation), and margin of safety. A loading capacity is the product of stream flow at the impaired reach and the surrogate TSS water quality standard. Five flow zones, ranging from low flow to high flow, are utilized so that the entire ranges of conditions are accounted for in the report.

The turbidity impairment seems to be directly correlated with rainfall events during the months of June, July and August. While the highest flows in the river occur in April due to the snowmelt runoff, the highest turbidity and TSS readings occur in June, which is the month with the highest average precipitation. Using the duration curve approach, and noting the hydrologic conditions where most of the exceedances occur, it shows that the increased load may be the result of sediment delivery associated with rainfall and runoff from riparian areas and saturated soils in the upland areas under wetter conditions.
Section 1: Introduction

1.1 Purpose

Section 303(d) of the Clean Water Act (CWA) provides authority for completing Total Maximum Daily Loads (TMDLs) to achieve state water quality standards and/or their designated uses. The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources.

A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Section 303(d) of the Clean Water Act (CWA) and its implementing regulations (40 C.F.R. § 130.7) require states to identify waters that do not or will not meet applicable water quality standards and to establish TMDLs for pollutants that are causing non-attainment of water quality standards.

Water quality standards are set by States, Territories, and Tribes. They identify the uses for each water body, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use.

A TMDL needs to account for seasonal variation and must include a margin of safety (MOS). The MOS is a safety factor that accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality. Also, a TMDL must specify pollutant load allocations among sources. The total of all allocations, including wasteload allocations (WLA) for point sources, load allocations (LA) for nonpoint sources (including natural background), and the MOS (if explicitly defined) cannot exceed the maximum allowable pollutant load:

\[
\text{TMDL} = \text{sumWLAs} + \text{sumLAs} + \text{MOS} + \text{RC}^*
\]

* The MPCA also requires that “Reserve Capacity” (RC) which is an allocation for future growth be addressed in the TMDL.

A TMDL study identifies all sources of the pollutant and determines how much each source must reduce its contribution in order to meet the quality standard. The sum of all contributions must be less than the maximum daily load.

Sources that are part of the waste load allocation, with the exception of “straight-pipe” septic systems, are largely controlled through National Pollutant Discharge Elimination System (NPDES) permits. Load allocation sources are controlled through a variety of regulatory and non-regulatory efforts at the local, state, and federal level.
The 2002 Minnesota TMDL Clean Water Act Section 303(d) list identified one impaired reach for the Pomme de Terre River Watershed. The reach was listed as impaired for failure to meet the aquatic life support designated beneficial use due to excessive turbidity concentrations.

1.2 Priority Ranking

The MPCA’s projected schedule for TMDL completions, as indicated on Minnesota’s 303(d) impaired waters list, implicitly reflects Minnesota’s priority ranking of this TMDL. The project was scheduled to begin in 2006 and be completed in 2010. Ranking criteria for scheduling TMDL projects include, but are not limited to: impairment impacts on public health and aquatic life; public value of the impaired water resource; likelihood of completing the TMDL in an expedient manner, including a strong base of existing data and restorability of the waterbody; technical capability and willingness locally to assist with the TMDL; and appropriate sequencing of TMDLs within a watershed or basin.

1.3 Criteria Used for Listing

The protocol for this assessment is outlined in MPCA “Listing Methodology” publications found at http://www.pca.state.mn.us/water/tmdl/index.html#support. The applicable water body classifications and water quality standards are specified in Minnesota Rules Chapter 7050. Minn. R. ch. 7050.0222, subp. 5 lists applicable water quality standards for the impaired reach and Minn. R. ch. 7050.0407 lists water body classifications. Assessment summary information for the impaired reach is listed in Table 1.1. The assessment protocol states that there needs to be at least 20 independent observations over the previous 10-year period. The reach is listed as being impaired if at least three (3) observations and ten percent (10%) of observations exceed the water quality standard of 25 Nephelometric Turbidity Units (NTUs).

<table>
<thead>
<tr>
<th>Reach</th>
<th>Description</th>
<th>Year Listed</th>
<th>River Assessment Unit ID</th>
<th># of observ. &gt;25 NTU</th>
<th>% of observ. &gt;25 NTU</th>
<th>Years of Data for Listing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pomme de Terre River</td>
<td>Muddy Creek to Minnesota River (Marsh Lake Dam)</td>
<td>2002</td>
<td>07020002-501</td>
<td>12</td>
<td>44.4</td>
<td>91-01</td>
</tr>
</tbody>
</table>

1.4 Watershed Association

The Pomme de Terre River (PdT) Watershed has been studied since May, 1964 when it was included in the West Central Minnesota Resource Conservation and Development Area (WesMin RC&D) plan. In 1981 the Pomme de Terre River Association was organized and a Joint Powers Board (JPB) was created and signed by the six counties and soil and water conservation districts (SWCDs) in
the watershed. The MPCA gave funding of $50,000 to the PdT Watershed Project at the end of June 2000 to compile all of the data that has been studied in the PdT River Watershed. The PdT River Association was awarded a grant in 2002 by the MPCA to investigate the water quality in the watershed. The Association was awarded a grant of $120,000 in 2008 by the MPCA to complete the turbidity TMDL and implementation plan. In addition, each of the six counties in the watershed contributed a total of $90,000 to the project. A Project Coordinator was hired in April of 2008 to complete the TMDL study and implementation plan.

**Section 2: Background Information**

**2.1 Watershed Characteristics**

The Pomme de Terre River Watershed is located in the upper Minnesota River Basin. It comprises nearly 560,000 acres or about 875 square miles. The majority of the watershed is in the Northern Glaciated Plains ecoregion with the northern tip in the North Central Hardwood Forest ecoregion. The counties and sub-watersheds are shown in Figure 2.1.
The average elevation in the watershed is 1198 feet above sea level. Precipitation in the watershed averages between 25 to 29 inches annually, with June being the month with the greatest average precipitation.

The majority of the Pomme de Terre Watershed is classified as rolling till prairie. Gently sloping to steep loamy glacial till soils with scattered sandy outwash soils and silty alluvial flood plain soils. This area is part of the prairie pothole region of the upper Midwest.

Drainage on the eastern side of the River is off the Big Stone Moraine, characterized by landscapes that are gently sloping to moderately steep (6-12%) and well drained silty and loamy soils. Water erosion potential within the Big Stone Moraine is generally classified as moderate. Waters falling on the western
side of the basin drain the Fergus Falls Till Plain, an outwash plain of nearly level to moderately sloping (0-6%) composed of poorly drained clayey and loamy soils. Slight to high water erosion potential exists across this section of the basin and is reflected by the character of the River below the town of Morris. South of this point, flowing through southern Stevens and eastern Swift Counties, the River is bordered by eroding, muddy banks becoming increasingly turbid before discharging into the Minnesota River at Marsh Lake.

The total human population in the watershed is estimated to be about 18,400 (2002 census, and 2006 League of Minnesota Cities). Of the total, nearly 9,700 people live in urban areas while 8,700 people live in rural areas (54% and 47% respectively).

Of the six counties within the drainage basin of the Pomme de Terre River, only four actually have the river within their boundaries. The PdT flows from north to south, originating in Otter Tail County amid numerous lakes and wetlands. The river then flows through Grant, Stevens and Swift Counties where it reaches the Minnesota River at Appleton. Big Stone and Douglas Counties have land areas that drain into the Pomme de Terre River through a series of small streams and tributaries. The land area of each county in the watershed is listed in table 2.1.

**Table 2.1: Acres and Percent of Watershed by County**

<table>
<thead>
<tr>
<th>County</th>
<th>Acres of County in Watershed</th>
<th>% of Watershed Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Stone</td>
<td>18,116</td>
<td>3.2</td>
</tr>
<tr>
<td>Douglas</td>
<td>19,930</td>
<td>3.6</td>
</tr>
<tr>
<td>Grant</td>
<td>100,334</td>
<td>17.9</td>
</tr>
<tr>
<td>Otter Tail</td>
<td>128,829</td>
<td>23.0</td>
</tr>
<tr>
<td>Stevens</td>
<td>221,334</td>
<td>39.5</td>
</tr>
<tr>
<td>Swift</td>
<td>71,421</td>
<td>12.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>559,964</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

There are about 104 Department of Natural Resources (DNR) protected lakes located in the watershed, 87 of which are located in Otter Tail and Grant Counties. These lakes act as buffers to the nutrient, sediment, and bacterial load to the river. Lakes, by virtue of their depth and volume, can slow the flow of a river, allow sediment to precipitate and dilute pollutants – sending cleaner water back to the river system.

There are four major tributaries that join the PdT River which are listed in Table 2.2. These tributaries connect the land use practices and their effects at the furthest reaches of the watershed to the main stem of the River, along with adding an additional volume of water.
### Table 2.2: Streams in the Pomme de Terre River Watershed

<table>
<thead>
<tr>
<th>STREAM NAME</th>
<th>TOTAL STREAM MILES</th>
<th>TOTAL PERENNIAL STREAM MILES</th>
<th>TOTAL INTERMITTENT STREAM MILES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artichoke Creek</td>
<td>2.7</td>
<td>0</td>
<td>2.7</td>
</tr>
<tr>
<td>Dry Wood Creek</td>
<td>10.1</td>
<td>3.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Muddy Creek</td>
<td>31.5</td>
<td>11.1</td>
<td>20.4</td>
</tr>
<tr>
<td>Pelican Creek</td>
<td>12.4</td>
<td>12.4</td>
<td>0</td>
</tr>
<tr>
<td>Pomme de Terre River</td>
<td>105.9</td>
<td>105.9</td>
<td>0</td>
</tr>
<tr>
<td>Unnamed streams and ditches</td>
<td>588.1</td>
<td>0</td>
<td>588.1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>750.7</strong></td>
<td><strong>132.6</strong></td>
<td><strong>618.1</strong></td>
</tr>
</tbody>
</table>

The 52 minor watersheds within the Pomme de Terre River Watershed can be combined by drainage areas into the following six sub-watersheds:
- Upper Pomme de Terre River
- Pelican Creek
- Middle Pomme de Terre River
- Muddy Creek
- Dry Wood Creek
- Lower Pomme de Terre River

A U.S. Geological Survey (USGS) flow gage, number 0529400, is located in the Lower Pomme de Terre River sub-watershed on the Pomme de Terre River in Appleton. Data has been collected from this flow gage since 1931 and is in current operation as a real-time site. Information about this USGS flow gage and available data can be found on the internet at:

### 2.2 Land Use

The Pomme de Terre River Watershed is largely rural. Cultivated land and grassland make up about 76% of the watershed, and urban land makes up nearly 2%. Cultivated includes confined animal feeding operations (CAFOs). Corn and soybeans make up about 50% of the crops grown in the watershed. The other 50% is made up mostly by smaller grains such as wheat, hay, and grasslands enrolled in the Conservation Reserve Program (table 2.3).

The majority of the cultivated land is in the lower three sub-watersheds (Dry Wood Creek, Muddy Creek, and Lower PdT) as seen in Table 2.4. These sub-watersheds also have the least amount of grassland and water/wetlands throughout the drainage area. The Middle PdT sub-watershed has a high percentage of cultivated land, but it also has one of the higher percentages of
grassland. The majority of the water/wetlands are located in the two most northern sub-watersheds, Pelican Creek and Upper PdT.

Table 2.3: Land Use in the PdT River Watershed

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Number of Acres</th>
<th>% Of Watershed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivated</td>
<td>386,362</td>
<td>68.9</td>
</tr>
<tr>
<td>Grassland</td>
<td>47,694</td>
<td>8.5</td>
</tr>
<tr>
<td>Forest</td>
<td>38,021</td>
<td>6.8</td>
</tr>
<tr>
<td>Water and Wetland</td>
<td>63,560</td>
<td>11.3</td>
</tr>
<tr>
<td>Urban/Residential</td>
<td>9,013</td>
<td>1.7</td>
</tr>
<tr>
<td>Other</td>
<td>15,314</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>559,964</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 2.4: PdT River Sub-Watershed Land Uses

<table>
<thead>
<tr>
<th>Sub-Watershed</th>
<th>Acres</th>
<th>Cultivated</th>
<th>Grassland</th>
<th>Forest</th>
<th>Water/Wetland</th>
<th>Urban/Residential</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Wood creek</td>
<td>61,778</td>
<td>82.5</td>
<td>5.2</td>
<td>2.2</td>
<td>8.0</td>
<td>0.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Lower PdT</td>
<td>97,382</td>
<td>83.5</td>
<td>6.3</td>
<td>3.0</td>
<td>1.9</td>
<td>3.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Middle PdT</td>
<td>137,733</td>
<td>72.4</td>
<td>9.4</td>
<td>3.9</td>
<td>9.5</td>
<td>2.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Muddy Creek</td>
<td>92,350</td>
<td>85.0</td>
<td>4.1</td>
<td>1.3</td>
<td>5.1</td>
<td>1.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Pelican Creek</td>
<td>84,939</td>
<td>42.2</td>
<td>15.5</td>
<td>14.7</td>
<td>22.7</td>
<td>1.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Upper PdT</td>
<td>85,496</td>
<td>44.7</td>
<td>9.5</td>
<td>16.7</td>
<td>23.2</td>
<td>1.4</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Section 3: Turbidity Standards and Assessment

3.1 Description of Turbidity

Turbidity is a measure of water clarity. Turbidity in water is caused by suspended sediment; organic material, dissolved salts, and stains that scatter light in the water column making the water appear cloudy. Excess turbidity can degrade aesthetic qualities of water bodies, increase the cost of treatment for drinking or food processing uses and can harm aquatic life. Aquatic organisms can have trouble finding food, gill function can be affected and spawning beds may become covered.
3.2 Applicable Water Quality Standards

The TMDL evaluation is a method of addressing and assessing the turbidity exceedances of the state standard. All waters of Minnesota are assigned classes, based on their suitability for the following beneficial uses (Minn. Rules part 7050.0200):

- Class 1- Domestic consumption
- Class 2- Aquatic life and recreation
- Class 3- Industrial consumption
- Class 4- Agriculture and wildlife
- Class 5- Aesthetic enjoyment and navigation
- Class 6- Other uses
- Class 7- Limited resource value

According to MN Rules ch. 7050.0430, the impaired reach covered in this TMDL report is classified as Class 2B, 3B, 4A, 4B, 5 and 6 waters. This TMDL is written for class 2B waters as this is the most protective class. MN Rules ch. 7050.0222 describes the designated beneficial use for 2B waters is as follows:

> The quality of Class 2B surface waters shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life, and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface water is not protected as a source of drinking water.

