

Case-Study Overview: Mullenbach Two-Stage Ditch, Mower County, MN

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Key Team Members: Representatives from the Mower County SWCD

Focus: The main water quality concern in this watershed is the elevated levels of nitrates which contribute to hypoxia in the Gulf of Mexico. This concern is currently being addressed through the voluntary use of in-field, riparian and in-stream BMP's, such as the two-stage drainage ditch design.

Land use and farming practices: Most producers are following a manure management plan, typically installing grass waterways, WASCOB's, side inlets and buffers. Most of the land has subsurface tile drainage with open intake risers that flow to a ditch or stream. All of the farmers in Mullenbach watershed have subsurface tile drainage without control mechanisms.

Cedar River Watershed Description

The Cedar River HUC 8 watershed is located in the Lower Mississippi River Basin along the border of Iowa (Figure 1). Only approximately 40% of the watershed is contained within Minnesota, the remainder is within the state of Iowa. The watershed is characterized by two biomes: deciduous forest and prairie grassland. It is also highly agricultural with extensive drainage and with nearly 74% of the land use as corn and soybean row crops. Impervious surfaces within the watershed are centered in the city of Austin (Figure 2).

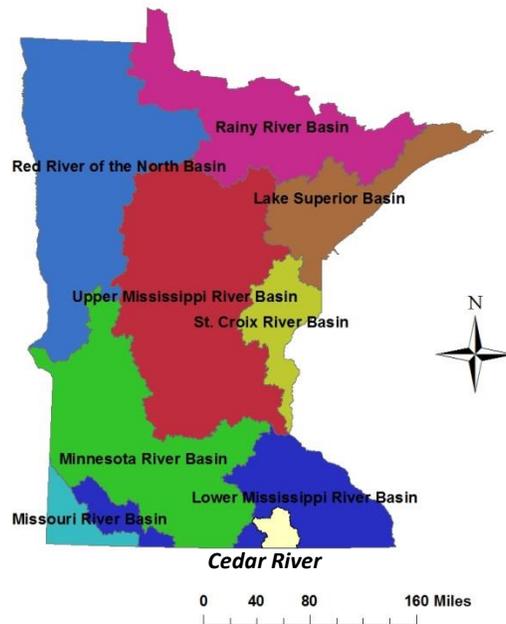


Figure 1: Location of the Cedar River HUC 8 watershed within Minnesota's basins.

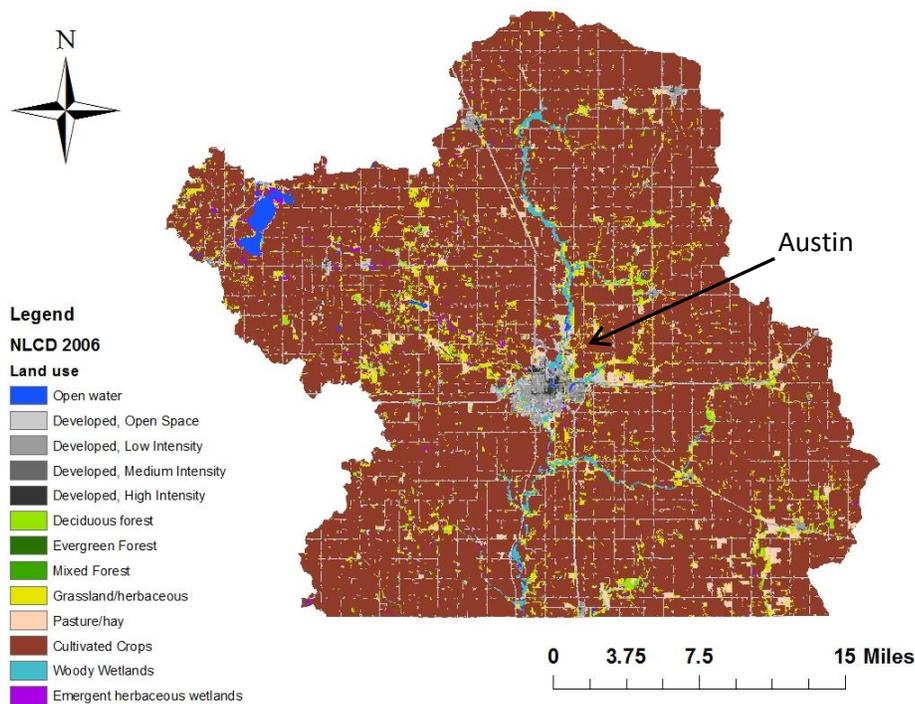


Figure 2: Land use and the city of Austin within the Cedar River HUC 8 watershed.

Mullenbach Watershed Description

The Mullenbach two-stage drainage ditch site (Figure 3) is located in rural Mower County in southern Minnesota, USA, approximately 8 km southwest of the town of Adams, MN, and 10 km south-southeast of the town of Rose Creek, MN. The ditch is located in the headwaters of the Little Cedar River within the Upper Cedar River watershed (8-digit HUC: 07080201). The Mullenbach ditch empties into the Little Cedar River approximately 4 km downstream of the constructed two-stage ditch reach, which then flows south into the state of Iowa (Figure 4). The watershed area is 12.6 km² (3,102 acres) and land use is predominantly row crop agriculture, the main crops being corn and soybeans. The topography is nearly level. Soils in the area comprise mainly poorly drained silty sediment over glacial till and outwash, deposited, most likely, prior to the Illinoian glaciation. Total annual average precipitation in this region is 80 cm (31.5 in).

