SECTION 319 NONPOINT SOURCE POLLUTION CONTROL PROGRAM

WATERSHED PROJECT FINAL REPORT

Effectiveness of Targeted Dobbins Creek BMPs

By Cedar River Watershed District

October 5, 2018

This project was conducted in cooperation with the State of Minnesota and the United States Protection Agency, Region 5

Grant #: 82795

EXECUTIVE SUMMARY

PROJECT TITLE **Effectiveness of Targeted Dobbins Creek BMPs**

PROJECT START DATE **May 1, 2015** **PROJECT COMPLETION DATE** **August 31, 2018**

FUNDING:	**TOTAL BUDGET**	**$ 700,019.50**
	TOTAL EPA GRANT	**$ 300,000.00**
	OF EPA FUNDS	**$ 297,189.00**
	TOTAL SECTION 319 MATCH ACCRUED	**$ 429,398.47**
	BUDGET REVISIONS	**NA**
	TOTAL EXPENDITURES	**$ 726,578.47**

SUMMARY OF ACCOMPLISHMENTS

The Dobbins 319 Grant was started in May of 2015. The grant project completed on August 31st, 2018. For the locals and partners, this project acted as a benchmark moment in the history of water resource work in Dobbins Creek and the Cedar River. Dobbins has had significant local interest, going back to settlement days, as the community developed and recreated on Dobbins and eventually East Side Lake. The grant set out to accelerate project development and bring with it an advanced monitoring network that would provide feedback for initial project results. But also feed into a long term data set that would establish anchor sites for tracking project development long term. To this end, the project was a success.

There were numerous partners involved in the project. State agencies played a prominent role in getting the project going. The Minnesota Pollution Control Agency was key to the grant formation and assistance with establishing the project. Board of Water and Soil Resources provided key grant funding through Clean Water Fund which was utilized as a matching resource to implement practices. Minnesota DNR assisted with stream bank technical assistance work and permitting. The Federal USDA partners assisted with key program assistance to implement practices on the landscape. They supported the effort by dedicating Mississippi River Basin Initiative and National Water Quality Initiative funds toward the project. This provided efficient application processing and nearly guaranteed funding for applicants in Dobbins. The Cedar River Watershed District provided local project levy funding and staffing resources to address the goal areas. The project also had a unique partner in the Hormel Foundation. The foundation funding support reflected local interest from the

community for waterway improvement in Austin and the surrounding area. Other agencies and community also supported the project through various levels.

The overarching goal was to develop systems that approached watershed management at a manageable scale and implemented practices that could influence change in the overall quality of the stream. The monitoring period needs to be extended to better understand the effects of those practices. The partnership also discovered that the scale of those projects also needed to be reduced, if actual and meaningful changes were going to be observed. The entire watershed did not get addressed through the window of the project. However, the BMP adoption that occurred in the focus areas was significant and almost unprecedented for this area in the past. Adoption rates were high and the landowners were engaged in adopting practices and being a part of the project. The project success lies in the total and comprehensive work that many partners contributed to create opportunity for voluntary BMP's on private lands.

The only downside was that the grant was short term and does not provide opportunity to build on the momentum gained..

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1.0 INTRODUCTION

The Dobbins Project started as a local priority over 25 years ago, and has since gained momentum and support, and has become a project of regional and statewide significance. Local leadership of staff and elected local government personnel, along with landowner engagement are two key aspects that make the Dobbins Project successful.

The primary water quality challenges are derived from ideal agricultural row crop opportunities. The land is productive, drained and cultivated on nearly all the landscape with exception to the riparian areas along the streams. The intense agriculture provides landowners with an opportunity to grow crops on nearly all of the land. In addition, the limited riparian areas that are seeded to perennial vegetation are also being grazed. Flooding and high runoff speed is also a concern and challenge for managing a healthy stream system in the Dobbins Watershed. These factors result in land use that is stressing the water quality in Dobbins Creek.

