Watershed Response to Water Storage

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Chippewa River Watershed

- 1.3 Million Acres
- Largest tributary watershed in the Minnesota River Basin
- 7 main drainage basins (watersheds)
- Over 2672 miles of ditch, stream and River
CRWP Work

- CRWP supports local conservation efforts and brings a watershed focus to these projects.
- CRWP monitors the rivers, streams and ditches of the Chippewa to help direct conservation work effectively.
- CRWP maintains flow and pollution monitoring sites throughout the Chippewa Watershed; some have been in operation since 1998.
- USGS maintains 2 flow monitoring stations, one since 1937.
Chippewa Flood History

- 252% increase in peak flood event.
- 1.8% increase in rainfall.
- Any way you look at it floods are getting higher.
Bank Erosion is most impacted by high flow
High Water’s impact on pollutant loading

Suspended Sediment Load Vs. Flow, Dry Weather Creek 2003

High flows result in high levels of sediment

63% of 2003 sediment came in late June
Low flow can be trouble also

- Less dilution, less habitat, less ability to overcome stressors and pollutants.
- Sloughing banks, carp, warm temperatures, high nutrients, algae blooms.
Every tributary watershed is unique

Upper Chippewa
Row crop: 60%
Trees and Grass: 24%
Water and wetlands: 12.8%

Middle Chippewa
Row crop: 68.2%
Trees and Grass: 17.3%
Water and wetlands: 12.3%

Lower Chippewa
Row crop: 89.6%
Trees and Grass: 6.9%
Water and wetlands: 2.9%

East Branch
Row crop: 66%
Trees and Grass: 23.5%
Water and wetlands: 9.3%

Dry Weather Creek
Row crop: 94.2%
Trees and Grass: 3.9%
Water and wetlands: 0.5%

Shakopee Creek
Row crop: 81%
Trees and Grass: 11%
Water and wetlands: 5.8%
All things equal, more perennial land uses in a watershed results in cleaner water, but there are exceptions. The same holds for water runoff, the more perennial land use the less water that runs out of a watershed.
2 Tributary Basins 2 Stories

**Upper Chippewa**
- 227,383 Acres
- Due to higher slopes sediment erosion predicted to be high (RUSLE)
- Land use:
  - 60.3% Row Crops
  - 13.8% Wetland and Open Water
  - 24% Grassland & forest
  - <1% Urban

**Shakopee Creek**
- 197,110 Acres
- Due to low slopes sediment erosion predicted to be low (RUSLE)
- Land use:
  - 81.4% Row Crops
  - 5.8% Wetland and Open Water
  - 11% Grassland & forest
  - <1% Urban
2 Flow Responses to 2002

- Spring melt peak 12 days later in Upper Chippewa
- Flood peaks are higher and faster in Shakopee Creek
- Shakopee Creek: 11.73 inches of rain, 36,272 Acre Feet
- Upper Chippewa: 15.84 inches of rain, 34,664 Acre Feet
Water Quality Data

Upper Chippewa vs. Shakopee Creek, 2002

<table>
<thead>
<tr>
<th></th>
<th>TSS</th>
<th>TP</th>
<th>OP</th>
<th>NO2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>3359</td>
<td>9.1</td>
<td>0.9</td>
<td>7</td>
</tr>
<tr>
<td>Shakopee</td>
<td>5782</td>
<td>12.4</td>
<td>2.1</td>
<td>128.9</td>
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</tbody>
</table>

TSS=Total Suspended Solids, TP=Total Phosphorous, OP=Ortho Phosphorous, NO2-3=Nitrate Nitrite Nitrogen
### 2 Small Watersheds, different land uses.