MN Rules ch. 7050.0222 subpart 5, turbidity water quality standard for class 2B waters, is **25 Nephelometric Turbidity Units (NTUs)**.

As turbidity is a dimensionless unit, loading allocations, capacities and reductions are commonly based on a surrogate parameter that is concentration based. Total suspended solids (TSS) are the measurement of sediment and organic matter that is suspended in a sample of water and is reported in milligrams per liter (mg/L). The TSS equivalence to 25 NTU for the Pomme de Terre River was determined to be 52 mg/L. Section 5.5 details the calculation of the TSS surrogate value to 25 NTU for this reach of the river.

3.3 Assessment Procedures

Transparency and TSS values reliably predict turbidity and can serve as surrogates at sites where there are an inadequate number of turbidity observations. Large sets of monitoring data have been used to develop transparency and TSS thresholds which will identify the large majority of waters with turbidity impairments while minimizing the number of waterbodies falsely identified. For transparency, a transparency tube measurement of less than 20 cm indicates a violation of the 25 NTU standard. For TSS, a measurement of more than 60 mg/L in the Western Corn Belt Plains and Northern Glaciated Plains ecoregions or more than 100 mg/L in the North Central Hardwood Forest ecoregion indicates a violation.

Turbidity is a highly variable water quality measure. Because of this variability, and the use of TSS and transparency as surrogates, a total of 20 independent observations (rather than 10) are now required for a turbidity assessment. If sufficient turbidity measurements exist, only turbidity measurements will be used to determine impairment. If there are insufficient turbidity measurements, any combination of independent turbidity, transparency, and total suspended solids observations may be combined to meet assessment criteria. If there are multiple observations of a single parameter in one day, the mean of the values will be used in the assessment process.

If there are observations of more than one of the three parameters in a single day, the hierarchy of consideration for assessment purposes will be turbidity, then transparency, then total suspended solids. For a water body to be listed as impaired for turbidity, at least 3 observations and 10% of observations must be in violation of the turbidity standard. This is an increase in the number of violations required, which was previously 10% of 10 required observations.

Section 4: Surface Water Quality Conditions

The turbidity and TSS dataset used for this TMDL was from 1997 to 2008 at the Appleton USGS monitoring station (STORET ID: S000-195). Transparency tube data was also collected at this site from 1997 to 2008, however, with the abundance of TSS data, the transparency tube data was not utilized. A summary of the data is provided in tables 4.1, 4.2 and 4.3.
Table 4.1 Summary of turbidity data for the PdT Watershed

<table>
<thead>
<tr>
<th></th>
<th>Appleton (S000-195)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years sampled</td>
<td>1997-2008</td>
</tr>
<tr>
<td>Number of observations</td>
<td>115</td>
</tr>
<tr>
<td>Percent of observations &gt; 25 NTU (state standard)</td>
<td>57%</td>
</tr>
<tr>
<td>Range, NTU</td>
<td>5.2-220</td>
</tr>
<tr>
<td>Mean, NTU</td>
<td>30.3</td>
</tr>
</tbody>
</table>

Although turbidity data was taken at the Appleton site from 1971-1976, no units of measurement were given for these samples, so these were not included in the data set. No turbidity data was taken from 1977-1996. The turbidity data used for this TMDL is from 1997-2008. It should be noted that this turbidity data was taken in three different measurement units, NTU, NTRU and FNMU. All the FNMU data was disregarded as the units of measurement were much different than the NTU and NTRU data. A statistical analysis was done by the MPCA and it was shown that the difference between the NTU readings and the NTRU readings was statistically insignificant, so turbidity readings with units of NTU and NTRUs were combined as one dataset (see appendix A). Only two turbidity and TSS samples were taken in both 1998 and 2000. In addition to 1998 and 2000, no TSS samples were taken in 2002, 1996 and 1978, so these years are not represented in tables 4.1 and 4.2, and figure 4.1.

TSS samples have been taken at the Appleton site since 1972, with the exception of the above noted years. From 1972-2003 the samples were taken approximately once a month, and from 2004 on, more frequent samples were taken. Stream transparency readings began to be taken in 1997 (fig. 4.3).

Table 4.2 Summary of TSS data for the PdT Watershed

<table>
<thead>
<tr>
<th></th>
<th>Appleton (S000-195)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Sampled</td>
<td>1972-2008</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>352</td>
</tr>
<tr>
<td>Percent of observations &gt; 52 mg/L (Surrogate value for the 25 NTU standard)*</td>
<td>41%</td>
</tr>
<tr>
<td>Range of TSS concentrations (mg/L)</td>
<td>.6 - 400</td>
</tr>
<tr>
<td>Mean TSS concentration (mg/L)</td>
<td>51</td>
</tr>
</tbody>
</table>

*See appendix A for description of TSS surrogate standard
Table 4.3 Summary of Transparency data for the PdT Watershed

<table>
<thead>
<tr>
<th></th>
<th>Appleton (S000-195)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years Sampled</td>
<td>1997-2008</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>119</td>
</tr>
<tr>
<td>Percent of observations &lt; 20 cm (Surrogate value for the 25 NTU standard)</td>
<td>54%</td>
</tr>
<tr>
<td>Range of Transparency readings (cm)</td>
<td>3-&gt;100</td>
</tr>
<tr>
<td>Mean transparency reading (cm)</td>
<td>23.4</td>
</tr>
</tbody>
</table>

Figure 4.1 shows the 1972-2008 yearly TSS concentration averages for the Pomme de Terre River at the S000-195 gauge in Appleton, MN. From 1972-1999 there were only 5 years where the yearly TSS average was above the 52 mg/L surrogate standard. From 2000-2008, there were 4 years where the yearly average was above the surrogate standard.

**Figure 4.1: 1972-2008 Yearly Average TSS concentrations (the corresponding TSS surrogate value for the 25 NTU standard is shown.)**
Section 5: Turbidity TMDL Development

The following describes the development process for the turbidity TMDL in the Pomme de Terre River Watershed.

5.1 Description of Impaired Reach

The Pomme de Terre River, from Muddy Creek located 7 miles south of Morris, MN down to Marsh Lake, just southwest of Appleton, MN was placed on the 303(d) impaired waters list in 2002 for excess turbidity. The impaired reach is the last 31 miles of the River, and is the last reach before the River empties into Marsh Lake and the confluence with the Minnesota River. Figure 2.1 displays the location of this impairment and its contributing 560,000 acre drainage area.

5.2 Components of Turbidity TMDL

Turbidity TMDLs consist of four components: Wasteload Allocation (WLA), Load Allocation (LA), Margin of Safety (MOS), and Reserve Capacity (RC).

WLA = Waste Load Allocation, which is the sum of all point sources, including:
- Permitted Wastewater Treatment Facilities (NPDES)
- Construction Stormwater (NPDES)
- Industrial Stormwater (NPDES)
- Permitted Municipal Separate Storm Sewer Systems (MS4) Communities

LA = Load Allocation, which is the sum of all nonpoint sources, including:
- Runoff from row cropland
- Feedlots with pollution hazards
- Livestock in riparian zone
- Impervious surface
- In-stream sources

MOS = Margin of Safety, a factor that accounts for any lack of knowledge concerning the effluent limitations and water quality.
- May be implicit and factored into conservative WLA or LA, or explicit

RC = Reserve Capacity (allocation for future growth)

The “Duration Curve” approach was utilized to address the turbidity TMDL. This process involved the following steps: compiling the flow data, producing a flow duration curve, calculating the TSS surrogate for the Pomme de Terre River, and determine loading capacity and allocations.
5.3 Compilation of Flow Data

The duration curve approach for turbidity involved using flow monitoring data from the Pomme de Terre River USGS gauging site (#05294000) located at Appleton, MN. The turbidity TMDL duration curve required daily mean flow values. A total of 7,012 daily flow values were compiled for the flow record, which spanned from 1977-2007. Flow data was available from 1931, but the last thirty years were used to better reflect current watershed conditions.

5.4 Development of the Flow Duration Curve

The daily flow values were sorted by flow volume, from highest to lowest, to develop a flow duration curve, shown in figure 5.1. The duration curve relates flow values to the percent of time those values have been met or exceeded. Thus, the full range of stream flows is considered. The cumulative flows are broken into five hydrologic conditions (low flows, dry conditions, mid-range flows, moist conditions and high flows). Low flows are exceeded a majority of the time, whereas floods are exceeded infrequently. Using this convention, flow duration intervals are expressed as a percentage, with zero corresponding to the highest stream discharge on record (flood conditions) and 100 to the lowest (drought). A flow duration of sixty associated with a stream discharge of 97 cfs implies that sixty percent of all observed stream discharge values equal or exceed 97 cfs.
5.5 Calculation of TSS Equivalent for Turbidity Standard

As turbidity is a dimensionless unit, loading allocations, capacities and reductions are commonly based on a surrogate parameter that is concentration based. Total suspended solids (TSS) are the measurement of sediment and organic matter that is suspended in a sample of water and is reported in milligrams per liter (mg/L). TSS is often used as a surrogate to calculate loading allocations and capacities for turbidity impairments.

MPCA protocol used for listed streams allows for the use of TSS data when adequate turbidity data is not available. The protocol suggests TSS values of 60 mg/L in the Western Corn Belt Plains Ecoregion and Northern Glaciated Plains Ecoregion is a violation of the standard. Most of the Pomme de Terre River is located in the Northern Glaciated Plains Ecoregion.

In reality, the relationship between turbidity and TSS varies in streams across Minnesota. Even different segments of the same stream can have varying relationships of TSS to turbidity. The relationship of turbidity and TSS will depend on contributing water sources and landscape features. Sediment particle size and type will also often change from one portion of a stream to another, which can have an impact on this relationship. To account for this issue, the MPCA
recommends that stream specific relationships of turbidity and TSS be made for each stream undergoing a TMDL (when adequate data exists). There was ample data to use the stream specific relationship for this TMDL.

To determine the TSS equivalent to the turbidity standard of 25 NTU, paired turbidity and TSS samples collected from the Appleton monitoring station (STORET ID S000-195) were compiled using data from 1997-2007. Based on criteria recommended by the MPCA (2007b), only sample sets with a turbidity value of 40 NTU or below and TSS values of 10 mg/L or above were used for the analysis. Review of turbidity data revealed varying methods of laboratory and field turbidity analysis. Following MPCA criteria, only accepted turbidity methods and types were used for the analysis. A total of 39 paired turbidity/TSS samples met these criteria. Of these 39 samples, 27 were NTRU samples and 12 were NTU samples. A regression analysis was completed on each as shown in figures 5.2 and 5.3. Using the regression line equation, a TSS concentration of 52 mg/L was determined to be the surrogate value to the 25 NTU standard. The complete write up and data set used for this analysis is in appendix A.

**Figure 5.2: Paired Turbidity (NTRU)/TSS samples**
5.6 Determining Loading Capacity (Maximum Amount of Pollutant)

Flow regimes were determined for high, moist, mid-range, dry and low flow conditions. The mid-range flow value for each flow regime was then used to calculate the total daily loading capacity (TDLC). Thus, for the “high flow” regime, the TDLC is based on the monthly flow value at the 5th percentile. Table 5.1 presents the flow regimes and the flow value used to calculate the TDLC.

Table 5.1: Flow Categories for the PdT River

<table>
<thead>
<tr>
<th>Flow Condition</th>
<th>Percent of Time Flow Exceeded</th>
<th>Flow Range (cfs)</th>
<th>Flow Used to Calculate Total Daily Loading Capacity (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0-10%</td>
<td>&gt;516</td>
<td>721</td>
</tr>
<tr>
<td>Moist</td>
<td>10-40%</td>
<td>170-516</td>
<td>273</td>
</tr>
<tr>
<td>Mid</td>
<td>40-60%</td>
<td>97-170</td>
<td>129</td>
</tr>
<tr>
<td>Dry</td>
<td>60-90%</td>
<td>27-97</td>
<td>56</td>
</tr>
<tr>
<td>Low</td>
<td>90-100%</td>
<td>&lt;27</td>
<td>18</td>
</tr>
</tbody>
</table>

Next, the TDLC for each flow regime was multiplied by the TSS surrogate standard of 52 mg/L, which is converted into tons of TSS per day using the following equation:
How to convert flow and concentration into sediment load

1. Determine the median flow value for each flow regime.

2. Calculate the TSS equivalent of 25 NTU (=52 mg/L)

3. For each flow regime, calculate the total liters per day:
   a. Flow (cfs) x 28.31 (cf/L) x 86,400 (sec./day)

4. For each flow regime, calculate total mg of TSS:
   a. TSS surrogate (52 mg/L) x total liters.

5. For each flow regime, calculate total tons of TSS per day:
   a. Total mg TSS/907,184,740 (mg/ton)

\[
\text{Flow x TSS surrogate x 28.31 x 86,400} \div 907,184,740
\]

Daily flows multiplied by the TSS surrogate value results in a load duration curve. Figure 5.4 presents the load duration curve for the Pomme de Terre River near Appleton with the TDLC for each of the five flow regimes. The loading capacity varies from 2.5 tons per day during low flow conditions, up to 101 tons per day during high flow conditions.