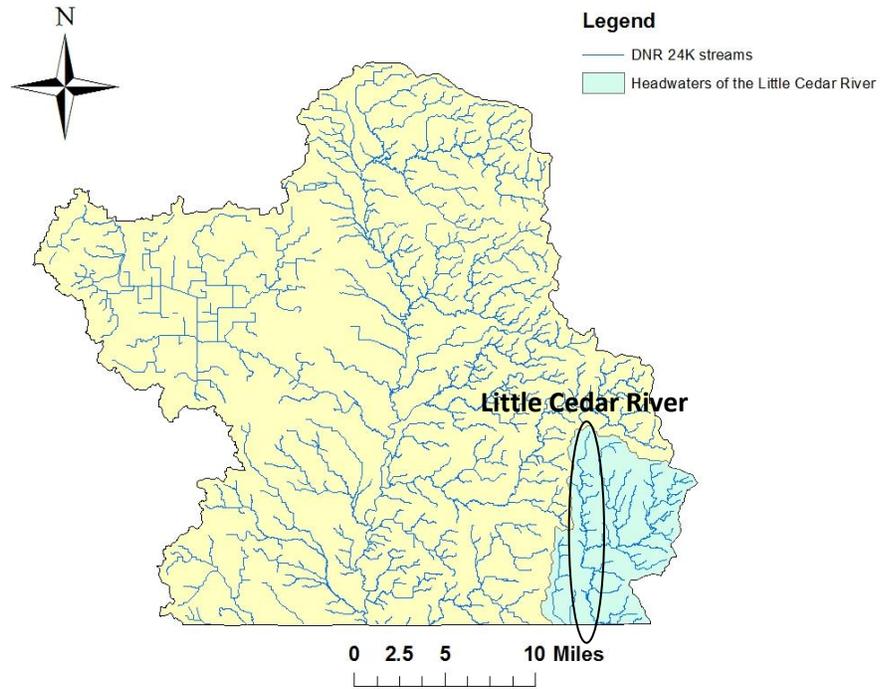


Figure 3: Location of the Headwaters of the Little Cedar River HUC 10 watershed within the Cedar River HUC 8 watershed with streams shown.

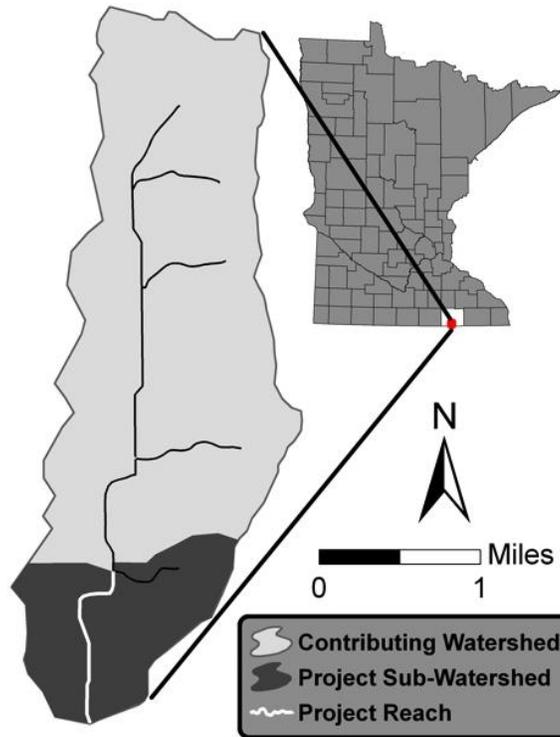


Figure 4. Location of the Mullenbach Drainage Ditch Watershed in Mower County, Minnesota.

Project Site

With funding and assistance from the Nature Conservancy and the Mower County SWCD, approximately one mile of the Mullenbach drainage ditch was converted to the two-stage design in October of 2009 (Figure 5).