1.1 Location of Dobbins Creek and Water Quality Impairment listings

Dobbins Creek is a HUC-12 watershed that drains predominantly agricultural land within the Middle Cedar River subwatershed (HUC-10) that flows into the Cedar River near Austin, MN. Dobbins Creek is on the 303-d impaired waters list for both excessive bacteria (e. coli) and sediment (total suspended solids, TSS). The impaired reaches of Dobbins Creek are included in the Lower Mississippi River TMDL for Fecal Coliform bacteria while a Watershed Restoration and Protection Strategy (WRAPS) for the Cedar River Watershed HUC-8 is currently being drafted that will work on the sediment impairment (Attachments: Cedar River WRAPs_Appendix C_Upper Cedar R_Dobbins_Ck, EOR_Cedar River WRAPS Strategy Table_6-1-2017_Final.xlsx). This draft is subject to change after the Public Notice and Comments are reviewed by MPCA (2018). The final draft of the WRAPS will be placed here: https://www.pca.state.mn.us/water/watersheds/cedar-river until final approval by the EPA.

Two Dobbins Creek WIDs are the focus of the EPA 319 grant (Figure 1, Table 1) where prioritized reaches and their watersheds were the target of upland and nearstream BMPs with the final actions being tailored to specific landowner management objectives. Table 1 also includes other water bodies and their listed impairments in relation to the two Dobbins Creek WIDs. Figure 2 is an example of the high turbidity/TSS conditions at the outlet station at Dobbins Creek that is listed for high turbidity/TSS.

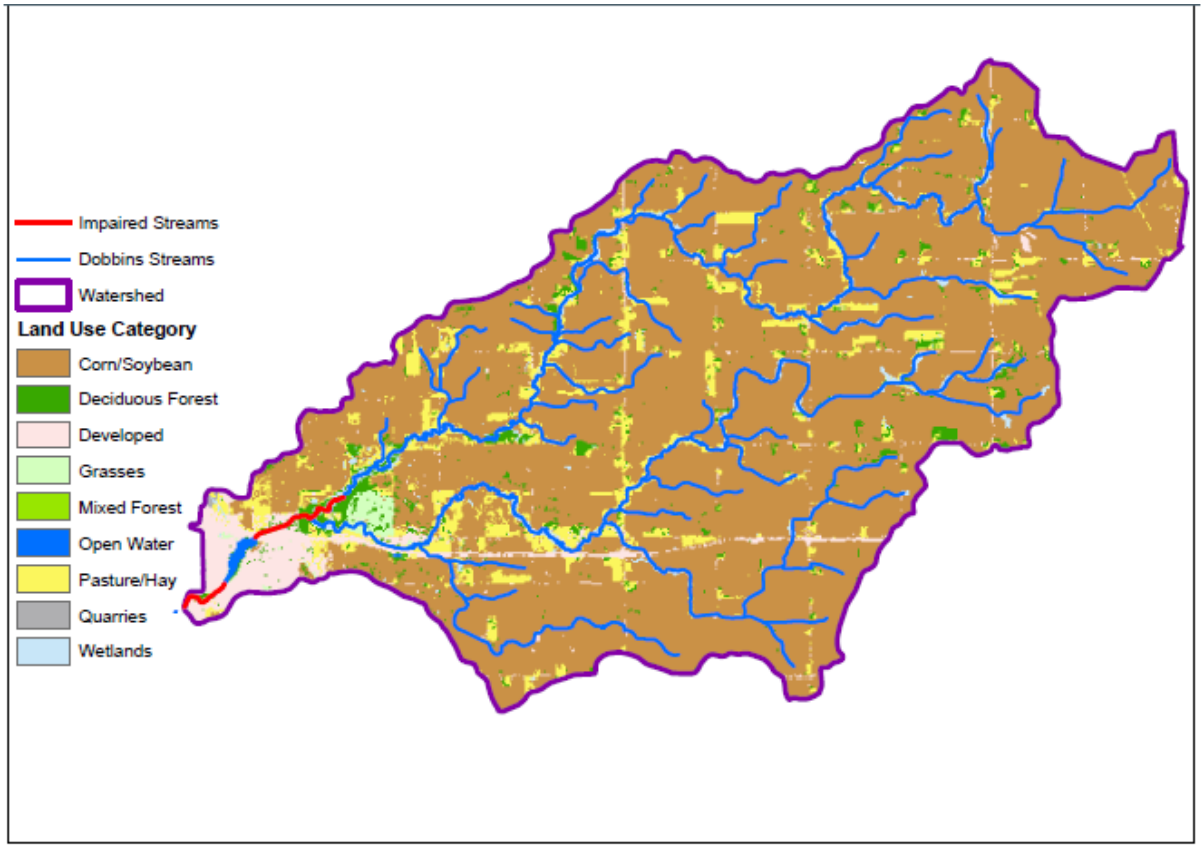

Figure 1. Dobbins Creek Impaired Stream WIDS (red) and land use primarily corn/soybean with some pasture. Note the two branches (North and South) that flow into Dobbins Creek.

