2014 Water Monitoring Report

Monitoring Location

The permanent monitoring station on Chub Creek is located at Dixie Avenue in the town of Randolph, MN. Water from the monitoring station on Chub Creek travels less than a mile before it mixes with the Cannon River, and then enters the Byllesby Reservoir.

Monitoring Objectives

- **Assess the water quality of Chub Creek by collecting samples on a routine basis.**
- **Measure stream level and flow to better understand the quantity of water moving through Chub Creek.**

News

- The 2014 Draft Impaired Waters List has been submitted by the Minnesota Pollution Control Agency (MPCA) to the Environmental Protection Agency and is awaiting approval. Chub Creek and Trout Brook were both added to the List for Aquatic Macroinvertebrate (bug) and Chub Creek was also added for Fish Bioassessments.
- In June, state water quality standards for river eutrophication were approved by the MPCA Board, including numeric criteria for total phosphorus (TP) and total suspended solids (TSS). Previously, only lake eutrophication criteria existed.
- Winter nitrate sampling at Trout Brook occurred in February 2014, revealing very high nitrate values which exceeded the state standard. See the full report at http://www.dakotacountyswcd.org/watersheds/ncrwmo/

2014 Activities

- Monitoring on Chub Creek was conducted by Dakota County Soil and Water Conservation District (SWCD).
- Level was measured continuously (every 15 minutes) with automated equipment.
- 4 flow measurements were completed.
- 7 water quality samples were collected (monthly from April through October).
- Data was submitted to the Minnesota Pollution Control Agency.
Weather and Stream Flow

Once again, it was an exceptionally wet spring, with a couple big spring storms in May. A late June storm caused a peak in the hydrograph just over 700 cubic feet per second (cfs), and the remainder of the summer and autumn were quiet. A big summer storm is fairly common, but 2014 wasn’t as big as past years. In 2013, a July flood peaked with a mean daily flow at 1503 cfs. In 2012, a June flood peaked with a mean daily flow at 1842 cfs.

Phosphorus

Phosphorus (P) is required by all living things, and is a main ingredient in fertilizer. When too much phosphorus enters lakes and streams as a result of human activity, algal blooms occur. Water quality becomes worse as algae die and decay, consuming dissolved oxygen that fish and bugs need to breathe.

Total Phosphorus (TP) includes all forms of phosphorus; particulate and dissolved. The state standard (0.150 mg/L) was exceeded on two occasions, with the June sample at 0.248 mg/L and the August sample at 0.555 mg/L. The other five samples from 2014 were within the state standard. Samples with high phosphorus values were taken shortly after rain events in which runoff likely carried pollutants into the stream. The June sample was taken after a weekend rain event which accumulated to ~2.40 inches and the August sample was taken one day after a ~0.18 inch rainfall.

Total dissolved phosphorus (TDP) includes only the phosphorus that is dissolved in the water and is easily taken up by plants, namely algae. The dissolved fraction tends to be higher in spring, when there is little demand from aquatic organisms which have not yet begun to use the excess phosphorus for growth, and unused phosphorus on the landscape is washed into the stream during runoff events.

E. coli Bacteria

Escherichia coli (E. coli) bacteria are measured as an indicator of the presence of disease-causing pathogens in the water. Sources include manure spread on land, animal waste, and failing septic tanks, among others.

Only on two occasions (April and May) were the E. coli levels within the state standard, and the cold water during these months likely kept the population down. After May, even during low flow conditions, every sample exceeded the state standard with the highest measured value occurring in June at more than 2,420 organisms/100mL, a value more than 19 times higher than the state standard of ≤126 organisms/100mL. Chub Creek has been listed as impaired for fecal coliform bacteria by the Minnesota Pollution Control Agency (MPCA).
Nitrogen

Nitrogen (N), like phosphorus, is an essential nutrient for plant and animal growth and is found in several forms. Main sources include septic systems, animal feed lots, manure spreading, and fertilizers (both for lawn maintenance and agricultural purposes). N enters rivers and streams, and ultimately reaches the Gulf of Mexico, exacerbating the hypoxic (lack of oxygen) zone.

**Nitrate:** At high levels, nitrate can cause reproductive stress to aquatic organisms. It can also be harmful to domestic animals and humans, particularly infants, when contaminated drinking water is ingested. The Environmental Protection Agency has set a standard of ≤10 mg/L in drinking water to protect human health.