Figure 5.4: TDLC by Flow Regime
5.7 Determining Margin of Safety

Next, a Margin of Safety (MOS) was determined for each flow regime. The purpose of the MOS is to account for uncertainty that the allocations will result in attainment of water quality standards. For this TMDL, an explicit 10% MOS is applied. This is expected to provide an adequate accounting of uncertainty, especially given that wastewater treatment facilities have generally demonstrated consistent meeting of TSS discharge limits, and the mechanisms for soil loss from agricultural sources and the factors that affect this have been extensively studied over the decades and are well understood.

In the low flow zone, where the allocation required use of an alternative method of calculation, i.e., a concentration-based limit, an implicit MOS was used. An implicit MOS means that conservative assumptions were built in to the TMDL and/or allocations. In this instance the river is expected to meet the TMDL because the permitted point source dischargers are limited to discharge concentrations below the TSS target, thereby providing additional capacity.

5.8 TDLC, MOS and TMDL Allocations

Table 5.2 presents the TDLC, MOS and TMDL allocations for the Pomme de Terre River near Appleton. The TDLC minus the MOS results in the available wasteload and load allocations. The values expressed are in tons of TSS per day.

<table>
<thead>
<tr>
<th>Flow Condition</th>
<th>TDLC (tons TSS/day)</th>
<th>MOS (tons TSS/day)</th>
<th>Allocation (tons TSS/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>101</td>
<td>10.1</td>
<td>90.9</td>
</tr>
<tr>
<td>Moist</td>
<td>38.2</td>
<td>3.8</td>
<td>34.38</td>
</tr>
<tr>
<td>Mid</td>
<td>18.0</td>
<td>1.8</td>
<td>16.2</td>
</tr>
<tr>
<td>Dry</td>
<td>7.9</td>
<td>.79</td>
<td>7.11</td>
</tr>
<tr>
<td>Low</td>
<td>2.5</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

In the very lowest flow zone, the total daily loading capacity is very small due to the occurrence of very low flows in the long-term flow record. Consequently the MOS would take up most of the loading capacity. To account for this unique situation, the WLA and LA are expressed as an equation rather than an absolute number. That equation is:

\[
\text{Allocation} = (\text{flow contribution from a given source}) \times (45 \text{ mg/L TSS})
\]

In essence, this amounts to assigning a concentration-based limit to the sources in the low flow zone, with the concentration limit being 45 mg/L TSS from the MN Rules, Chapter 7050.
5.9 Split the TMDL into a Wasteload Allocation and Load Allocation

**WASTELOAD ALLOCATION**

**NPDES Industrial and Municipal Wastewater Treatment Facilities (WWTF)**

Through permit requirements, WWTFs may be allocated a concentration and or load based TSS effluent discharge limit. This TSS limit was then converted into tons per day of TSS. Table 5.3 provides the tons per day TSS discharge permitted to each of the facilities in the Pomme de Terre River Watershed. To account for potential future growth/expansion impacts, a reserve capacity of an additional 50 percent was added to each NPDES wasteload allocation.

**Table 5.3: Wastewater Treatment Facilities and Industrial Facilities with Numeric Discharge Limits for TSS**

<table>
<thead>
<tr>
<th>Name</th>
<th>Permit Number</th>
<th>Wasteload Allocation (Standard Tons TSS/day)</th>
<th>Wasteload Allocation with Reserve Capacity (Standard Tons TSS/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta</td>
<td>MNG580002</td>
<td>0.050</td>
<td>0.075</td>
</tr>
<tr>
<td>Appleton</td>
<td>MN0021890</td>
<td>0.055</td>
<td>0.0825</td>
</tr>
<tr>
<td>Del Dee Foods¹</td>
<td>MNG960027</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ashby</td>
<td>MNG580087</td>
<td>0.147</td>
<td>0.221</td>
</tr>
<tr>
<td>Barrett</td>
<td>MN0022713</td>
<td>0.171</td>
<td>0.256</td>
</tr>
<tr>
<td>TWF Industries²</td>
<td>MNG960027</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chokio</td>
<td>MNG580007</td>
<td>0.147</td>
<td>0.221</td>
</tr>
<tr>
<td>Chokio WTP</td>
<td>MNG640022</td>
<td>0.0015</td>
<td>0.0022</td>
</tr>
<tr>
<td>Dalton¹</td>
<td>MN0023141</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Morris</td>
<td>MN0021318</td>
<td>1.425</td>
<td>2.175</td>
</tr>
<tr>
<td>Underwood¹</td>
<td>MN0025071</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Denco LLC</td>
<td>MN0060232</td>
<td>0.031</td>
<td>0.045</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>2.027</strong></td>
<td><strong>3.041</strong></td>
<td></td>
</tr>
</tbody>
</table>

¹No discharge to surface water
²Discharges to Barrett WWTF

Six of the eight municipalities with WWTFs discharge to surface water, while two WWTFs, Dalton and Underwood, do not discharge to surface water, but discharge by spray irrigation and groundwater infiltration respectively. Alberta, Ashby, Barrett, Chokio, and Morris are all pond systems. Chokio also has a water treatment plant that has a filter backwash discharge TSS limit. Appleton is the only community with a mechanical system. TWF Industries Inc. is a metal finisher in Barrett. It discharges to the Barrett WWTF and no WLA is required. Del Dee Foods in Appleton has a land application of industrial byproducts pretreatment permit. There is no surface discharge and no WLA is required.

Denco LLC, an ethanol plant located in Morris, was the only industrial facility with a TSS effluent limit (table 5.3). The facility has a TSS concentration limit of 30 mg/L and a maximum design flow of .250 million gallons per day. This equates to a limit of .03 tons per day. This industrial wasteload allocation was utilized with the municipal WWTF allocations in table 5.4.
Municipal, Industrial and Construction Stormwater

In addition to the NPDES industrial TSS effluent limit, Denco LLC also has a stormwater outfall. This outfall also has a 30 mg/L TSS effluent limit but no design flow upon which an allocation could be based. This discharge will be handled with the industrial stormwater discharge WLA. If the facility is in compliance with its NPDES industrial stormwater permit requirements it will also be considered to be in compliance with the wasteload allocation.

APEC LLC has a permit to build an ethanol plant in Alberta. The permit authorizes the discharge of stormwater from outfall SD001. There is a TSS limit of 30 mg/L but no design flow value to calculate a load or allocation. Currently this project is on hold due to failure to obtain a permit from the DNR because of issues with the capacity of the aquifer to be able to supply the water needed for plant operation.

When applicable, permitted MS4 communities are also allocated a portion of the loading capacity based on percentage of land coverage in the impaired watershed. The City of Morris is designated for permit coverage because their population exceeds 5000 and they are within a half mile of an impaired water body (HUC: 07020002-502, biotic impairment for fish). The City of Morris currently covers about 0.79 percent of the watershed and thus receives 0.79 percent of the loading capacity. To account for future growth (reserve capacity), allocations in the TMDL for Morris as an MS4 community were rounded to 1% of the loading capacity to calculate the wasteload allocation.

The wasteload allocation for construction and industrial stormwater was determined based on percentage of land in the watershed affected by these uses. These uses primarily involve road construction projects, sand and gravel operations and new construction projects. The estimates are determined by the average number of acres per year in the last 4.5 years disturbed by these activities, divided by the total acreage in the watershed. Estimates as of 2007 are that 0.03% of the watershed has land disturbed by construction activities, and 0.06% of land disturbed by industrial activities.

Construction stormwater activities are considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install, and maintain all BMPs required under the permit, including any applicable additional BMPs required in Appendix A of the Construction General Permit for discharges to impaired waters, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

Industrial stormwater activities are considered in compliance with provisions of the TMDL if they obtain an industrial stormwater general permit or General Sand
and Gravel general permit (MNG49) under the NPDES program and properly select, install, and maintain all BMPs required under the permit.

**Load Allocation**

Once the WLA and MOS were determined for the given reach and flow zone, the remaining loading capacity was considered the load allocation. The load allocation includes nonpoint pollution sources that are not subject to NPDES permit requirement, as well as “background” sources, such as natural soil erosion from stream channel and upland areas.

**5.10 Turbidity TMDL for the Pomme de Terre Watershed**

Table 5.4 presents the Wasteload and Load Allocations for the impaired reach. The table provides allocations in tons per day and also in percent of total loading capacity.

**Table 5.4: TSS Total Daily Loading Capacities and Allocations**

<table>
<thead>
<tr>
<th>Pomme de Terre River: Muddy Creek to Marsh Lake</th>
<th>Flow Zone</th>
<th>High</th>
<th>Moist</th>
<th>Mid-Range</th>
<th>Dry</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU ID: 07020003-501</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watershed area: 560,000 acres 855 sq. mi.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Daily Loading Capacity</strong></td>
<td></td>
<td>101</td>
<td>38.2</td>
<td>18.0</td>
<td>7.9</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Wasteload Allocation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater Treatment Facilities and Industrial Facilities with Numeric Discharge Limits for TSS (NPDES)</td>
<td></td>
<td>3.041</td>
<td>3.041</td>
<td>3.041</td>
<td>3.041</td>
<td>*</td>
</tr>
<tr>
<td>Communities Subject to MS4 NPDES Permit Requirements</td>
<td></td>
<td>1.01</td>
<td>0.382</td>
<td>0.18</td>
<td>0.079</td>
<td>*</td>
</tr>
<tr>
<td>Construction Stormwater (NPDES)</td>
<td></td>
<td>0.03</td>
<td>0.011</td>
<td>0.005</td>
<td>0.002</td>
<td>*</td>
</tr>
<tr>
<td>Industrial Stormwater (NPDES)</td>
<td></td>
<td>0.06</td>
<td>0.023</td>
<td>0.011</td>
<td>0.004</td>
<td>*</td>
</tr>
<tr>
<td><strong>Wasteload Allocation Total</strong></td>
<td></td>
<td>4.14</td>
<td>3.45</td>
<td>3.23</td>
<td>3.12</td>
<td>*</td>
</tr>
<tr>
<td><strong>Load Allocation</strong></td>
<td></td>
<td>86.76</td>
<td>30.93</td>
<td>12.97</td>
<td>3.99</td>
<td>*</td>
</tr>
<tr>
<td><strong>MOS</strong></td>
<td></td>
<td>10.1</td>
<td>3.82</td>
<td>1.8</td>
<td>.79</td>
<td>Implicit</td>
</tr>
</tbody>
</table>

Value expressed as percentage of total daily loading capacity

<table>
<thead>
<tr>
<th>Pomme de Terre River: Muddy Creek to Marsh Lake</th>
<th>Flow Zone</th>
<th>High</th>
<th>Moist</th>
<th>Mid-Range</th>
<th>Dry</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU ID: 07020003-501</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watershed area: 560,000 acres 855 sq. mi.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Daily Loading Capacity</strong></td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Wasteload Allocation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater Treatment Facilities and Industrial Facilities with Numeric Discharge Limits for TSS (NPDES)</td>
<td></td>
<td>3.0%</td>
<td>7.9%</td>
<td>16.9%</td>
<td>38.5%</td>
<td>*</td>
</tr>
<tr>
<td>Communities Subject to MS4 NPDES Permit Requirements</td>
<td></td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>*</td>
</tr>
<tr>
<td>Construction Stormwater (NPDES)</td>
<td></td>
<td>0.03%</td>
<td>0.028%</td>
<td>0.029%</td>
<td>0.025%</td>
<td>*</td>
</tr>
<tr>
<td>Industrial Stormwater (NPDES)</td>
<td></td>
<td>0.06%</td>
<td>0.06%</td>
<td>0.06%</td>
<td>0.051%</td>
<td>*</td>
</tr>
<tr>
<td><strong>Wasteload Allocation Total</strong></td>
<td></td>
<td>4.09%</td>
<td>8.99%</td>
<td>17.99%</td>
<td>39.57%</td>
<td>*</td>
</tr>
<tr>
<td><strong>Load Allocation</strong></td>
<td></td>
<td>85.91%</td>
<td>81.01%</td>
<td>72.01%</td>
<td>50.43%</td>
<td>*</td>
</tr>
<tr>
<td><strong>MOS</strong></td>
<td></td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Implicit</td>
</tr>
</tbody>
</table>

* See section 5.8 for allocations for this specific category in this flow zone
5.11 Impacts of Growth on Allocations

Potential changes in population and land use over time in the Pomme de Terre River Watershed could result in changing sources of excess turbidity. Discussion on how these changes may impact TMDL allocations are discussed below.

Wasteload Allocations
Monthly TSS discharge limits for facilities with NPDES permits typically are from 30 to 45 mg/L. As discussed previously, the TSS equivalent to 25 NTU in the Pomme de Terre River is approximately 52 mg/L. While new facilities may add increased sediment loading to the system, they would also add additional water. As long as facilities continue to meet existing and new effluent limits, point sources would continue to have a minimal impact on the turbidity of receiving waters. There are no un-sewered communities in the watershed that would be building new WWTFs.