Table 1: WIDS in the Dobbins Creek watershed ordered from headwaters to Cedar River near Austin. In blue bold italics are the two WIDs that are targeted for the 319 grant. The WIDs are ordered from downstream to upstream.

Name	WID	Location	Length/Size	Beneficial Uses Affected (Impairment, yr list)
Dobbins Cr	***07080201-535***	***T103 R18W S36, east line to East Side Lk***	***1.2 miles***	***Aquatic Recreation (bacteria, 2006)*** ***Aquatic Life (turbidity, 2006)***
East Side Lake	50-0002-00	East of Austin	16 hectacres	Aquatic Consumption (mercury in fish tissue, 1998)
Ramsey Mill Pond	50-0004-00	East of Austin	37 hectacres	Aquatic Consumption (mercury in fish tissue, 1998)

Dobbins Cr	***07080201-537***	***East Side Lk to Cedar R***	***0.7 miles***	***Aquatic Recreation (bacteria, 2006) Aquatic Life (turbidity, 2012)***
Cedar R	07080201-514			Aquatic Consumption (mercury in fish tissue, 1998), Aquatic Recreation (bacteria, 2012)

Figure 2: James Fett, CRWD watershed technician, checks water-monitoring equipment on the North Branch of Dobbins Creek along 250th Street in Red Rock Township. Note the high turbidity of the stream.

1.2 Other water quality issues of concern and threatened waterbodies

The fish and macroinvertebrate communities in Dobbins Creek, the North and South Branches, and small headwater streams also experiencing stress by high turbidity/TSS and nitrates as well as poor habitat quality. Fish and macroinvertebrate IBI scores collected between 2014 and 2017 are near their impairment thresholds for Aquatic Life. Dobbins Creek and other stream reaches were not assessed in 2011 for Aquatic Life for fish and macroinvertebrate communities (MPCA, 2012). The MPCA plans to return to the Cedar River watershed for effectiveness monitoring and assessment in 2019-2020.

1.3 TMDL Load Duration Curves for e. coli and Total Suspended Solids

Load Duration Curves for the e. coli TMDLs for both Dobbins Creek WID's (-535 and -537) were completed by Barr Engineering Company for the MPCA and are included in the Attachments ("Dobbins_LDC_TMDL Allocation Tables").

Dobbins Creek WID-535, is 1.2 miles in length, and includes the final stream segment of the North Branch Dobbins Creek, as well as the combined stream reach from the confluence with the South Branch, to the East Side Lake reservoir. This WID has TSS and bacteria impairments, with data from 1998-2017:

TSS: There are exceedances in all flow zones except low flows. There are significantly more exceedances in the high flow zone category of the LDC.

E. coli bacteria: There are exceedances of the target for high and very high flow zones. Comparing the concentrations from samples collected in this reach, to the water quality standards (WQS), 12 of 41 samples in this reach exceed that "maximum" standard of 1260 cfu/100 ml. June was the month with the highest geometric mean (677 cfu/100 mL), with July and August at 336 cfu/100 mL and 377 cfu / 100 mL, respectively.

Dobbins Creek AUID-537, is 0.7 miles in length, and is located below East Side Lake and the Cedar River.

TSS: There are exceedances of the target under all flow zones, except low flows.

E. coli bacteria: There are exceedances of the target in low, mid, and high flow zones. Comparing the concentrations from samples collected in this reach, to the WQS, there were no exceedances of the "maximum" standard from 31 samples. July and August slightly exceeded the monthly geometric mean WQS, with value of 139 cfu/100mL and 133 cfu/100 mL, respectively.

1.4 Sources of bacteria and sediment

Sources of bacteria - Bacteria fingerprinting has not been extensive in the watershed. However, local data suggests that bacteria is reaching the waterway through active pastures in the riparian sections of Dobbins Creek. The county is also working to address failing septic systems. There are also contributions from manure application and wildlife.