Excess nitrate leaves farm fields through runoff and drain tiles which are used to quickly remove water from excess rain or irrigation practices. Concentrations tend to be higher during low flow conditions and tend to be lower during high flow conditions. High nitrate measured in the stream during low flow conditions, as with Chub Creek, suggests that nitrate is leaching into the ground and traveling to the stream through drain tile. Much of Dakota County is characterized by coarse soils which make the shallow groundwater more susceptible to nitrate pollution. Some nitrate in streams is natural, but natural levels are generally around 0.5-2 mg/L. If nitrate is leaching down to drain tile, it may also be contaminating shallow groundwater where private drinking water wells may be located. Well testing is available, for a fee, through Dakota County.

Total Kjeldahl Nitrogen (TKN): TKN, along with ammonia, can be used to determine organic nitrogen, which may come from living organisms, human and animal waste, and/or decomposing organisms. Levels are generally low but seem to increase in spring, when snowmelt runoff carries material to the stream. TKN is often monitored in wastewater effluent because organic nitrogen can be converted into ammonia, then oxidized to nitrite, then nitrate with the help of bacteria. The method that the laboratory uses to analyze Total Phosphorus also provides data for TKN. There is no state standard for TKN or organic N.

Ammonia nitrogen (unionized): Unionized ammonia is calculated using the temperature and pH measured at the time of the ammonia sample collection. It is important to monitor because ammonia in its unionized form is particularly toxic to fish. The state standard for unionized ammonia, established to protect aquatic life, is ≤40 µg/L. Levels of unionized ammonia seem to be higher in spring when snowmelt water enters the stream than in other parts of the monitoring year; however, samples remain far below the standard.

Testing Well Water

- **Pick up a water test kit at the Dakota County Extension Office or the Dakota County Water Resources Department at Western Service Center**
- **Request that a water test kit be mailed—call Dakota County at 952-891-7000**
- **Order a private water supply test kit from the Dakota County website www.co.dakota.mn.us**
Total Suspended Solids and Turbidity

Total Suspended Solids (TSS) is a measure of all the suspended particles in the water. Potential sources include eroded soils from fields and stream banks, decaying vegetation, and algae.

For each of the samples collected in 2014, the total suspended solids were within the proposed state standard of 65 mg/L, although the standard may have been exceeded on days when samples were not collected.

Total Suspended Volatile Solids (TSVS) is an estimate of the fraction of TSS which is combustible, or organic. During low flow conditions, organic components such as very small plant and animal material make up roughly a third of the already very low TSS value. During snowmelt and storm events, only about 25% of the suspended solids were organic suggesting that the other suspended particles were inorganic sources such as silt or clay from fields and stream banks.

Turbidity is a measure of the cloudiness of the water. All samples collected in 2014 were within the established state standard of 25 NTU, although the standard may have been exceeded on days when a sample was not collected. Recently, a new TSS standard was established to replace the outdated and flawed turbidity standard. Accordingly, turbidity will no longer be monitored at Chub Creek in favor of the TSS monitoring which is already occurring.

Temperature, Dissolved Oxygen, Transparency, Conductivity, pH

Temperature: Influences bacteria populations, dissolved oxygen concentrations, and fish and bug reproduction.

Dissolved oxygen (DO): A measure of the oxygen available to aquatic organisms. When levels drop too low, phosphorus in sediment may be released into water.

Transparency: A black and white disc is lowered in a tube of water until it can no longer be seen. A fast, inexpensive measure of water clarity.

Conductivity: A measure of water’s ability to transmit an electrical current. Chemicals like sodium chloride (salt) dissolve in water and the ions can have physiological effects on plants and animals.

pH: A measure of acidity (less than 7) or alkalinity (greater than 7). A change in pH can alter the behavior of other chemicals in the water making them toxic (ammonia and some heavy metals). Very low pH can damage gills and membranes and affects reproductive success of fish and aquatic bugs.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Desired range</th>
<th>2014 range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (C)</td>
<td>Less than 30</td>
<td>3.5 to 22.7</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Greater than 5</td>
<td>7.91 to 12.43</td>
</tr>
<tr>
<td>Transparency</td>
<td>Greater than 25</td>
<td>22 to more than 100</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Less than 698</td>
<td>414 to 638</td>
</tr>
<tr>
<td>pH (S.U.)</td>
<td>6.5 to 9.0</td>
<td>7.74 to 8.06</td>
</tr>
</tbody>
</table>

TSS values are used to quantify suspended particles in the water.