Load Allocations
The amount of land in agricultural land use in the Pomme de Terre River Watershed is likely to remain fairly consistent over the next two decades. The watershed is comprised primarily of row crops (corn and soybeans) and pasture and hay land. While the majority of the landscape is likely to remain in an agricultural land use, it is possible a shift from pasture/hay land to row crops could occur. While this could occur, this shift would likely not affect the loading capacity of the stream. This is due to the loading capacity being based on long-term flow value, and slight shifts in land use would likely not substantially increase or decrease annual flows.

Section 6: Turbidity Assessment

The following section details the most recent ten-year period of TSS loading and necessary reductions by varying flow conditions. The presentation of data also attempts to provide a general sense of the magnitude, timing and sources of TSS.

6.1 TSS Loading

Figure 6.1 presents TSS samples plotted on a load duration curve using flow data from the USGS gauging station # 05294000 at Appleton and water quality data from the Appleton monitoring station (STORET ID# S000-195). Figure 6.1 shows the loading capacity over the flow record (1977-2008) along with the 126 samples collected in the last eleven year period. For each sample, the TSS concentration was multiplied by the daily flow value to compute a daily load in tons of TSS. Values that lie above the load duration curve represent samples that exceed 52 mg/L. In addition, the 90th percentile values, and the median values are shown for each flow regime. The 90th percentile value is that reading that is
only exceeded by 10% of the data points. The median value is the reading in the middle of the data set. 50% of the readings are greater than the median value and 50% are less than the median value. The data show that exceedances of the TSS surrogate of 52 mg/L is more likely to occur at higher flow rates. When flows were less than the 50th percentile flow value (129 cfs), 53% of the samples exceeded the standard. When flow values are above 129 cfs, 61% of the samples exceeded the standard.

**Figure 6.1: Loading Duration Curve for PdT River**

![Figure 6.1: Loading Duration Curve for PdT River](image)

### 6.2 Necessary Load Reductions

An estimate for an overall load reduction percentage can be made using the existing dataset. To do so, it makes sense to consider the listing/delisting criteria for TSS, which is based on whether or not 10 percent of the data points within a dataset exceed the 52 mg/L TSS surrogate standard. Therefore, to meet the standard 90 percent of the time would mean reducing the 90th percentile value from the dataset down to 52 mg/L. The watershed-wide 90th percentile for TSS is 110 mg/L. And to reduce that to 52 mg/L would mean a reduction of:

\[
\frac{(110-52)}{110} \times 100 = 53\%
\]
This reduction percentage is only intended as a rough approximation, as it does not account for flow, and is not a required element of a TMDL. It serves to provide a starting point based on available water quality data for assessing the magnitude of the effort needed in the watershed to achieve the standard. This reduction percentage does not supersede the allocations provided in section 5.10 in which the loading capacity will be meeting the standard 100% of the time.

6.3 Potential Sources of TSS

Sources of TSS and turbidity in stream settings are often categorized as external and internal sources. External sources include point and non-point contributors. External point contributors would include municipal and industrial wastewater facility discharges. Examples of external non-point sources would include runoff from agricultural lands and stormwater from non-permitted communities. Internal sources would include streambed load movement and bank slumping. Internal processes can also include growth and decay of algae and other plant material in the channel or water column.

To help assess the sources of TSS loading, the duration curve was further enhanced to characterize wet weather concerns. Average daily stream discharge measurements on days preceding the collection of the ambient water quality sample were examined. Flow data on the day the sample was collected was compared with the flow the preceding day. Any one-day increase in flow is assumed to be the result of surface runoff (Cleland, 2003). In figure 6.2 these samples are identified with a green diamond.
Bruce Cleland of the US EPA (2002) has indicated that a weight of evidence relationship between the load duration curve intervals (Low Flows, Dry Conditions, Mid-Range Flows, Moist Conditions, High Flows) and the proximity or energy required by types of sources to be significant loaders may be use to support targeting implementation measures. To use the weight of evidence process, the relationships that exist for any one source between proximity (transport) and the ratio of stream loading must be better understood. Not all of the sources will dominate the conditions of a river during all duration curve intervals. The understanding of when the source is expected to be a dominant factor is used.

The percentage of TSS samples that violate the 52 mg/L TSS standard is greatest in the Mid-Range Flows (72% of samples exceed the standard) and in the Moist Conditions (62% of samples exceed the standard). Figure 6.3 is the load duration curve with the addition of two key transport discussions. The discussions are developed as a weight of evidence application for known sources and expected occurrence in the watershed.

1. The orange small dashed oval indicates the area where materials are typically transported from close proximity erosion areas in the watershed.
Mid-Range flows usually represent the rise of a hydrograph as it progresses out of the dry condition range and enters into wetter conditions. The zone of land use that is most likely to contribute during this period would be the riparian corridor of the river. This is because limited upland soil saturation and quite possibly soil erosion has yet to take place during the early period of storm events or in smaller events that can only deliver localized eroded soils. In agricultural areas, targeted programs for mid-range flow exceedances should focus on riparian protection. The targeted activities would be riparian buffers like the Conservation Reserve Program (CRP) or Conservation Reserve Enhancement Program (CREP).

2. The purple dashed oval indicates the area where material loading typically originates from both upland soils which under these wetter conditions are now saturated and begin contributing to the more effective transport of eroded materials and continuing to move riparian corridor eroded materials. In agricultural areas, target programs should also focus on saturated upland soils. Targeted activities could include conservation tillage techniques, contour strips and grassed waterways.

**Figure 6.3: Using the Load Duration Curve to Discuss Contributing Erosion Zones**

![Load Duration Curve](image-url)
6.4 Critical Condition and Seasonal Variation

The Environmental Protection Agency (EPA) states that the critical condition “…can be thought of as the “worst case” scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence” (USEPA, 1999). Turbidity levels are generally at their worst following significant storm events during the late spring and early summer months.

While the highest flow levels in the Pomme de Terre River occur in April and May due to snowmelt runoff (figure 6.4). The highest turbidity and TSS levels occur in June-September. There is a strong correlation when the turbidity and TSS levels are graphed with average monthly rainfall amounts (figures 6.5 and 6.6). This shows that high turbidity and TSS levels on the Pomme de Terre River are linked with rainfall events rather than snowmelt runoff. This is most likely due to the erosive power of raindrops on the soil before agricultural crop cover is fully developed.

Figure 6.4: Average Monthly flow

![Graph showing average monthly stream discharge](image_url)
When the USGS flow data is compared with TSS readings taken in Appleton, the amount of suspended solids flowing past the gauge can be computed as a monthly average (figure 6.7). The greatest amount of suspended solids occurs in June with a monthly average of 3,000 tons. The next highest month is April with a
monthly average of 2,940 tons per month. While the average Turbidity and TSS levels in April are below the 25 NTU standard and 52 mg/L TSS surrogate, the sheer volume of water flowing in the river during the month of April means a large volume of sediment is being transported down the river.

June is the month with the highest precipitation average, but with much less flow compared to April, indicating that rainfall runoff is the driving force. When combined, April, May, and June account for 73% of the sediment load in the river during the April through September monitoring season.

**Figure 6.7: Average Tons of Suspended Solids per Month**

![Average Tons of Suspended Solids per Month](image)

**Section 7: Monitoring Plan**

Water quality monitoring of the Pomme de Terre River will be needed to assess if reductions in turbidity are being achieved. A detailed monitoring plan will be included in the implementation plan which will be completed within one year of approval of this TMDL. Monitoring will be conducted by the Pomme de Terre River Watershed Association and the MPCA.

Currently, the S000-195 site in Appleton is part of the MPCA’s Major Watershed Pollutant Load Network Program. The purpose of this long term monitoring is to monitor nutrient and sediment loads at the mouths of 81 major watersheds in Minnesota (MN) based on the 8 digit HUC. It is also part of the MN Milestone River Monitoring Program. The purpose of this monitoring is to monitor site
specific long term trends, at a fixed set of more than 80 stream locations with sufficient length of data record, for a limited list of parameters that measure an aspect of stream health.

The Pomme de Terre River Watershed is also part of the MPCA’s intensive watershed monitoring program. This project is a problem investigation of water quality and biological impairments throughout the watershed. It is completed in two phases with phase I testing random sites throughout the watershed to determine the health of the stream system. Phase II identifies problem areas and focuses additional research to finding the sources of the problems. This project is funded through MPCA and is on a 10 year cycle. The Pomme de Terre River Watershed was the subject of phase I monitoring in 2007 and phase II starting in 2009. This watershed is scheduled to be re-tested in 2017.

Section 8: Implementation Activities

This section provides general implementation strategies targeted towards reduction of turbidity. Following approval of the Pomme de Terre turbidity TMDL study, a more detailed implementation plan will be developed. The implementation plan will use the potential source assessment, potential erosion factors, land use, public input, and other sources of information to determine which implementation strategies will best reduce turbidity. Implementation activities should focus on the priority areas of Muddy Creek, Dry Wood Creek and Lower Pomme de Terre sub basins.

8.1 Pasture Management

Pasture management includes exclusion of livestock from streams and use of rotational grazing.

Livestock with access to streams pose a major risk of contaminating waters in the stream or along the banks. Livestock can cause instability of stream banks, which leads to greater turbidity during higher flows. Exclusion of livestock through fencing will be an important step in reducing turbidity and fecal Coliform in the Pomme de Terre River.

8.2 Conservation Tillage

Conservation tillage is any tillage or planting system that leaves at least 30% of the soil surface covered by residue after planting. Conservation tillage maintains a ground cover with less soil disturbance than traditional cultivation, thereby reducing soil loss and energy use while maintaining crop yields and quality. Increased soil residue protects the soil from the erosive power of raindrops and helps reduce soil loss due to wind erosion. Conservation tillage techniques include minimum tillage, mulch tillage, ridge tillage, and no-till. As of 2007, 18.8% of cultivated land in the watershed is cultivated using conservation tillage.
techniques. In Stevens County, the county with the largest percentage of land in the watershed, only 0.7% of fields are cultivated with conservation tillage techniques.

8.3 Vegetative Practices

Vegetative practices include wetland restorations, filter strips, riparian buffers and grassed waterways. These practices minimize sediment runoff from agricultural lands through increased infiltration and decreased pollutant transport.

Wetland Restorations
Wetlands are natural swamps, bogs, sloughs, potholes or marshes that have saturated soils and water loving plants. Wetlands are important as they provide wildlife habitat and serve as a natural filter for agricultural and urban runoff. They also remove nutrients, pesticides and bacteria from surface waters. Wetlands slow overland flow and store runoff water, which reduces both soil erosion and flooding downstream.

Filter Strips
Filter strips are strips of grass and trees and/or shrubs that slow water and cause contaminants like sediment, chemical, and nutrients to collect in the vegetation. The nutrients and chemicals are then used by the vegetated filter strips, rather than entering water supplies and water bodies. Filter strips are often constructed along ditches, thus moving row crop operations farther from the stream.

Riparian Buffers
Riparian buffers are also strips of grass, trees and/or shrubs that slow water flow and prevent contaminants like sediment, chemical and nutrients from reaching streams and lakes. Riparian buffers are created in and along the cultivated floodplain and along the main stem of streams.

Grassed Waterways
A grassed waterway is where a natural drainage way is graded and shaped to form a smooth, bowl shaped channel. This area is seeded to sod-forming grasses. Runoff water flows down the drainage way, across the grass rather than tearing away soil and forming a larger gully. An outlet is often installed to stabilize the waterway and prevent a new gully from forming. The grass cover protects the drainage way from gully erosion and can act as a filter to absorb some of the chemicals and nutrients in runoff water.

8.4 Structural Practices

Water and sediment control basins, terraces, diversions, grade control structures, and channel restoration measures are all structural practices that help reduce runoff, reduce soil erosion, and reduce in channel erosion.
Terraces
Terraces break long slopes into shorter ones. As water makes its way down a hill, terraces serve as small dams to intercept water and guide it to an outlet. There are two types of terraces; storage terraces and gradient terraces. Storage terraces collect water and store it until it can infiltrate into the ground or be released through a stable outlet. Gradient terraces are designed as a channel to slow runoff water and carry it to a stable outlet like a grassed waterway.

Water and Sediment Control Basins
A water and sediment control basin is an embankment that is built across a depressional area of concentrated water runoff to act similar to a terrace. These basins trap sediment and water running off farmland above the structure. These structures help reduce gully erosion by controlling water flow within a drainage area. Spacing for water and sediment control basins depends on the land slope, tillage, and management system.

Diversions
A diversion is much like a terrace, but its purpose is to direct or divert runoff from an area. A diversion is often built at the base of a slope to divert runoff away from bottom lands. A diversion may also be used to divert runoff flows away from a feedlot, or to collect and direct water to a pond. Diversions help reduce soil erosion on lowlands by catching runoff water and preventing it from reaching farmland below.

Grade Control Structures
A grade control structure is a dam, embankment or other structure built across a gassed waterway or existing gully control. The structure drops water from one stabilized grade to another and prevents overfall gullies from advancing up a steep slope. Grassed, non-eroding waterways made possible with grade control structures give better water quality; can be crossed with equipment, and look better than non-stabilized gullies. Grade control structures can also be used to store water, which provides a water source and habitat for wildlife.

Open Tile Inlet Removal
Traditional open surface tile intakes can be a significant contributor of sediment to ditches, streams and rivers. Replacing open tile intakes with alternative designs like rock intakes, pattern tile with open inlets removed, and Hickenbottom intakes have the potential to reduce sediment while still providing adequate drainage.

Channel Restoration Practices
Practices that help stabilize streambank erosion to help restore channel stability and return the river to a more natural form. Measures such as arming the banks with bioengineering techniques or managing the thalweg with rock weirs or veins could be considered. These techniques should be part of a larger effort of
encouraging natural stream functions such as restoring meander access to a working flood plain and reintroducing pool-riffle-run characteristics.