Sources of sediment -There were a number of areas showing advancing headcut gullies with a loss of cropland acreage (Figure 3), slumping and eroding gullies (Figure 4), and actively eroding stream banks (Figure 5) that were transporting sediment from headwater streams and both branches in the Dobbins Creek watershed. The watershed is also challenged with surface flow that runs across the landscape with little storage. Watershed Studies are showing that surface flow coming into the stream is at a high velocity. Traditional cultivated land is a concern for this area due to the sensitivity levels that come with an agricultural watershed. The result is sediment delivery numbers at nearly 50%, based on modeling estimations through TMDL process. This is why a variety of land treatment methods are so critical for driving improvement in the stream. Soil and Water Assessment Tool (SWAT) modeling for Dobbins Creek showed that the majority of sediment was derived from contributions of sediment coming from the North Branch. This study also suggested that Best Management Practices should be targeted for the North Branch, as it would provide the most efficient treatment for the watershed.

Figure 3. Field erosion in Red Rock Township in the Dobbins Creek Watershed.

Figure 4. Gully erosion in Dexter Township before a Targeted Dobbins project.

Figure 5. Streambank erosion on Tapp property in Red Rock Township in the Dobbins Creek Watershed.

1.5 Background and rationale for seeking 319 funding

Our rationale for seeking 319 funding was due to a few reasons:

1. The largest sediment and nutrient contributors, principally farmers, had already exhibited a conservationist ethic and a desire to improve water quality through BMP practices. They wanted to demonstrate that farmers can manage the land in a manner that will generate minimal non–point source (NPS) pollution. This landowner observed behavior and attitude presented a unique opportunity for project success and sustainability.

2. Secondly, although the Dobbins Creek watershed has a high percentage of pasture and agricultural land use, the excessive sediment and nutrients in surface waters remains less than those of similar watersheds in southern Minnesota, so there was a greatly likelihood that reducing loading would improve water quality to achieve the end goal of delisting.

3. Thirdly, CRWP was awarded a Board of Water and Soil Resources (BWSR) Targeted Watershed grant, that together along with EPA 319 grant, we hoped to more fully saturate the watershed with neighborhood–inclusive and targeted BMP activities in order to increase the likelihood of success and sustainability.

4. Finally, we hoped to demonstrate that through GIS modeling (TOMER), that areas of greatest concern for sediment and nutrient loading (phosphorus) that is causing or contributing to the issue of high turbidity/TSS could be identified and prioritized for BMP implementation. From prior experience, we felt that the primary water quality stressor in agriculturally–dominated watersheds is the lack of comprehensive BMP application to obtain a cumulative in–channel

response to biophysical metrics (Magner, 2011; McLellen et al., 2018). Through modeling of the watershed beforehand, we hoped to better prioritize areas where BMPs would provide the most benefit. Through the work plan we developed, we also hoped to develop an effective GIS model that are tailored to the crop-growers management objectives, we hoped the project would have a greater likelihood of success and sustainability.

2.0 PROJECT GOALS, OBJECTIVES, AND ACTIVITIES

The primary goals of the project were to reduce the sediment and e. coli loading to Dobbins Creek using a suite of targeted conservation practices (BMPs) as described by Tomer et al, (2013). With BMPs implemented at the watershed and field scale, we anticipate 10% to 30% reduction in sediment and nutrient loads due to multiple tier treatments, understanding that additional work on the landscape (See attachment: Solsted, 2017) may be needed to fully achieve delisting goals.

And secondly, use effectiveness monitoring associated with physical, chemical, biological, and socio-economic metrics to document water quality response to BMP treatment trains (e.g., Lein and Magner, 2018) designed with new GIS and LiDAR technologies.

Secondarily, we hoped that the reduction in sediment and nutrient loading would improve water quality and aquatic habitat that could lead to more resilient fish and macroinvertebrate communities. Currently, the Dobbins Creek North and South Branch FIBI and MIBI scores are near their respective thresholds for Aquatic Life.

The Cedar River Watershed WRAPS set out target goals, which are part of the long term approach for addressing the multiple water resource challenges in Dobbins. Specifically, the TSS goal for Dobbins is to make incremental improvements to the conditions. Over the next several years, the district hopes to establish monitoring trends that demonstrate a six year average turbidity level below 25 NTU's. The district is also working towards a stable system that reduces the number of times that the river exceeds the State standard for TSS levels in Dobbins. Current data suggests that Dobbins exceeds those standards 21.6% of the time. This is a manageable number for locals to address. There are agricultural watersheds that are exceeding the turbidity levels more regularly than Dobbins. The solutions in these areas are more difficult to identify. Locals believe that Dobbins improvements are within reach, through diligent work with ag partners and water resource stakeholders.