Transparency is measured using a Secchi tube.
**Historical Perspective**

Monitoring strategies for Chub Creek have changed over the years. Historically, high flow events were targeted and data was supplemented with sampling during low flow conditions. Currently, a scheduled sampling approach is being used where samples are collected monthly, regardless of flow condition. The historical mean for all data is shown here to provide a quick snapshot of the water quality in Chub Creek; however, season and flow conditions play a role in stream dynamics and should always be considered when interpreting results.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Years Monitored*</th>
<th>Number of Samples</th>
<th>Historical Mean</th>
<th>State Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>1999-2014</td>
<td>85</td>
<td>0.17</td>
<td>≤ 0.15</td>
</tr>
<tr>
<td>Total Dissolved Phosphorus (mg/L)</td>
<td>2004-2014</td>
<td>56</td>
<td>0.08</td>
<td>—</td>
</tr>
<tr>
<td><em>E. coli</em> bacteria (organisms/100mL)</td>
<td>2008-2014</td>
<td>54</td>
<td>553</td>
<td>≤126 (geometric mean)</td>
</tr>
<tr>
<td>Nitrate (mg/L)</td>
<td>2011-2014</td>
<td>39</td>
<td>4.57</td>
<td>≤ 10 (drinking water)</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen (mg/L)</td>
<td>1999-2014</td>
<td>86</td>
<td>0.95</td>
<td>—</td>
</tr>
<tr>
<td>Ammonia nitrogen (unionized) (µg/L)</td>
<td>1999-2014</td>
<td>60</td>
<td>1.58</td>
<td>≤ 40</td>
</tr>
<tr>
<td>Organic Nitrogen (mg/L)</td>
<td>1999-2014</td>
<td>75</td>
<td>0.90</td>
<td>—</td>
</tr>
<tr>
<td>Total Suspended Solids (mg/L)</td>
<td>1999-2014</td>
<td>88</td>
<td>30</td>
<td>≤ 65</td>
</tr>
<tr>
<td>Total Suspended Volatile Solids (mg/L)</td>
<td>1999-2014</td>
<td>72</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>1999-2014</td>
<td>77</td>
<td>9</td>
<td>≤ 25</td>
</tr>
<tr>
<td>Temperature (degrees C)</td>
<td>1999-2014</td>
<td>83</td>
<td>16.40</td>
<td>≤ 30°C</td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/L)</td>
<td>1999-2014</td>
<td>93</td>
<td>8.79</td>
<td>≥ 5.0</td>
</tr>
<tr>
<td>Transparency (Secchi tube) (cm)</td>
<td>2012-2014</td>
<td>33</td>
<td>68</td>
<td>—</td>
</tr>
<tr>
<td>Conductivity (µS/cm)</td>
<td>2004-2014</td>
<td>41</td>
<td>580</td>
<td>—</td>
</tr>
<tr>
<td>pH (S.U.)</td>
<td>1999-2014</td>
<td>73</td>
<td>8.09</td>
<td>6.5 to 9.0</td>
</tr>
</tbody>
</table>

*Chub Creek was not sampled 2001-2003, 2006-2007, 2009-2010. Yellow boxes indicate means which exceed state standards, where state standards exist.

*SWCD staff collect flow data throughout the monitoring season each year.*
Conclusions

Cloudy water, with elevated nutrients is common during snowmelt and immediately following rain events which produce runoff; however, levels are generally supportive of aquatic life during low flow conditions. Alternatively, nitrate is likely stressing the aquatic community and *E. coli* bacteria levels indicate a human health risk. Nitrate standards are currently within the drinking water standard, but are higher than natural background values and may already be at a level that is harming aquatic organisms. The nitrate standard was established to protect drinking water, and the bacteria standard was established to protect aquatic recreation and public health; both pollutants are often measured at levels near or beyond benchmarks.

Chub Creek was added to the DRAFT 2014 Impaired Waters List for Fish Bioassessments and Aquatic Macroinvertebrate (bug) Bioassessments (Trout Brook was also added to the list for Aquatic Macroinvertebrate (bug) Bioassessments). This means that the fish and bug communities were not as diverse and/or abundant as expected and that some factor is stressing the community. More work is required to identify specific stressors and develop a plan to restore the fish and bug populations.

Reducing pollutant sources to Chub Creek is important for maintaining a healthy stream for the plants and animals that live there and the people who enjoy it. Chub Creek would benefit from a combination of practices which increase water storage on land, and reduce bacteria and nutrient sources to the stream. Continued monitoring will help to better assess long term trends at Chub Creek and track progress toward meeting water quality goals.

Future Monitoring

In 2015, Dakota County Soil and Water Conservation District staff will continue to monitor Chub Creek for water quality and quantity parameters as shown in this report. Trout Brook nitrate monitoring was conducted in early 2014 and is scheduled to occur again in early 2017, according to the 3rd Generation Watershed Management Plan for the North Cannon River Watershed Management Organization.

SWCD staff talk about water quality monitoring at the Chub Creek permanent monitoring station during the annual Conservation Tour, July 2014.