2013 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.

News

- The United States Geological Survey (USGS) installed a permanent stream gaging station on Chub Creek in spring of 2013 to monitor stream level and flow (waterdata.usgs.gov).
- Chub Creek has been added to the 2014 Draft Impaired Waters List for Aquatic Macroinvertebrate (bug) and Fish Bioassessments.
- Trout Brook has been added to the 2014 Draft Impaired Waters List for Aquatic Macroinvertebrate (bug) Bioassessments.

2013 Activities

- Monitoring was conducted by Dakota County Soil and Water Conservation District.
- Level was measured continuously (every 15 minutes) with automated equipment.
- 9 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

The stream was running high in the spring as snow melted and water entered Chub Creek. The 2013 spring was wet, and the creek seemed to be carrying more water than it does in a typical year at that time. In mid-July, a massive rain event occurred and Chub Creek rose more than 5 feet in just over a day. Some minor rain events occurred after the July storm but had little impact on stream flow, and the creek was fairly stable until the beginning of November.

Phosphorus

Phosphorus (P) is required by all living things. 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 April sample, collected during the snowmelt period was 50% higher than the proposed state standard threshold (0.15 mg/L). A sample from July, following a big storm event, indicates that the proposed standard was exceeded again with a total phosphorus concentration of 0.299, twice the proposed threshold. The other five samples from 2013 were collected during low flow conditions and were at or within the proposed state standard.

Total dissolved phosphorus (TDP) includes only the phosphorus that is dissolved in the water and is easily taken up by plants, namely algae. TDP followed a similar pattern to TP with the snowmelt and storm event samples peaking at 0.185 and 0.154 mg/L, respectively. Low flow conditions yielded TDP values at or below 0.088 mg/L. There is no approved or proposed state standard for TDP.

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 standards, 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 July at 1203 MPN/100mL, exceeding the state standard by almost ten-fold. Chub Creek has been listed as impaired for fecal coliform bacteria by the Minnesota Pollution Control Agency (MPCA).

“...exceeding the state standard by almost ten-fold.”
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, and fertilizers.

**Nitrate:** At high levels, nitrate can cause reproductive stress to aquatic organisms. It can also be harmful to domestic animals and humans, particularly infants. Excess nitrate leaves farm fields through runoff and drain tiles which are used to quickly remove water from excess rain or irrigation practices. N enters rivers and streams, and ultimately reaches the Gulf of Mexico, exacerbating the hypoxic (lack of oxygen) zone problem.

Nitrate concentrations tend to be higher during low flow conditions and tend to be lower during high flow conditions. A proposed nitrate standard of 4.9 mg/L has been drafted to protect aquatic life in warm water streams, but has not yet been approved. During low flow conditions, nitrate concentrations in Chub Creek exceed the proposed state standard.

**Total Kjeldahl Nitrogen (TKN):** A measure of all forms of organic nitrogen (ammonia and ammonium). Levels seem to be highest in spring (1.8 mg/L), when snowmelt carries a lot of pollutants to the stream, and lower in the fall (0.42 mg/L in September) when flow is low. There is no approved or proposed state standard for TKN.

**Ammonia-nitrogen:** Similarly to TKN, ammonia seems to be highest in the spring. There is no established state standard for ammonia; however, values can be used to calculate the unionized ammonia present in the water. 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 much higher in spring when snowmelt water enters the stream than in other parts of the monitoring year; however, none of the samples revealed a standard exceedence.
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 2013, the total suspended solids were within the proposed state standard of 65 mg/L. The sample collected in July, one day after the flow peaked, had a TSS value of 31 mg/L, about half the proposed standard.

Total Suspended Volatile Solids (TSVS) is an estimate of the fraction of TSS which is combustible, or organic. During low flow conditions, organic components make up roughly half 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.

Turbidity is a measure of the cloudiness of the water. All samples collected in 2013 were within the established state standard of 25 NTU, except for the July sample which had a value of 28.57 NTU. Following the July storm event, the turbidity standard was exceeded while the TSS proposed standard was not, likely because many of the very small particles remained suspended while heavier ones had time to settle out.