Similar goals have been set for Fecal Coliform. However, the specificity of those reductions is a bit more broad for the purpose of this project. Fecal data was collected as part of the project, which will assist to identify sources. However, Fecal Coliform issues are primarily being addressed through regulatory measures at the county level, through septic and feedlot permits. Project and cost-share activity with this project were designed primarily for TSS reductions. Fecal Coliform and E.Coli treatment was a secondary benefit.

The aim of the 319 grant was to develop a work plan (In Attachments: "319 Grant Agreement: Effectiveness of Targeted Dobbins Creek BMPs") to locate and implement land use and near stream practices that would lower the sediment and e. coli production and delivery to Dobbins Creek. The work plan was developed by the Cedar River Watershed District in cooperation with local partners. Primary partners included; USDA, MPCA, BWSR, Mower SWCD, Cedar WD and Hormel Foundation. The objectives of the project were to locate targeted areas in the subwatershed (Smith, 2014) where different BMP treatment trains (McLellen *et a*l., 2018) would work best and provide cost-effective results. In order to measure outcomes, an effectiveness monitoring strategy was implemented to track

physical, chemical, biological, and socio-economic metrics that would monitor and document the instream water quality response in Dobbins Creek to the BMP treatment trains implemented.

The primary objective of the project was to implement and document the performance of targeted BMPs in reducing sediment and nutrient loads and analyze these changes from financial and watershed perspectives. We used new GIS and light detection and ranging (LiDAR) technology to prescreen where in the watershed that targeted BMPs would work best with respect to watershed hydrologic pathways and processes. A number of BMP treatment trains were developed using the TWAIM approach (described in 3.0). These treatment trains were designed with new GIS and LiDAR technologies that we hope will serve as an example for other watershed managers of how to guide and implement a targeted BMP approach. We hope our example will serve as a model for future comprehensive BMP project planning, implementation, and evaluation.

Below is an outline of the project objectives with the location in the report where the tasks and deliverables are discussed. At the end of the report, we also include mention of other projects planned to be implemented in the near future and interest for ongoing work in the Dobbins Creek watershed (8.0 Future Activity Recommendations).

Objective 1: Apply Tomer and TWAIM tools to the Dobbins watershed (3.1)

Objective 2: Develop an effectiveness monitoring protocol (4.0)

Objective 3: Design 3-tier BMP treatment trains across targeted drainage areas (3.1)

Objective 4: Implement/construct BMPs (3.1)

Objective 5: Monitor BMP performance by assessing Dobbins Creek water quality (4.0)

Objective 6: Financial analysis of BMP costs and water quality benefits (3.3)

Objective 7: Fiscal management and administration (5.3)

2.1 Tomer Framework, ACPF model of prioritization zones, and BMPs completed or planned

Table 2 shows a tally of practices implemented (either completed or currently in progress) either inside or outside the areas identified by ACPF for that best management practice (BMP) category (see 3.0 for descriptions of BMPs). Additionally, included in the Table 3 are practices not considered by ACPF, such as Conservation Reserve Program (CRP) areas or Capital Improvement Projects (CIPs) that have also been completed or planned.

Table 2. Suggested BMPs from ACPF Model and Number of BMPs Implemented.

ACPF Model BMP Suggestions	Implemented Practices (Completed and In Progress) in Suggested Areas	Implemented Practices (Completed and In Progress) Outside of Suggested Areas	Total BMPs Implemented	Estimated TSS Reductions Tons/Year	Estimated Phosphorus Reductions lbs/Year
Grassed Waterways	15	16	31	198.6	198.6
Grade Stabilization	2	1	3	--	--
WASCOBs	0	20	20	20.0	10
WASCOB Cleanouts	0	9	9	17.8	7.1
Saturated Buffer*	0	1	1	--	--
Totals	**17**	**45**	**62**	**236.4**	**215.7**

*Saturated buffers are implemented more for nitrogen removal, and not TSS or phosphorus.

Table 3. Non-ACPF BMP practices that have been completed or planned.