<table>
<thead>
<tr>
<th>% Landuse</th>
<th>CD29</th>
<th>Huse Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Rain (in)</td>
<td>22.94</td>
<td>22.94</td>
</tr>
<tr>
<td>Total runoff (ac ft)</td>
<td>922</td>
<td>268</td>
</tr>
<tr>
<td>Slope</td>
<td>13 ft/mile (0.2%)</td>
<td>30 ft/mile (1%)</td>
</tr>
<tr>
<td>Acerage</td>
<td>3,123</td>
<td>2,257</td>
</tr>
<tr>
<td>Row Crops</td>
<td>72%</td>
<td>24%</td>
</tr>
<tr>
<td>Water and Wetlands</td>
<td>4%</td>
<td>21%</td>
</tr>
<tr>
<td>Grass</td>
<td>16%</td>
<td>21%</td>
</tr>
<tr>
<td>Woodland</td>
<td>7%</td>
<td>27%</td>
</tr>
</tbody>
</table>

**Map of CD29 and Huse Creek 2010**

- **Huse Cr.**
- **CD29**

**Graphs:**
- Daily Average Flow (cfs)
  - Huse
  - CD29
  - Daily Rainfall (in)

**Dates:**
- 3/13/2010 to 9/29/2010
CD 29 Vs. Huse Creek

- CD 29 is 38% larger than Huse Creek.
- CD29 delivered 344% more water to Norway Lake.
- Each acre of CD29 yielded 2.5 times as much water as Huse Creek.
- Higher volumes of water means more pollutants.
Impact of Soil Types on Flow Responses

- Dry Weather Cr. is 13% smaller than Cottonwood Cr.
- Dry Weather Cr. Yielded 54% more water.
- In 2005 rainfall differed by 0.43 inches.
- Land use pattern is the same for both watersheds.
- Soil type makes a difference when considering these two watersheds. Tile drainage is widespread in Dry Weather Creek less so in Cottonwood Creek, both watersheds have public and private ditch systems.
2005 stream response to soil differences.

- Peak discharges are greater in DWC
- It takes more rainfall to bring the river up in CWC
- Late season base flow is higher in CWC, (good for aquatic wildlife)
Shakopee Creek Headwaters

Benefits to flood response 2001

- **County Ditch 27**
  - 10,093 Acres
  - 82% Row Crops
  - 2.6% Wetland and Open Water
  - 4.7% Grassland & forest

- **Shakopee Creek Overall**
  - 197,110 Acres
  - 81.4% Row Crops
  - 5.8% Wetland and Open Water
  - 11% Grassland & forest

- **Shakopee Headwaters**
  - 30,833 Acres
  - 51.4% Row Crops
  - 18.9% Wetland and Open Water
  - 14% Grassland & forest
April 10, 2001

- CD27, culvert is full
- Lake Andrew, barely flowing
- Shakopee Creek Outlet, bridge is under water
2001 Spring Flood Peak

Spring Peaks:
- Hwy 40, 4-11
- Shakopee Outlet, 4-10
- CD 27, 4-11
- Lake Andrew Outlet, 4-29
- Shakopee Headwaters delayed its peak delivery of 31,000 acres by 18 days.

2001 Chippewa & Shakopee Hydrographs

Discharge (cfs)

Lake Andrew Shakopee Outlet Hwy 40 CD27 (estimated)
Not all Storage is created equal

The case of Shakopee Lake

- 260 acre Lake
- Classical dam and pool.
- Designed as a sediment pond.
- Currently full of silt, carp and algae.
- From 2008-2010 the lake was responsible for 5.6% of all Suspended Solids and 4.3% of all Phosphorous pollution in the Chippewa Watershed.
Shakopee Lake Impoundment does not help water quality

- Shakopee Lake does not decrease flooding.
- Shakopee Lake adds TSS (as algae) and phosphorous.
- Shakopee Dam causes downstream erosion.
Summary

- High water causes more erosion and flood damage.
- Land use, landscape cover and soil types impact quantity, timing and duration of water discharge.
- Water retention can drastically impact high water timing and is a major part of the solution in improving water issues.
- Management of water is complex be careful not to create a larger problem.
- Solutions are site dependant.
- Consider your soils, landscape, agricultural practices and watershed when designing drainage plans.