8.5 Municipal Stormwater Management

The city of Morris will be required to apply for an MS4 permit which includes BMP implementation and education. Active enforcement of MS4 permit requirements and application of the required Storm Water Pollution Prevention Plans (SWPPP) will be required. Other communities in the watershed not required to obtain MS4 permits will be encouraged to implement BMPs. Educational efforts will also be conducted to inform residents about stormwater pollution. Urban stormwater BMPs such as street sweeping, raingardens, and stormwater conscious development will be promoted.

8.6 NPDES Permit Management

Municipal and Industrial NPDES permit holders are given discharge limits for TSS as part of their permit. The wasteload allocations assigned to these facilities are based upon their current permit limits and thus no reduction activities will be required. Construction and industrial stormwater activities following BMPs stated in a permit obtained from the NPDES program will not require further implementation activities.

8.7 Locally Targeted Implementation

Stevens County: The NRCS has 16 Wetlands Reserve Program (WRP) easements totaling 1,672.4 acres. There are 52 Conservation Reserve Enhancement Program (CREP)/Reinvest in MN (RIM) easements covering 1,635.2 acres

Muddy Creek Sub-Watershed: Located in Stevens County, has been identified as a high priority in the Local Water Management Plan (LWMP). It is listed as a priority for Continuous Conservation Reserve Program (CCRP) filter/buffer strips and wetland restoration. Reducing the turbidity and fecal coliform bacteria levels in Muddy Creek is identified as a priority action item in the Plan. Fencing and livestock exclusion practices are also targeted for this sub-watershed.

Swift County: Focus in Swift County has been on CRP wetland restoration and buffers to decrease the flash flows on the Pomme de Terre River. The Farmed Wetland Program has been successful for low areas in fields

Dry Wood Creek Sub-Watershed: Dry Wood Creek itself lies mostly in the Swift County boundaries, but the watershed is split between Swift, Stevens and Big Stone Counties. Monitoring has placed this sub-watershed in the high priority category.
**Grant County:** Grant County has utilized accelerated state cost-share programs to enroll buffers along waterways through a BWSR challenge grant. Buffers and wetland restoration remain a top priority in the Grant County LWMP.

**Otter Tail County:** At the top of the Watershed, Otter Tail County has focused their annual state cost-share dollars on sediment basins, funding six within the Pomme de Terre.

**Douglas County:** Over 400 acres have been set aside in CRP grass easements within this watershed. A very small portion of the Watershed is located in Douglas County and Lake Christina covers about one-fourth of it. A large portion of the remaining land is grassed due to wetness and poor cropping use.

**Big Stone County:** Even though a minimal amount of the watershed is in this County, they have four CREP easements totaling 205 acres, 40 acres in RIM, and a 133 acre WRP easement.

**8.8 Cost Estimate**

After approval of this TMDL, a detailed implementation plan will be created with extensive stakeholder involvement. This plan will spell out management practices and costs of implementing the recommendations of this TMDL. While payment rates and cost share amounts have not yet been set, it is estimated that over ten years, the cost to implement the management strategies to decrease turbidity in the Pomme de Terre River Watershed will be between $5.5 and $6 million dollars.

**Section 9: Reasonable Assurance**

As a requirement of TMDL studies, reasonable assurance must be provided demonstrating the ability to reach and maintain water quality endpoints. The source reduction strategies described in section 8.0 have been shown to be effective in reducing sediment load and turbidity. These strategies are capable of widespread adoption by landowners and local resource managers.

Many of the goals outlined in this TMDL study run parallel to objectives outlined in the six watershed counties’ Local Water Plans. These plans have the same goal of removing streams from the 303(d) Impaired Waters List. These plans provide watershed specific strategies for addressing water quality issues.

Various program and funding sources will be used to implement measures that will be detailed in an implementation plan to be completed in the year following approval of this TMDL. Funding sources include a mixture of state and federal programs, such as the Environmental Quality Incentive Program (EQUIP), Conservation Reserve Program (CRP), and Clean Water Legacy funding. Local
officials agree there is a need for additional BMP’s and through implementation water quality improvement can be realized.

Section 10: Public Participation

Public participation opportunities were provided during the project in the form of public meetings held in September of 2008, March of 2009, and November of 2009, monthly newspaper articles about the watershed and its impairments, and project informational handouts. The public participation materials can be found in Appendix B. At the onset of the project, a Technical Advisory Committee (TAC) was formed that served as an advisory and review role for the project. This group was comprised of staff from the following groups:

- Ottertail County SWCD
- Douglas County SWCD and Planning and Zoning
- Grant County SWCD and Planning and Zoning
- Stevens County SWCD and Environmental Services
- Swift County NRCS and Planning and Zoning
- Big Stone County SWCD and Planning and Zoning
- WesMin RC&D
- MN Board of Water and Soil Resources (BWSR)
- MN DNR
- West Central Environmental Consultants

The technical committee met quarterly. The committee assisted with reviewing the project workplan, outreach materials and the draft TMDL report. Key findings were discussed and input was gathered from the group.

Public outreach for this project also included the following activities:

- May 2008 Project coordinator gave a presentation about the TMDL project to Morris Area High School Environmental Science Class.
- May 2008 Project coordinator gave a radio interview about the Pomme de Terre TMDL project
- May 2008 Project coordinator and Stevens SWCD participated in a joint DNR MAHS shoreline restoration project at PdT Park in Morris, MN. Coordinator talked about the project to school children assisting with the project, and a newspaper article was written about the project.
- May 2008 Article about the TMDL projects was submitted to the Pomme de Terre Lake Association annual newsletter.
- May 2008 PdT Watershed Project submitted newspaper article one to five watershed newspapers.
June 2008  PdT TMDL display board displayed at MN DNR shore lands meeting in Alexandria, MN.

July 2008  PdT Watershed Project submitted newspaper article two to five watershed newspapers.

July 2008  PdT TMDL display board displayed at the University of Minnesota, West Central Research and Outreach Center annual field day.

July 2008  PdT coordinator attended a meeting with Stevens County Farm Bureau members and the MN Ag Waters Resource Coalition. Topic of this meeting was the TMDL process and the importance of producer stakeholder involvement.

July 2008  PdT display board displayed at the University of Minnesota, West Central Research and Outreach Center annual Horticulture Night.

Aug. 2008  PdT Watershed Project submitted newspaper article three to five watershed newspapers.

Aug. 2008  PdT Watershed Project displayed at the Stevens County Fair, TMDL materials handed out at Swift County Fair.

Sept. 2008  PdT Watershed Project submitted newspaper article four to five watershed newspapers 

Sept 2008  Watershed Public Meeting held in Morris

Sept 2008  PdT canoe trip with C.U.R.E. in Appleton, MN

Oct. 2008  PdT Watershed Project submitted newspaper article five to five watershed newspapers.

March. 2009  Combined JPB, TAC, Turbidity stakeholder group meeting held in Morris.

A meeting was held on November 23, 2009 to present the draft TMDL report to the public.
Section 11: References


Minnesota Tillage Transect Survey Data Center. Located at: [http://mrbdc.wrc.mnsu.edu/transect/minnesotamn.htm](http://mrbdc.wrc.mnsu.edu/transect/minnesotamn.htm). [Accessed February 27, 2009.]


Turbidity TMDL Assessment for the Pomme de Terre River

Appendix

Appendix A: Development of Total Suspended Solids Surrogate
Appendix B: Public Participation Materials
Appendix A: Development of Total Suspended Solids Surrogate

Development of Total Suspended Solids (TSS) Surrogate for Turbidity in the Pomme de Terre River Watershed

April 2009
Katherine Pekarek-Scott
Minnesota Pollution Control Agency

1. Background

The Pomme de Terre River Watershed is in the Minnesota River Basin and has one reach impaired for turbidity. This impaired reach, AUID 07020002-501, is located on the Pomme de Terre River and starts from where Muddy Creek enters and ends at Marsh Lake where the Pomme de Terre River enters the Minnesota River. While this watershed is within the Minnesota River Basin, this impaired reach was not included in the Minnesota River Turbidity TMDL. A map of the project area is shown in Figure 1.

![Figure 1: Pomme de Terre River Watershed](image)
Turbidity is a means of measuring the clarity of water by measuring how much light is absorbed or scattered in a sample of water (Johnson, 2007). This light can be scattered or absorbed by suspended sediments, algae, organic matter, and color. TMDL allocations are calculated as concentrations of a specific pollutant. To determine a concentration, the mass of that pollutant is needed. Turbidity is an optical measurement, not one of mass. For this reason, turbidity is not used directly in a TMDL, but rather a surrogate is developed from the turbidity data.

Research has been compiled to correlate Total Suspended Solids (TSS) to turbidity, making it a viable surrogate. The MPCA’s Guidance Manual for Assessing the Quality of Minnesota Surface Waters states 60 mg/L and 100 mg/L of TSS in Western Corn Belt Plains and North Central Hardwood Forest ecoregions respectively equal the turbidity water quality standard (MPCA, 2007a). Often referred to as surrogates, these concentrations will identify the majority of turbidity-impaired waters while keeping falsely identified waters to a minimum. It should be noted that there are enough differences between sites, streams, and watersheds that an individual correlation should be made for each monitoring site.

2. Methods

2a. Data Utilized

The data used in this analysis was collected from one site in Appleton. The STORET station identification number is S000-195 and is located on the Pomme de Terre River upstream of MN Highway 119 and US Highway 59. Although data has been collected at this station since 1971, only data from 1996 and later was used in this analysis.

Turbidity data can be reported in a number of units, depending upon the meter and method used for testing. For site S000-195, the turbidity data was reported in units of NTU, NTRU, FNMU, FNU, and NONE in STORET. The units of FNMU and FNU are field measurements and do not have laboratory paired data for comparisons. Given potential variation in values between reporting units, a comparison is needed to correlate the field measurement with the turbidity water quality standard in units of NTU (MPCA, 2007). This data, therefore, will not be used since it does not have paired laboratory data and cannot be correlated to the standard. The units of NONE are from field testing and laboratory testing. It was determined that the field units were FNMU and thus not used. The laboratory testing was conducted from 1971 to 1981 and may have been in units of NTU. However, through unit conversions and with insufficient information about the data, this data was not used due to a lack of certainty in reporting units. Of the remaining data points, five observations were not used as a result of the Stearns DHIA Laboratory not being certified for testing turbidity. The remaining data for analysis are summarized in Table 1 for each unit. A complete list of the data used is at the end of this Appendix.

Table 1: Units, years of data, and the number of observations possible to utilize in the analysis

<table>
<thead>
<tr>
<th>Units</th>
<th>Years of Data</th>
<th>Number of Observations</th>
<th>Lab</th>
</tr>
</thead>
</table>
2b. Comparing NTU and NTRU

There are different methods and different equipment that can measure turbidity and these can produce different units. These units of raw data should not be considered directly interchangeable since they can differ by factors of two or more (MPCA, 2007b). The two units in this analysis were found to be from the same type of meter, Hach 2100AN. The Hach 2100AN meter can report in units of NTU and NTRU, depending if the ratio compensation is used. ERA Laboratories reported in NTU by using the Hach 2100AN with the ratio compensation “off” (Magnuson, personal communication, 2008). With the ratio compensation “off”, the meter uses a single white light source with a single light detector located at 90 degrees to the light source. The Minnesota Department of Health (MDH) laboratory reported in NTRU by using the Hach 2100AN with the ratio compensation “on” (Johnson, 2007). The meter, when the ratio compensation is “on”, uses a single white light source and multiple light detectors. The first detector is located at 90 degrees to the light source and the other light detector is located at a wider angle with a “ratio” being made between the two.

Since two different methods were used, a comparison was needed. Of the data set that is available for comparing NTUs and NTRUs, only data from 2006 to 2007 overlap. This gives 21 NTU and 25 NTRU sampling occasions. After an overview of the data, there were two occasions of paired data and three occasions of “nearly paired” data where the samples were taken within a day of each other. All of the data were plotted by date (Fig. 2) and with flow (Fig. 3) to visually see if there are any apparent differences. These visual comparisons do not show any apparent differences between NTU and NTRU.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Period</th>
<th>Value</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTU</td>
<td>2004-2007</td>
<td>40</td>
<td>ERA</td>
</tr>
</tbody>
</table>

Figure 2: NTU and NTRU Turbidity units compared by date
With no apparent difference between the two data sets, further analysis was completed. Assuming normality with skewness and kurtosis values, a t-test was run. The results of the t-test indicate that there is no significant difference between the means of the NTU and NTRU data. However, with the assumption of normality, a decision was not made on this result alone.

The raw turbidity data was then compared to the TSS data for the purpose of checking the validity of the turbidity data. A linear regression was completed and TSS concentrations were calculated from 25 NTU and 25 NTRU. The difference between the two TSS values was within ten percent of each other. The differences between the slopes and intercepts were not calculated, but could be in the future if needed.

To see how the NTU and NTRU data relates more directly, a regression analysis was completed with the paired and “nearly paired” data. It is important to note that with only 5 data sets, there is limited confidence in the results. Using the regression equation, a 25 NTRU value produced a 24.5 estimated NTU value.

Recent work completed by MPCA staff compared the two units and developed a conversion factor. This was completed by using paired data from a river remote sensing study in 2004 by MPCA staff and was developed for the Minnesota River, West Fork Des Moines River, and Pipestone Creek (Johnson, 2007). However, as stated earlier, there is variability and uncertainty with turbidity and work should be completed for each individual site. A regression analysis was run to compare NTU values and the values of
NTRU after being converted to NTU to TSS. The TSS values calculated from the regression equation produced two TSS values that have a difference of over 30 mg/L. Therefore, the conversion factor that was developed through this work was not utilized for the Pomme de Terre River data due to a lack of supporting evidence that a difference in NTU and NTRU values was present.