BMP practice	Number completed	Number planned	Total Number	Estimated TSS Reduction Tons/Year (Completed)	Estimated Phosphorus Reduction lbs/year (Completed)
CRP	5	**6**	**11**	**77.6**	**119.4**
Capital Improvement Projects	2	**12**	**14**	**134**	**306.9**
Diversions	3	**-**	**3**	**10**	**10**
Cover Crops	3	**-**	**3**	**14.7**	**28**
Totals	**32**	**18**	**31**	**236.3**	**464.3**

2.2 Evaluation of goal achievement and relationship to the State management plan

The goal of the plan was to implement practices on the land and cause a positive change in water chemistry and biology results. That positive change would establish a trend towards improvement that would eventually de-list the impaired waters that have been influenced by activity in Dobbins Creek Watershed. The change in results was aggressive based on the timeline and scale.

The project identified traditional adopted practices, such as grass waterways, sediment control basins, prairie planting and cover crops. These practices were planned and presented to landowners. The staff also presented less traditional practices, such as large dams and dikes for water retention and stormwater storage. New data suggested that Soil Health and Cover Crops were providing significant benefits to water resources. These practices were presented to landowners, using education based events and field days.

The practices utilized in the project have known water quality benefits. They also promote healthy and sustainable agriculture, which was beneficial to the ag partners that were implementing the practices on their fields. This balance was important as we worked towards solutions that made progress towards the State management plan, while also providing benefit to the farmer.

The adoption of practices was successful in the small area that we focused. The staff focused on the headwaters of the North Branch. There was considerable work to do in this area and high adoption rates from the landowners implementing practices. This created a workload that was significant and effective. The project initially intended to address projects throughout the 25,000 acre watershed of Dobbins. The practical reality is that there was enough work being done in the headwaters that the staff were able to concentrate efforts and opportunity to this small area.

The Effectiveness of Targeted Dobbins Creek BMPs Project (Dobbins Project) is involved with many aspects of Minnesota's Nonpoint Source Management Program Plan (NPS Plan, https://www.pca.state.mn.us/sites/default/files/wq-cwp8-15.pdf). This is a comprehensive plan intended to set Minnesota's statewide NPS goals and put forward the approach to address water quality problems from NPS pollution. This plan includes the Section 319 program and projects, and it is reviewed and approved by the U.S. EPA. The current plan was developed by numerous committees and stakeholders and was finalized in 2013. The main reason that the Dobbins Project addresses many issues in the NPS Plan is that it involves a prioritized watershed at an appropriate scale, that is striving to continually improve both land and water conditions, including water quality. The Dobbins Project started as a local priority over 25 years ago, and has since gained momentum and support, and has become a project of regional and statewide significance. Local leadership of staff and elected local government personnel, along with landowner engagement are two key aspects that make the Dobbins Project successful.

The following is a partial list of how the Dobbins Project involvement aligns with the NPS Plan and where it is included in the following Report sections as well as a brief statement about how/why it is important:

Minnesota's Watershed Approach (3.0) - Projects focused onto a smaller scale help support improvements at the HUC-8 and ecoregion scales.

Monitoring (4.0) - Goal 4 of the monitoring chapter is to "promote effective use of BMPs through assessing the improvement in water quality relative to specific NPS reduction actions." This is in essence the objective of the Dobbins Project with use of "treatment trains" of BMPs.

Rivers and streams strategy (4.3) - The Dobbins Project supports a comprehensive effort involving chemical, physical and biological components of water quality.

Coordination efforts (6.0) - One other important aspect for the Dobbins Project that makes it more successful, is the coordinated efforts of numerous levels of government, and the private sector. This means that ongoing work by local government (county, soil and water district, watershed district, townships and city), state government (BWSR, MPCA, and others), and private sector farms and agronomy suppliers – engages more people, increases awareness and ownership, which all translates into more actions and tangible results, over time.

Information and Education (7.0) - The Dobbins Project addresses many of the five goals in this section, and in particular, Goal 1 which covers "build and improve the capacity to deliver NPS-related information and education at state and local levels."

The Dobbins Creek project is focused on a smaller subwatershed scale (HUC-12) that aims to support water quality improvements not only within the Dobbins Creek Watershed but also downstream waterbodies such as the Cedar River which is currently impaired as well for Aquatic Life (total suspended solids) and Aquatic Recreation (excess bacteria). The Dobbins Creek project therefore is nested within the Watershed Restoration and Protection Strategy (WRAPs) for the Cedar River HUC-8 watershed and MPCA's ongoing major watershed Effectiveness Monitoring Approach. Information from the Dobbins Creek project was used to provide better cost estimates in both the TMDL and WRAPS reports, for NPS implementation in the entire Cedar River Watershed HUC-8.