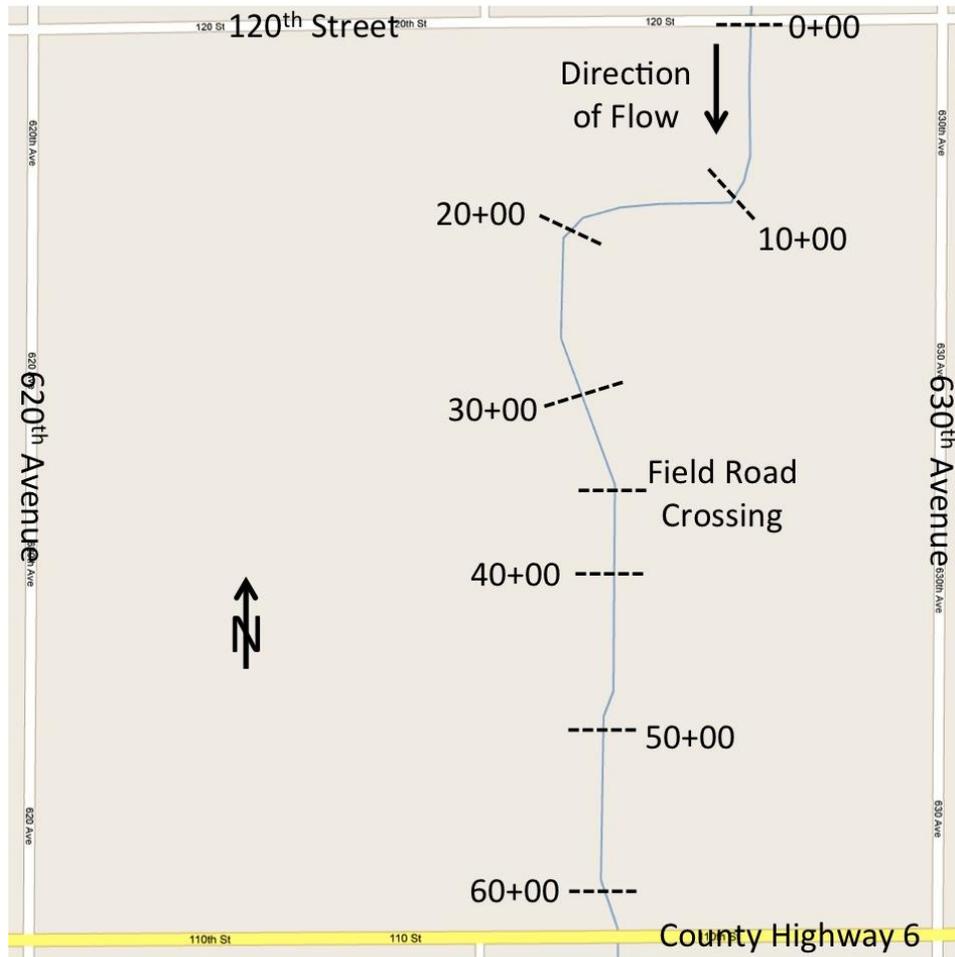


Figure 5. Mullenbach Two-Stage Drainage Ditch Site in Southern Mower County, Minnesota. Base Map © Google.

Data

With funding from the Minnesota Pollution Control Agency, the University of Minnesota has collected 5 years (2009 – 2013) of water quality and quantity data from the ditch, with emphasis on nitrates and flow. We have collected in-stream, tile, well and linear wetland data. This data includes a total of 104,654 continuous nitrate, flow, pH, conductivity, temperature and precipitation readings as well as 1,113 grab samples which includes the above types of data plus numerous other parameters including isotopes, phosphorus, metals and nitrous oxide gas.

Results to Date

17.42%/day in-stream nitrate removal in August 2010

10.11% average groundwater lost to ET in August 2011

ET averaged 2.15 mm/day in August 2011 (average ET/PET value of 59.8%)

23.08%/day nitrate lost to riparian, in-stream and linear wetland soil denitrification (22.89%/day lost to riparian and in-stream soil denitrification) in July 2013

The number of fish species increased from 7 in 2009 (pre-construction) to 9 in 2011 and the total number of individual fish increased from 574 to 1050.

The amount of benthic insectivores increased 21%, the amount of simple lithophilic spawners increased 9% and the amount of tolerant individuals decreased by 44% from 2009 to 2011.

The number of pools and riffles increased from 5 to 65 and from 5 to 68, respectively, from 2009 to 2013.

Average bench biomass was 218.58 and 202.61 g while average slope biomass was 92.26 and 96.4 g in August – October of 2010 and 2011, respectively.

State and Federal Programs

State Cost-Share Program, Low Interest Loan Program (Ag BMP), Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP), Reinvest in Minnesota (RIM) Program, Wetlands Reserve Program (WRP).

Socio-Economic Factors: In 2009, the MPCA performed intensive sampling of the surface waters within the Cedar River Watershed as part of their WRAPS process. In 2014, Dobbins Creek, north of the Mullenbach watershed and just east of the city of Austin, became a watershed of focus in the Targeted Watershed Program initiated by BWSR in 2014. There has been much previous work in this watershed performed by the local watershed district (Cedar River), including SWAT modeling, which was completed in 2010. In 2011, the CRWD also conducted the Dobbins Creek Restoration Project in which the banks of the upper reaches of Dobbins Creek were graded and revegetated to stabilize eroding soils. The Mower County SWCD is very active in the Cedar River Watershed and works in conjunction with the CRWD on various management and restoration projects.

Previous and Existing Grants:

2014: BWSR Targeted Watershed Program (Dobbins Creek) - \$1.5 million (Clean Water Funds), \$600 k (cash match from CRWD and the Hormel Foundation; in-kind from UMN; other federal contributions)

2009 – 2014: MPCA Cedar River Alternative Drainage Ditch Designs – \$286,128 (Clean Water Funds), \$87 k (cash match from Mower SWCD), \$148,904 (in-kind from MDA and UMN)