A determination was made that NTU units and NTRU units would be compared separately to TSS. However, with the amount of evidence provided, a TSS surrogate should be developed for 25 NTU and 25 NTRU assuming that the turbidity data is similar.

2c. Developing a TSS Surrogate

TSS was compared with turbidity by following the “Turbidity TMDL Protocol and Submittal Requirements” (MPCA, 2007b). This included filtering the data set so that the turbidity was less than 40 NTU and the TSS was greater than 10 mg/L. TSS was plotted as the independent variable (x-axis) and turbidity as the dependent variable (y-axis). Excel and Minitab were used to run the regression analysis.

In order to use regression analysis to calculate a TSS surrogate, paired data between TSS and turbidity is needed. Of the possible 84 turbidity observations, 58 were paired with a TSS observation. After the data was filtered, there were 41 TSS samples (Table 2).

<table>
<thead>
<tr>
<th>Data Set</th>
<th># of TSS Observations</th>
<th># of NTU Observations</th>
<th># of NTRU Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Data</td>
<td>58</td>
<td>20</td>
<td>39</td>
</tr>
<tr>
<td>Filtered Data</td>
<td>41</td>
<td>13</td>
<td>29</td>
</tr>
</tbody>
</table>

A regression analysis was performed for individual turbidity units and the TSS surrogate value was correlated to 25 NTU and 25 NTRU as indicated in Section 2b.

The datasets were tested for normality and found to have reasonably normal distributions. Since there are normal distributions, linear equations were able to be produced without having to transform the data. There was one data point that had been removed as an outlier since it had obviously skewed the regression (Table 3). No statistical calculation was performed to prove this assumption, but may be performed in the future if needed.

3. Results

The following TSS-turbidity regression plots, Figures 4 and 5, are for each turbidity unit. Figure 4 shows a fairly strong correlation ($r^2$: 0.76) of NTU data to TSS data. Figure 5
displays the NTRU and TSS data, although the correlation is not as strong as Figure 4 ($r^2$: 0.62), data still indicates a positive relationship.

![Figure 4: Regression analysis for TSS and NTU Turbidity units](image1)

![Figure 5: Regression analysis for TSS and NTRU Turbidity units](image2)

The TSS surrogate values for 25 NTU and 25 NTRU are summarized in Table 4 with the corresponding $r$-squared value. These values are estimates for the given data and conditions during data collection. For the purposes of the Pomme de Terre Turbidity Assessment, the TSS concentration of 52 mg/L will be used for determining allocations.

![Table 4: TSS surrogate value for each turbidity unit](table)

<table>
<thead>
<tr>
<th>Turbidity Unit</th>
<th>TSS Surrogate (mg/L) value of 25</th>
<th>$r^2$</th>
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</thead>
<tbody>
<tr>
<td>NTU</td>
<td>52</td>
<td>0.76</td>
</tr>
<tr>
<td>NTRU</td>
<td>52</td>
<td>0.62</td>
</tr>
<tr>
<td>SAMPLE DATE</td>
<td>TSS (mg/l)</td>
<td>Turbidity (NTRU)</td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td>4/14/1997</td>
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<tr>
<td>5/17/2006</td>
<td>60</td>
<td>28</td>
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</table>
References


Magnuson, Bob. Personal communication. 2008. ERA Laboratories, Duluth, MN.


Appendix B: Public Participation Materials

Turbidity Brochure

What Happens After the TMDL is Developed?
Once the TMDL is approved by the EPA, an implementation plan will be developed. The plan will identify sources and causes of each pollutant and provide a strategy for implementation of preventative management measures needed for the water body to meet water quality standards.

Citizen involvement, education and outreach, and pollution prevention are key components of all TMDL implementation plans.

What is Turbidity?
Turbidity is measurement of water clarity. A decrease in water clarity is caused by suspended and dissolved matter such as clay, silt, algae, silt, and mud. Turbidity is recognized as an indicator of water quality. Increased turbidity levels from light pollution and similar habitat plan growth. High turbidity can make it a little call for aquatic organisms to find food, which then increases the turbidity. What is the TMDL?

What is a TMDL?
According to the Environmental Protection Agency, “Total Maximum Daily Load” is a calculation of the maximum amount of pollution a waterbody can receive and still meet water quality standards, and an attempt to determine the amount of pollutants in the pollutants source.

The TMDL identifies the sources of each pollutant that is to meet the water quality standards. Water quality monitoring and computer modeling determine how much each pollutant source water release to the contribution to ensure the water quality standard is met.
By Diane Mckown, Coordinator, Pomme de Terre Watershed Project

As most of us who live in the area know, the Pomme de Terre is a beautiful river. But do you know where it is? Do you know exactly what is meant by a watershed? Do you know how the Pomme de Terre Watershed Project can help preserve the river and ensure its continued health?

A watershed is an area of land where all of the water that drains toward a common point—be it a river, lake, or reservoir—originates from that land mass. The Pomme de Terre Watershed is the area of land that drains into the Pomme de Terre River. It includes all of the land within the drainage basin of the river.

The Pomme de Terre Watershed Project was established in 1992 to protect and enhance the river's natural resources. The project works to reduce pollution, improve water quality, and increase public awareness of the river's importance.

The Pomme de Terre Watershed is one of the largest in Minnesota, stretching from the Red River of the North to the Iowa border. It includes parts of 11 counties and covers more than 1.3 million acres.

The project's goals are to reduce non-point source pollution, improve water quality, and enhance the river's natural resources. This includes activities such as stream cleaning, habitat restoration, and education programs.

In addition to its work on the Pomme de Terre River, the project also works to protect and enhance other watersheds within the region. This includes the Red River of the North, the Big Fork River, and the Jay Cooke River.

The Pomme de Terre Watershed Project is a non-profit organization funded by membership dues, grants, and donations. It is supported by a dedicated group of volunteers and partners who work together to ensure the continued health and vitality of the Pomme de Terre River and its watersheds.

If you would like to learn more about the Pomme de Terre Watershed Project or get involved, visit their website at pomme-de-terre.org. Together, we can work to protect and enhance this beautiful and important resource.
Impaired waters topic of Farm Bureau meeting

Stevens County Farm Bureau is hosting an informational meeting for local producers on July 15 at 3:30 p.m. in the AgCountry Conference Room.

Warren Formo, director of the Minnesota Agricultural Water Resources Coalition (MAWR), will provide background information on the TMDL process and the importance of farmer involvement at the local level. The MAWR is a recently formed coalition consisting of Minnesota's Farm Bureau, Corn Growers, Soybean Growers, Milk Producers, Pork Producers, and Wheat Growers organizations. Shaun McNally, Pomme de Terre Watershed Project Coordinator, will also be there to explain the process of developing and implementing a TMDL reduction plan.

Recently, the MPWCA has placed a stretch of the Pomme de Terre River from Muddy Creek just south of Morris to a point just south of Marsh Lake in the impaired waters list due to excessive levels of fecal coliform form and excessive turbidity. Turbidity TMDL's often focus on erosion from fields, livestock over-grazing pastures, or damaging stream-banks, and link streambank erosion to tile drainage.

Stevens County Farm Bureau is concerned about inadequately accounting for natural background levels, and streambank erosion. Newer research is finding that the vast majority of turbidity is from near-channel sources (stream banks, gullies, ravines, etc.) and not from runoff from fields that are farther from the stream. The MPWCA and the Pomme de Terre Watershed Project encourage local agricultural producers to contribute ideas and suggestions to develop and implement plans to meet the TMDL's pollution reduction goal and restore the waters to standards.

Pomme de Terre Watershed Project

Point and Non-Point pollution

Pomme de Terre Watershed Project

Turbidity and suspended solids

The following is taken from a series of articles about the Pomme de Terre Watershed Project. The series is sponsored by the Minnesota Agricultural Water Resources Coalition (MAWR) and the Minnesota Geological Survey (MGS).

Muddy water, murky water: clearly water. If you've ever used these terms to describe a body of water, you're probably thinking of water that is cloudy or murky. This type of water can be caused by a variety of factors, including natural processes, human activities, and climate conditions. In the Pomme de Terre Watershed, turbidity and suspended solids are a major concern.

Turbidity is measured using special optical equipment that can detect small particulate matter in water. Turbidity can be caused by a variety of factors, including natural processes, human activities, and climate conditions. In the Pomme de Terre Watershed, turbidity and suspended solids are a major concern.

Suspended solids are particles that are suspended in water and can cause water to appear cloudy or murky. These particles can include sediments, organic debris, and other matter. In the Pomme de Terre Watershed, suspended solids can be transported by wind, rain, and other natural processes.

The Pomme de Terre Watershed Project is working to reduce turbidity and suspended solids in the Pomme de Terre River and its tributaries. The project uses a combination of strategies, including land management practices, sediment control structures, and public education.

Our website has been recently updated. Please check it out at new.pomme-de-terre.org.
Public Meeting
Thursday Sept. 18, 2008

Old #1 Bar and Grill Southside
412 Atlantic Ave
Morris, MN

7-9 pm

Come and find out about the new Pomme de Terre Watershed turbidity TMDL project and get an update on the approved fecal Coliform TMDL and implementation plan. Find out how you can play a role in helping develop an implementation plan to clean up the Pomme de Terre River.

Free Refreshments!
PUBLIC MEETING
Thursday, Sept. 18, 2008
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412 Atlantic Avenue
Morris, MN • 7-9 PM

Come and find out about the new Pomme de Terre Watershed turbidity TMDL (Total Maximum Daily Load) Project and get an update on the approved fecal Coliform TMDL and implementation plan. Find out how you can play a role in helping to develop a turbidity implementation plan to clean up the Pomme de Terre River Watershed.
Pomme de Terre River Watershed
Public Meeting
Sept. 18, 2008

Comment Form

1. After hearing tonight’s presentation, do you have any specific questions regarding the Pomme de Terre TMDL studies?

2. Do YOU have any suggestions for improving the water quality within the Pomme de Terre Watershed?

3. Are you willing to attend future meetings to receive updates and provide input regarding the Pomme de Terre TMDL study?

Name (optional): ___________________________________________
9/18/08 Kickoff Meeting Slideshow

**What is Turbidity?**

- Turbidity is caused by particles suspended or dissolved in water that scatter light.
- Particles can include: sediment especially clay and silt, fine organic and inorganic matter, soluble colored organic compounds, algae, and other microscopic organisms.
- In the MN River Basin, sediment is the primary cause of high turbidity.

**How is Turbidity Measured?**

- Using a specialized optical turbidity meter.
- A beam of light is shot through the sample and the amount the light is scattered is measured.
- The unit of measure is the Nephelometric Turbidity Unit (NTU).
- The more turbid the water, the more the light will be scattered leading to a higher NTU reading.

**Muddy Water**

- Turbidity is linked to the "look" of the water and therefore the public perception of water quality.
Turbidity Sources

- Runoff and erosion of agricultural areas is one of the biggest contributors of sediment to rivers, lakes, and streams.
- These are considered "non-point sources."

Erosion Rates

- Agricultural birds can contribute on average 7.544 tons per sq. mile per year of sediment to waterways due to erosion.

Erosion Rates

- Compare that with erosion rates on lands with undisturbed grass cover:
  - 1.75 tons per sq. mile per year of eroded sediment.

What Does This Mean For The Pomme de Terre?

- The Pomme de Terre is classified as a class 2B stream.
  - It's beneficial use is cool and warm water fisheries and all recreation.
  - The EPA sets numeric criteria for each class of stream.

Turbidity Standard

- For a water body to be listed as impaired for turbidity 10% of samples must be in violation of the turbidity standard.
- 61% of the samples from the lower reach of the Pomme de Terre during the last 10 years violated the standard.
**Yearly Turbidity Averages on the Pomme de Terre**
- The graph shows the yearly turbidity averages since 1997.
- The trend is consistently increasing turbidity levels.

**Turbidity on the Pomme de Terre**
- This graph shows the average turbidity levels in the river month by month.
- The standard is 25 NTU.
- Exceeded June-Sept.

**Impacts of High Turbidity**
- Reduce the aesthetic quality of the water
  - Necrotic tissue from dirty water
- Increased cost for water treatment
- Lakeshore property values directly relate to water clarity.
- Harm aquatic life
  - Reduce food supplies
  - Degraded spawning beds
  - Affect gill function

**Total Suspended Solids (TSS)**
- TSS is often used as a surrogate measurement for turbidity.
- A water sample is poured through a filter, and the solids that are left on the filter are weighed.
- TSS levels are reported as mg of solid per liter of water (mg/L).
- In the浦T, the relationship between TSS and turbidity is 52 mg/L. TSS is approximately equal to 25 NTU.

**Turbidity Effects on Fish**
- Environmental trends of fish activity to turbidity values and time
- Effects on spawning beds.
- Reduced larval survival.

**TSS and Turbidity**
- As the amount of suspended solids in the river increases, so do the turbidity levels.
  - TSS concentration vs turbidity chart.
  - Data from 2000-2007.
Turbidity Levels and Rainfall Amounts

Rain Events and High Turbidity Are Linked

Suspended Solids and Rainfall

Rain Events and High Turbidity are Linked

What is a TMDL?
Total Maximum Daily Load

Now What?

- Our highest turbidity readings occur during our highest rainfall events.

- The total suspended solids levels follow the same pattern as turbidity levels, plume with rainfall amounts.

- Rainy Creek, June 5, 2006

- Post rain (1.11"

- Now that the Runoff de Terre is on the Impaired waters list we are required to do a TMDL study to determine how much pollutants the water can handle, where they are coming from, and what flow conditions they are coming from.