The Dobbins Project has been a significant initiative for the local water management team (Cedar River Watershed District, CRWD) working extensively over the years on other projects and TMDLs within the larger Cedar River 8-HUC watershed. It has also shown to be significant in terms of duplication and replication of how a watershed management can successful with project implementation on a small watershed scale (HUC-12). The staff tested a long standing theory that project implementation can be successful if the staff has an opportunity to utilize flexible funding, heavy cost share rates and trust building between staff and landowner. The model utilized by SWCD staff can be replicated in other areas of the watershed where priority initiatives are pursued.

While we anticipate that the upland, nearstream, instream BMPs implemented will eventually provide an improvement in the primary impairments (excess bacteria, sediment as TSS), we recognize that there may be a considerable lag-time needed for demonstrated improvements in the 319 targeted waterbody of Dobbins Creek. According to a USEPA Technical Note (Meals and Dressing, 2008) lag-time estimations often include one or more of the following considerations: timeline for project development and landowner relationship building, designing and implementing BMP practices and other projects, the time for source delivery to be reduced, given the BMP type, the pathway and delivery time of the sources, as well as the size of the watershed of the receiving waterbody. We recognize that the 3-year timeframe of our project planning and BMP implementation is too short a time to expect water quality improvements to be documented within Dobbins Creek.

The work we have completed within the timeframe of the 319 grant should be viewed as baseline information with which to measure and compare overtime for trend analysis of BMP effectiveness. Additional BMPs are in process or planned within the next 5 to 7 years. We would hope to evaluate the effectiveness of the 319 grant funded activities and others by re-monitoring the same four EQUiS

stations that were monitored within the timeframe of the grant (2015 to 2018) again within 10 years (e.g., 2025 to 2028) as well as other more targeted locations nearest to concentrated BMP implementation areas. We also hope to continue interim monitoring through MPCA's round 2 IWM Effectiveness Monitoring scheduled for 2019 for the Cedar River Watershed well as other funds that support the continued work within Dobbins Creek and the larger Cedar River Watershed (See also *8.0 Future Activity Recommendations*).

2.3 Supplemental information

There have been multiple water quality programs and initiatives, past and ongoing in the Cedar River Watershed, with many projects and programs specifically within the Dobbins Creek watershed, including education and outreach with school groups, community members (tree planting), working alongside Conservation Corp interns, and workshops and initiatives on soil health with crop growers (Figures 6, 7, and 8). These projects have been well supported within the community. With the assistance of the local media, many of these projects were highlighted in newspaper articles and on TV.

Figure 6. Cody Fox, CRWD project manager, talks about erosion that was occurring on the Tapp farm to Project E3 students.

Figure 7. Conservation Corps summer apprentice David Wick conducts survey work in summer 2017 for a grass waterway project in Red Rock Township.

Soil Health Initiative - During the same time frame as the Dobbins Creek 319 project, there was a 3-year project funded by The Hormel Foundation in partnership with MSWD and Riverland College (See Attachments) to look at the underlying soil health of cropland in Mower County, including one set of fields in the Dobbins Creek watershed. Measures of the physical, chemical, and biological structure of field plots were collected and will be analyzed to see which measures inform crop growers of the condition of their land as well as compare the soil condition of both conventional tilling and conservation tilling and cover crop practices. An additional soil biology assessment method was also applied to provide a comparison between typical lab based methods and novel microscope assessments of the soil ecology (i.e., food web and structural support built by bacteria, fungi, protozoa, nematodes, and earthworms; Ingham et al., 1985) developed by Dr. Elaine Ingham with the Soil Food Web, Inc. Soils with a higher organic matter content and greater organism diversity can bind and protect soil particles better from wind and water erosion and minimize topsoil loss, improve water infiltration, lock nutrients in the soil during the non-crop growing season, and unlock the nutrient and mineral pool already available in the soil particles during the growing season at the time and amount that plants need. This work may aid the direction of future BMPs within croplands to further reduce sediment and nutrient losses to receiving waterbodies like Dobbins Creek.

3.0 Best Management Practices developed and/or revised

The TWAIM approach considers water movement, starting with upland BMPs in the cropland fields where rainfall occurs, tracks both surface and subsurface pathways, then seeks to trap and treat pollutants prior to entering the creek. Many corn-belt streams have enlarged channels resulting in a loss of aquatic habitat. Applying natural channel design techniques we hope to improve and stabilize fluvial processes to improve both fish and macroinvertebrate IBI scores. The combination of these practices

along a drainage catena is called a treatment train. Because these practices would not be intrusive, but would be tailored by each producer we expect increased adoption over more demanding BMPs that take land out of production.