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). 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>2013 range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (degrees C)</td>
<td>Less than 30</td>
<td>4.75 to 21.9</td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/L)</td>
<td>Greater than 5.0</td>
<td>7.37 to 11.23</td>
</tr>
<tr>
<td>Transparency (cm)</td>
<td>Greater than 25</td>
<td>15 to more than 100</td>
</tr>
<tr>
<td>Conductivity (µS/cm)</td>
<td>Less than 698</td>
<td>218 to 613</td>
</tr>
<tr>
<td>pH (S.U.)</td>
<td>6.5 to 9.0</td>
<td>7.93 to 8.84</td>
</tr>
</tbody>
</table>
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(\text{a})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus (mg/L)</td>
<td>1999-2013</td>
<td>78</td>
<td>0.17</td>
<td>0.15 (proposed)</td>
</tr>
<tr>
<td>Total Dissolved Phosphorus (mg/L)</td>
<td>2004-2013</td>
<td>49</td>
<td>0.08</td>
<td>—</td>
</tr>
<tr>
<td>E. coli bacteria (MPN/100mL)</td>
<td>2008-2013</td>
<td>47</td>
<td>1003</td>
<td>126</td>
</tr>
<tr>
<td>Nitrate (mg/L)</td>
<td>2011-2013</td>
<td>32</td>
<td>4.45</td>
<td>4.9 (proposed) 10 (drinking water)</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen (mg/L)</td>
<td>1999-2013</td>
<td>79</td>
<td>0.96</td>
<td>—</td>
</tr>
<tr>
<td>Ammonia-nitrogen (mg/L)</td>
<td>1999-2013</td>
<td>70</td>
<td>0.06</td>
<td>—</td>
</tr>
<tr>
<td>Ammonia-unionized (µg/L)</td>
<td>1999-2013</td>
<td>54</td>
<td>1.68</td>
<td>40</td>
</tr>
<tr>
<td>Total Suspended Solids (mg/L)</td>
<td>1999-2013</td>
<td>81</td>
<td>32</td>
<td>65 (proposed)</td>
</tr>
<tr>
<td>Total Suspended Volatile Solids (mg/L)</td>
<td>1999-2013</td>
<td>68</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>1999-2013</td>
<td>70</td>
<td>9.43</td>
<td>25</td>
</tr>
<tr>
<td>Temperature (degrees C)</td>
<td>1999-2013</td>
<td>76</td>
<td>16.78</td>
<td>30°C</td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/L)</td>
<td>1999-2013</td>
<td>86</td>
<td>8.72</td>
<td>&gt;5.0</td>
</tr>
<tr>
<td>Transparency (Secchi tube) (cm)</td>
<td>2012-2013</td>
<td>26</td>
<td>67</td>
<td>—</td>
</tr>
<tr>
<td>Conductivity (µS/cm)</td>
<td>2004-2013</td>
<td>34</td>
<td>582</td>
<td>—</td>
</tr>
<tr>
<td>pH (S.U.)</td>
<td>1999-2013</td>
<td>66</td>
<td>8.11</td>
<td>6.5 to 9.0</td>
</tr>
</tbody>
</table>

*Chub Creek was not sampled 2001-2003, 2006-2007, 2009-2010.

*Standards indicate upper limit, except for DO (lower limit is indicated) and pH (range is indicated). Draft state standards which have not been legislatively approved are listed as proposed.
Conclusions

Cloudy water, with high phosphorus and ammonia, 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 and bacteria are likely stressing the aquatic community. The nitrate standards were established to protect aquatic life (proposed standard) and drinking water, and the bacteria standard was established to protect aquatic recreation and public health; both pollutants are often measured at levels beyond these 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.

Future Monitoring

In 2014, 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. Additionally, as scheduled in the new 2013 North Cannon River Water Management Organization Watershed Management Plan, Trout Brook and nearby springs will be sampled for nitrate, where values as high as 17 mg/L have been measured. Collecting these data will help us to better understand the sources and transport of nitrate as well as assess the impact of land use practices.