- It is a process:
  1. Assess waters
  2. Determine impaired
  3. Place water on S306 list
  4. Monitor, study water body
  5. Compute pollutant load abatement formula
  6. Develop implementation strategy
  7. Monitor changes in water body
  8. Clean?

- It is a number:
  - The TMDL is the maximum amount of a specific pollutant that can be discharged into a body of water and still meet water quality standards.
  - Or, "How much crap we can put in the water and still not be considered polluted?"
Why are TMDL Studies Important?

Provides the mechanism for studying a water body so that:

- You can determine how much pollution must be reduced from all sources
- You can plan an effective strategy for reducing existing pollutant loads to meet water quality standards

Why Develop a TMDL Study?

- Required by the Federal Clean Water Act
- Protects community assets and quality of life
- Restores beneficial uses of surface waters
- Provide a useful, long-range planning tool for managing water quality
- Clean water protects property values

Do TMDLs Mean More Regulation?

- No
  - Point Sources are already regulated and permit requirements are enforceable.
  - Municipal WWTFs
  - CAFOs
  - Municipal separate sewer systems (MSSs)
  - Constructionstormwater permits
  
  - Existing regulations that are currently unenforced may have to start to be enforced.
  - i.e., county ditch buffer requirements

Do TMDLs Mean More Regulation?

- For Non-Point Sources
  - The goal is to pull effective non-point sources.
  - We will rely on financial incentives and education to address certain non-point sources

Fixing the Problem

- We will focus on the watershed as a whole, not just the Pomm de Terre River itself.

- That means looking at the river itself plus Muddy Creek, Drywood Creek, Pelican Creek and the county ditches.

- It doesn't make sense to fix the river, but ignore the waters flowing into the river.

An exclusion fence is installed along the edge of this property protects the shoreline and riparian areas from grazing animals.
How will we implement these BMP’s?

- Our goal is to provide incentives to landowners to implement BMP’s on their lands.

- Since we are in a ‘high priority’ watershed an approved TMDL and implementation plan means more money for the watershed to provide competitive incentives to landowners.

- It all comes down to $

Incentive Money

- Clean Water Legacy Act Funding
  - Administered by BWSR, DNR, MDA, MPCA
  - Provides funding to protect, restore, and preserve the quality of MN surface water.
  - Generated from a combination of state general fund, federal EPA 319 funds, general obligation bonding, Environmental and Natural Resources Trust Fund.
  - Able to apply for CAW, funds once TMDL and implementation plan are approved.

- Other Programs
  - CRP, CREP, RIM, EQUIP, WRP.
  - New WRP/RIM partnership pays 100% of township ELV.

For More Information, Contact
Shaun McNally
PoT Watershed Project Coordinator
Stevens SWCD

320-569-4906 Ext. 109
shaun.mcnelly@mn.nacdnet.net

Pomme de Terre River
Watershed Project
Questions and Comments from the  
Pomme de Terre River Watershed Turbidity TMDL Kickoff Meeting  
Morris, MN  September 18, 2008 7:00 – 9:00 pm

Turbidity Presentation  
1. How do we determine where it is coming from?  
2. How far back has this study gone to get an idea of trends?  
3. Are the lakes being monitored also?  
4. Does everyone across the country use a Load Duration Curve as a standard method to determine sources?  
5. If an island is formed from riverbank erosion, can we take them out and straighten the river?

Fecal Coliform Presentation  
1. How much rain was in a rain event?  
2. Why are septics included when data show it is not a main part of the problem?  
3. Is the funding for the Muddy Creek area of the entire watershed?  
4. What does it mean in practice to have 2,400 cfu/100 mL of E. coli?  
   a. Is it too high?  
   b. Does it change the health of the stream and fish?  
5. How much E. coli or fecal coliform does it take in the tributaries to cause a negative effect in the Pomme de Terre River?  
   a. What is the dilution factor?  
6. How much of Drywood Creek is pasture?  
   a. Can we pinpoint the exact area or source of the fecal coliform?  
7. Comment: Bald eagles have been sighted by Drywood Creek.  
8. Comment: Drywood Creek has had a green tint, so we need to find an exact source.  
9. Comment: With low fecal coliform during rain events, it would indicate that little fecal coliform is coming from cattle being directly in the stream. Relates to the cattle exclusion part of the implementation plan.  
10. Which waterways are included in the implementation plan?  
11. If this process fails and we do everything without tangible results, what happens?  
12. Was the fecal TMDL and/or implementation plan approved?  
13. If geese are shown to be 75% of the problem, then what?  
14. How many feet of buffer are good enough?  
15. Is the CRP standard more than needed?  
16. Is the implantation plan using the nutrient trade system?

General Questions  
1. What is the condition of Drywood Lake?  
2. How deep are the lakes?  
3. Is Artichoke Lake currently being monitored?  
4. Is there a garbage clean up component?  
   a. Comment: There is a lot of garbage on the river.  
5. How long has Shaun been on board with this project?  
6. Is fertilizer runoff high?  
   a. Has this been tested for?
MEETING AGENDA
Pomme de Terre River Association
Joint Powers Board
Friday, March 6, 2009
9:00 a.m.
USDA-ARS Soils Lab, Morris

I. Introductions, agenda additions and approval

II. Approve minutes from December 5, 2008 meeting

III. Review 2008 financial summary

IV. MPCA Update – Kelli Daberkow

V. Watershed Project Coordinator Update – Shaun McNally

VI. Set next meeting date & time and adjourn

PLEASE NOTE: The Technical Advisory Committee will be meeting after our board. There will be two presentations given to the members of both groups, after our business meeting and before the TAC convenes.

• Kim Laing, MPCA will present the preliminary results from the 2008 Dry Wood Creek Phase 2 monitoring.

• Shaun McNally, Watershed Project Coordinator, will present the turbidity TMDL data.

Kim Laing Drywood Phase II Presentation:
Kim Laing of the MPCA’s St. Paul office gave a presentation on the 2008 Drywood Creek sub-watershed phase II preliminary data. She stated the Drywood Creek area was chosen for additional monitoring based on low biological scores during the 2007 intensive watershed monitoring.

The general goal of phase II monitoring is to try to determine the stressors on the stream system and characterize the watershed and stream system.

All fish sampling sites scored as impaired on the current IBI scoring system, although she said the scoring matrix is currently being re-worked, so those scores might not mean the same under the new scoring system.

Certain sites on the creek had levels of dissolved oxygen well below the 5 mg/L standard, the site with the beaver dam had the lowest levels, falling to near zero on a number of occasions for up to 12 hours at a time.

Blue green alga is present in Drywood Lake.

Turbidity levels were very high all year.

Nitrate levels were high during the spring snowmelt period, but were below the standard during the summer months.

E. coli levels were extremely high all summer.

Plans for this year include more nitrates testing during snowmelt period, more lake sampling of Drywood Lake, more stream geomorphology studies, possibly adding another biological monitoring site.

Shaun McNally Turbidity TMDL presentation
Shaun presented the turbidity data that will be used in the turbidity TMDL. 60% of the turbidity readings in the last 11 years have exceeded the 25 NTU standard.

The TSS surrogate for 25 NTU was determined to be 52 mg/L.

Shaun showed the flow duration curve for the PdT River

Shaun explained how a load duration curve was created and how the TSS readings are converted into a load of tons per day and placed on the load duration curve.

Turbidity and TSS levels are highest in the months with the highest rainfall.

The load duration curve shows most of our exceedences occurring in the mid-range and moist condition flow zones.

This pattern indicates our TSS loading is coming from near channel sources during the mid-range flows and from saturated upland areas during the moist conditions.

This info will let us focus our implementation efforts.
What is Turbidity?

- Turbidity is caused by particles suspended or dissolved in water that scatter light.
- Particles can include: sediment especially clay and silt, fine organic and inorganic matter, soluble colored organic compounds, algae, and other microscopic organisms.
- In the MN River Basin, sediment is the primary cause of high turbidity.

Impacts of High Turbidity

- Reduces the aesthetic quality of the water:
  - Nobody likes to recreate in dirty water.
- Increased cost for water treatment.
- Lakeshore property values directly related to lake water clarity.
- Harms aquatic life:
  - Reduces food supply.
  - Degradation of spawning beds
  - Can affect gill function
  - Affects sport fishing

Turbidity in the Pomme de Terre

- The Pomme de Terre is classified as a class 2B stream.
- It's beneficial use is cool and warm water fisheries and all recreation.
- The EPA sets numeric criteria for each class of stream.
- The turbidity limit for a class 2B stream is...
So How Much Stuff is in the River?

- Turbidity is a dimensionless unit
- Loading allocations, capacities and reductions are commonly based on a surrogate parameter, total suspended solids (TSS)
- TSS is the measurement of sediment and organic matter in a sample of water and is reported in mg/L
- Each stream has a different turbidity/TSS ratio

\[ y = mx + b \]...Remember High School Math?

- To determine the TSS equivalent to 25 NTU you need paired turbidity and TSS measurements
- Plot the paired measurements on a graph and then do a regression analysis.
- 52 mg/L TSS is the equivalent to 25 NTU in the PDT River
Duration Curve Approach

- Allows for characterizing water quality data at different flow regimes.
- Provides a visual display of the relationship between stream flow and loading capacity.
- Accounts for how stream flow patterns affect changes in water quality over the course of a year.
  - Seasonal variation is a TMDL requirement

Duration Curve Approach

- Compile flow data for the river
- Produce a flow duration curve
- Calculate the TSS surrogate for the PdT (52 mg/L)
- Produce a load duration curve
- Integrate all the TSS measurements
- Determine loading capacity and allocation

Compile Flow Data and Develop the Flow Duration Curve

- USGS gauging site in Appleton has daily flow data from 1991.
- Last 30 years were used to better reflect current watershed conditions
- 7,012 daily flow values were compiled and then sorted by flow volume from highest to lowest and placed on a curve.

Flow Duration Curve

- Identifies intervals, which can be used as a general indicator of hydrologic condition (wet vs. dry and to what degree)
- Divide the curve into 5 flow regimes to provide additional insight about conditions and patterns associated with the impairment
- High flows, moist conditions, mid-range flows, dry conditions, low flows

Flow Duration Curve

- Percent of the Flow Established
- Percentage of the Flow Established
- Flow Duration Curve
- Percent of the Flow Established

Diagram of Flow Duration Curve
Flow Duration Intervals

- Low flows are exceeded a majority of the time
- Floods are exceeded infrequently
- Flow duration intervals are expressed as a percentage
  - 0% corresponds to the highest stream discharge on record (flood conditions, 8,890 cfs, 4/7/97)
  - 100% corresponds to the lowest stream discharge on record (drought, 0.01 cfs, 1988)

Flow Duration Intervals

- A flow duration interval of 60% is associated with a discharge of 97 cfs
- Implies that 60% of all observed stream discharge values equal or exceed 97 cfs.

Determine the TMDL (Maximum Amount of Pollutant) ... More Math!

- Do this for each of the 5 flow regimes
- Each flow regime has a different TMDL (the more water flowing, the more pollution the River can take)
- Use the mid-range flow value for each flow regime
- Convert the flow and TSS concentration into a load of tons per day
- TMDL = median flow (cfs) x 320 (mg/L) x 28.310 (ft³/s) x 86,400 (s/day)
  - 562,309,740 (mg/ton)

An Example: Moist Condition Flow Regime

- Flow range 170.516 cfs
- Median flow 273 cfs
- 273(cfs) x 28.310 (ft³/s) x 86,400 (s/day) = 667,753,632 (L/day)
- 52(mg/L) x 667,753,632(L/day) = 3.47 x 10¹⁰ (mg/day)
- 3.47 x 10¹⁰ (mg/day) / 907,184,740 (mg/ton) = 38.2 tons/day
- Use the TMDL values at each regime to create a load duration curve.
TSS Loading

- Convert the TSS readings into a daily load using flow data from the USGS station and the water quality data from the Appleton monitoring station.
- mg/L → tons/day
- Plot these readings on the load duration curve
- Values that lie above the load duration curve represent samples that exceed the 52mg/L TSS surrogate standard.

What Does the Duration Curve Tell Us?

- Useful to characterize water quality concerns and to describe patterns associated with the impairment
- By looking at the hydrologic conditions that have the most exceedences one can determine where the potential contributing areas are.
What Does This Pattern Mean?

- The problems start to develop above a flow duration interval of 60%. The Mid-Range Flows and Moist Conditions
- According to Bruce Cleland of the EPA, in an agricultural area, this type of pattern indicates the increased sediment load is the result of pollutant delivery associated with rainfall and runoff from riparian areas.

What Does This Pattern Mean? Mid-Range Flow Exceedences

- Mid-Range Flows usually represent the rise of a hydrograph as it progresses out of the dry condition range and enters into wetter conditions.
- The contributing zone of land is most likely the riparian corridor of the river.
- This is because limited upland soil saturation and quite possibly soil erosion has yet to take place during the early period of storm events or in smaller events that can only deliver localized eroded soils.

What Does This Pattern Mean? Moist Condition Exceedences

- Under the Moist Condition flow regime, material loading typically originates from both upland soils which under these wetter conditions are now saturated and begin contributing to the more effective transport of eroded materials and continuing to move riparian corridor eroded materials.
- In addition to riparian areas, a larger portion of the watershed drainage area is potentially contributing runoff.

Duration Curves as a Diagnostic Tool

- Duration curves and water quality data can help guide local implementation efforts to achieve meaningful results.
- Can be used as a diagnostic tool which supports a “bottom up” approach towards TMDL development and water quality restoration by identifying target programs and BMPs.
Value of Duration Curves

- Can add value to the TMDL process by identifying:
  - Targeted participants (i.e. NPDES permittees, row crop farmers) at critical conditions
  - Targeted programs (i.e. CRP)
  - Targeted activities (i.e. conservation tillage)
  - Targeted areas (i.e. bank stabilization projects)

In Agricultural Areas

- Mid-Range Flows
  - Targeted programs should focus on riparian protection
  - Targeted activities
    - Riparian buffers, CRP or CRP

- Moist Conditions
  - Target programs should also focus on saturated upland soils
  - Targeted activities:
    - Conservation tillage
    - Contour strips
    - Grassed waterways

Questions??
Pekarek-Scott, Katherine (MPCA)

From: Shaun McNally [shaun.mcnelly@stevensswcd.org]
Sent: Monday, November 30, 2009 8:12 AM
To: Pekarek-Scott, Katherine (MPCA)
Subject: Meeting newspaper stuff
Attachments: 09 newspaper ad pdf

Here is a scan of the newspaper advertisement.
It ran in the following papers the two weeks prior to the meeting except for the Morris paper which ran for 3 weeks:

Morris Sun Tribune
Chokio Review
Hancock Record
Grant County Herald
Appleton Gazette
U of M, Morris Register

Shaun McNally
Pomme de Terre River
Watershed Project Coordinator
12 Iwy 28 E, Ste. 2
Morris, MN 56267
(320) 589-486 ext. 109
(320) 287-1202 cell
shaun.mcnelly@stevensswcd.org
Dear Interested Stakeholder of the Pomme de Terre Watershed,

You are cordially invited to the 2009 Pomme de Terre Watershed annual public meeting:

Monday November 23rd 2009
Old #1 Bar and Grill Southside
412 Atlantic Ave Morris, MN
6 pm

The turbidity Total Maximum Daily Load (TMDL) assessment is completed and undergoing the review and approval process. Find out what the report says about the turbidity problem in the Pomme de Terre River Watershed. Find out how you or your organization can comment on the report, and become part of a stakeholder group that helps create a plan to reduce turbidity levels in the river.

Also, get information about the new fecal coliform bacteria implementation grant and find out about new cost share and incentives for Best Management Practices to reduce fecal coliform bacteria levels in the watershed.

Please see the map on the back side of this invitation for the location of the meeting place. If you have any questions feel free to contact me.

Thank you,
Shaun McNally
PdT River Watershed Project Coordinator
320-589-4886 x109 shaun.mcnally@stevensswcd.org
November 3, 2009
Township Board Chairman,

As you may know, the Pomme de Terre River Watershed is currently the subject of a Total Maximum Daily Load (TMDL) assessment for excessive turbidity levels (sediment). The TMDL study is complete and is currently undergoing the review and approval process. Part of the TMDL process is developing an implementation plan to determine the focus and types of landowner Best Management Practices that will help in cleaning up the water in the Pomme de Terre Watershed. A vital part of this process is landowner stakeholder involvement. As township leaders, your input in this process is very important. We want you to have a say in how management practices are implemented.

I would like to invite you and/or members of your township board to be part of our watershed stakeholder group for the turbidity TMDL study and implementation plan. As part of this process, I plan on holding approximately four stakeholder meetings this winter. During these meetings, the stakeholder group will decide how we should focus our efforts to reduce the amount of sediment reaching the river.

On November 23rd, there will be a public meeting to go over the turbidity TMDL so you can find out what the report says about the turbidity problem in the watershed. We will also discuss the stakeholder process, and what the implementation plan entails. I would like to invite you and/or a member of your township board to this meeting. This would be a good chance to get involved early and find out about the project, the results we are finding, what the next steps are, and your role in the process.

**PdT Watershed Public Meeting**
**Monday November 23rd 2009**
**Old #1 Bar and Grill Southside**
**412 Atlantic Ave. Morris**
**6 pm**

Please pass this information on to the rest of your board, and anyone else you feel may be interested.

Thank you.
Shaun McNally
PdT River Watershed Project Coordinator
Agenda for Tonight

1. How you or your organization can officially comment on the turbidity TMDL: Katherine Pekarek-Scott, MNPCA
2. Turbidity TMDL: What's in the report
3. Feasal Coliform TMDL: Implementation plan and the new incentive and cost share money
4. Lake Assessment Project
   - I'd like the meeting to be concluded by 8 pm, but I'll stick around afterwards to discuss any additional questions anyone may have (wtf if you keep me too late, you'll have to buy me a round of shots)

Rules for Tonight

- We are not here to argue about whether or not the river should be listed as impaired......it is.
- I don't want to hear the terms "hippie environmentalists", "corporate agriculture", or "that PMSH" (fill in the blank) agency
- Other people have differing views and perspectives of the river...please respect their opinions.
- No finger pointing or rattling out your neighbor
- Let's not talk about the damn geese 😵

Public Comment Period

- Public Comment Period will be this winter or upcoming spring
- Published in the State Register for comment at http://www.state.mn.us/statedoc/primary.html
- When on Public Comment Period the TMDL can be found on the Internet at http://www.state.mn.us/statedoc/primary.html

Your Options:

1. Written Comments
2. Petition for Public Informational Meeting
3. Petition for a Contested Case Hearing
4. MFCA Decision

Contact Information:
Katherine Pekarek-Scott
Minnesota Pollution Control Agency
1420 East College Drive, Suite 900
Mankato, MN 56001
507-424-2637
katherine.pekarek-scott@state.mn.us

If You or your Organization Wish to be Notified When the Public Comment Period Officially Opens

- Sign up on the "Public Comment Notification" form
What is Turbidity?

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\[ y = mx + b \]. Remember High School Math?

- To determine the TSS equivalent to 25 NTU you need paired turbidity and TSS measurements
- Plot the paired measurements on a graph and then do a regression analysis.
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Duration Curve Approach
- Allows for characterizing water quality data at different flow regimes.
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- Do this for each of the 5 flow regimes
- Each flow regime has a different TMDL (the more water flowing, the more pollution the River can take)
- Use the mid-range flow value for each flow regime
- Convert the flow and TSS concentration into a load of tons per day

\[
\text{TMDL} = \text{median flow} \times \text{flow} \times \frac{28.3}{2400} \times 85,400 \times 0.01
\]

An Example: Moist Condition Flow Regime

- Flow range: 170-536 cfs
- Median flow: 273 cfs
- \(\frac{273 \text{ cfs}}{28.3} \times 85,400 \times 0.01 = 4.6 \times 10^4 \text{ L/day} = 1.3 \times 10^4 \text{ mg/day} \)
- \(52 \text{ mg/L} \times 667,753 \text{ L/day} = 3.47 \times 10^4 \text{ mg/day} \)
- \(3.47 \times 10^4 \text{ mg/day} / 907,184 = 38.2 \text{ tons/day} \)
- Use the TMDL values at each regime to create a load duration curve.
TSS Loading

- Convert the TSS readings into a daily load using flow data from the USGS station and the water quality data from the Appleton monitoring station.
- mg/L $\rightarrow$ tons/day
- Plot these readings on the load duration curve
- Values that lie above the load duration curve represent samples that exceed the 52 mg/L TSS surrogate standard.

What Does the Duration Curve Tell Us?

- Useful to characterize water quality concerns and to describe patterns associated with the impairment
- By looking at the hydrologic conditions that have the most exceedances one can determine where the potential contributing areas are.
What Does This Pattern Mean? Mid-Range Flow Exceedences

- Mid-Range Flows usually represent the rise of a hydrograph as it progresses out of the dry condition range and enters into wetter conditions.
- The contributing zone of land is most likely the riparian corridor of the river.
- This is because limited upland soil saturation and quite possibly soil erosion has yet to take place during the early period of storm events or in smaller events that can only deliver localized eroded soils.

What Does This Pattern Mean? Moist Condition Exceedences

- Under the Moist Condition flow regime, material loading typically originates from both upland soils which under these wetter conditions are now saturated and begin contributing to the more effective transport of eroded materials and continuing to move riparian corridor eroded materials.
- In addition to riparian areas, a larger portion of the watershed drainage area is potentially contributing runoff.

Duration Curves as a Diagnostic Tool

- Duration curves and water quality data can help guide local implementation efforts to achieve meaningful results.
- Can be used as a diagnostic tool which supports a “bottom up” approach towards TMDL development and water quality restoration by identifying target programs and BMPs.
Value of Duration Curves

- Can add value to the TMDL process by identifying:
  - Targeted participants (i.e. NPDES permittees, row crop farmers) at critical conditions
  - Targeted programs (i.e. CRP)
  - Targeted activities (i.e. conservation tillage)
  - Targeted areas (i.e. bank stabilization projects)

In Agricultural Areas

- Mid-Range Flows
  - Targeted programs should focus on riparian protection
  - Targeted activities
    - Riparian buffers, CRP

- Moist Conditions
  - Target programs should also focus on saturated upland soils
  - Targeted activities
    - Conservation Tillage
    - Contour strips
    - Grazed waterways

What's Next? Implementation Plan Creation

- We need representatives from a diverse group of watershed interests to help create the turbidity Implementation Plan.
- Time commitments? Approximately 4 meetings this winter and early spring
- Please sign up on the back of the suggestion sheet, or on the signup sheet
Pomme de Terre River Turbidity Total Maximum Daily Load (TMDL) Report
Formal Public Meeting
November 23, 2009 6:00pm
Old #1 Southside Bar and Grill, Morris MN

Meeting Minutes

Number of People in Attendance: 40

The meeting started at 6:10pm with an introduction of the meeting presented by Shaun McNally with the Pomme de Terre River Watershed Project. McNally presented the agenda for the meeting and went over the rules that will be followed during the meeting.

Katherine Pekarek-Scott with the Minnesota Pollution Control Agency (MPCA) described that the Public Comment Period will be coming either later this winter or early in the spring and went through the options that the public had to participate in the Comment Period. Pekarek-Scott asked for the people who wished to receive a notice of the Comment Period in the mail to put their contact information on a signup sheet.

McNally presented the findings of the TMDL Report. He started by identifying the location of the impairment, discussed what turbidity was and how it impacted the water. McNally then described the levels of turbidity in the Pomme de Terre (PdT) River Watershed, the process of developing a total suspended solids (TSS) surrogate, the TSS levels in the PdT, and the formation of the Load Duration Curve. He explained how a TSS loading capacity was formulated and that there were exceedences issues during mid flow and moist flow regimes.

McNally explained the next steps of developing an implementation plan and requested volunteers to be part of a stakeholder committee to help develop the plan.

The presentation concluded at 6:53pm and was opened up for questions which are listed below.

Q: When Shaun is taking turbidity readings, is he using a Transparency Tube or a Turbidity meter?
A: A meter is used to take turbidity readings.

Q: Are the regression lines (for developing a TSS surrogate) different for different water bodies?
A: Yes they are.

Q: How many times per month are turbidity readings taken?
A: Shaun took on average one reading a week, but other groups such as the MPCA also sample.
Q: On the graph showing turbidity rising (slide 14), what landmarks are associated with these?
A: Where Muddy Creek enters, there is not much of an increase. Where Dry Wood Creek enters, there is not much of an increase, but the turbidity levels were down this year and this might have looked different last year. Geology is also impacting the rise in turbidity.

Q: Can Shaun indicate on the map where 70th street is located?

Q: Does Dry Wood Creek have different geology?
A: There is more silt in the soil in the southern portion of the watershed.

Q: What is the elevation change in the watershed?
A: There is not much of an elevation change, about a 3.5 foot drop. There is not much for bluff or gully erosion in this watershed that is associated with more of an elevation change.

Q: Is the 3.5 foot drop for the entire watershed?
A: For the most part, except below Appleton where it is more, but turbidity readings are not taken after Appleton and thus not reflected in the data.

Q: Would you expect to see the turbidity reading go down after the lakes empty?
A: The lakes do help to settle out sediment in the system.

Q: Why do turbidity readings jump in the southern part of the watershed?
A: The geology changes, soil changes, and the river has more wide sweeping bends in it. This all impacts the turbidity levels.

Q: Would enforcing buffer statutes help and should we enforce these before we complete the study?
A: The MN DNR is currently revising the shoreline rules that regulate this and possible enforce can result from it.

Q: There is more turbidity coming from banks and where buffers already exist there is still a problem.
A: When the implementation plan is being developed, more in stream practices will have to be looked at for these situations.

Q: Have you seen any patterns in spikes over the years?
A: In the last 15 years, the flows of the river does spike higher, the high flows are going up, and peak flows are on the rise. The yearly precipitation, however, has stayed the same, but there are fewer storms in a year so each storm has more water associated with it.

Q: BMPs should include something to deal with what happens to banks under high flows.
A: That will be part of the implementation plan development.
Q: How does this TMDL and others such as the Chippewa and the Hawk relate to the Minnesota River Turbidity TMDL?
A: Pekarek-Scott answered this question. The Minnesota River Turbidity TMDL is for the main stem up to the Lac qui Parle Dam which is below the Pomme de Terre. The MN River TMDL includes the last reach of tributaries such as the Chippewa and the Hawk and forms allocations for them. The Chippewa River Turbidity TMDL for example is not doing a TMDL for that last reach so that it is not doubled up on TMDL allocations. There is a group of stakeholders working on this TMDL and they are working out the details of how to do the implementation plan at this point. There might be an implementation plan for the entire basin or the watersheds in the basin will develop an implementation plan, this has yet to be decided.

Q: Follow up question of what are the reductions in the MN River TMDL?
A: Not sure on the specific number. (The questioner stated that it is a 50% reduction) The PdT TMDL can only help in that reduction number.