The framework we used was first described in Tomer *et al.,* (2013) and has been refined into the current ACPF User's Manual (Porter *et al*., 2018). The model uses LiDAR data to create a digital elevation model (DEM) which is then hydrologically conditioned to model streamflow. This dataset is combined with soils, land cover, and field boundary datasets to identify the locations within fields and riparian zones that would be best suited for flow- and constituent-attenuating practices such as grassed waterways, nutrient removal wetlands, water and sediment control basins, and controlled drainage. The model is not intended to create an implementation plan on its own, but rather to be used as a starting inventory of conservation practice opportunities in a watershed; the authors stress the importance of local knowledge and landowner participation and input to the watershed planning process.

1. The first tier in the treatment train is the upland area where crops are grown. Within this area the project will accelerate focus on demonstration and education of cover crops, a more diverse crop rotation [currently corn/soybean], and practices that support soil health building principles that reduce compaction and increase soil biological health. These practices would increase soil organic matter, improve soil structure, build soil moisture holding capacity, increase infiltration rates, increase cation exchange capacity and change how nutrients are cycled [not lost through leaching] resulting in increased crop productivity.

2. The second tier is the area at or near the edge of a field; includes both overland flow and subsurface flows. Tile outlets typically discharge directly into surface waters, whether it is an open drainage ditch, stream, river, lake or wetland. Under current drainage scenarios, this water is untreated and can contain high levels of nitrate nitrogen. Treatment methods we plan to demonstrate include bioreactors, saturated buffers, constructed wetlands, floating islands and enhanced chemical treatment. These treatment methods have been researched and proven effective in removing nitrate nitrogen and to a lesser known extent, phosphorus; nevertheless design tailoring will be required at each location. A key part of this work is to demonstrate lab tested BMPs at the field scale and monitor their performance over time.

3. The third or final tier in the treatment train is the in-stream treatment methods. These are placed in the channel, just below the tile outlet or side inlets to provide further nutrient treatment and increase microbial and macroinvertebrate habitat. Methods demonstrated will include placement of floating islands that will provide live plant nutrient sequestration and habitat, wood, rock placement into the bed and bank for microbial and macroinvertebrate habitat, induced hyporheic flow with constructed riffles, and addition of buried biochar and slag iron in constructed glides. We will monitor the performance of these systems in controlled lab scale and field scale settings.

3.1 Application of GIS tools in designing 3-tier treatment trains

Menus of BMP options were created using GIS models and presented to landowners.

Objective 1: Apply Tomer and TWAIM tools to the Dobbins watershed.
Deliverables: Maps with BMP options, presentations to landowners, and ideally, signed contracts with landowners.

Task A: Use the Tomer approach to develop menus of BMPs for the landowners by 1) gathering LiDAR/GIS data, and 2) building muti-layerd menus of BMPs.

Task B: Apply the TWAIM, 3-tier landowner engagement approach throughout the project by 1) hosting an initial meeting(s) with defined groups of landowners by location in the watershed, and 2) present BMP menus to landowners and gain practice buy-in.

The district sponsored several cover crop field days over the course of the grant and targeted landowners in Dobbins Creek Watershed for education and outreach. The district also established working relationship with a farmer in the watershed that was utilizing cover crop management as part of his system. The district worked with him to provide outreach events where he could share his success story and lessons learned in residue management, cover crops and livestock management (Figure 8). During this time the district also initiated a Soil Health team in Mower County. This was established to build a network of individual landowners who were using cover crops and provide them a forum for discussing the success and lessons learned in soil health management. Events were planned and held in 2015, 2016 and 2017.

Figure 8. Tom Finnegan (left), who raises beef and crops in the Dobbins Creek Watershed, speaks during a free Field Day bus tour in May 2017 that focused on cover crops and other soil-health practices. Finnegan and area farmer Tom Cotter were 2017 Cover Crop Champions with the Mower Soil & Water Conservation District. Cattle graze (right) on Tom Finnegan's cover crop field in the Dobbins Creek Watershed. Finnegan has also been a mentor at Soil Health outreach meetings, providing coaching and assistance to landowners interested in learning more about Soil Health practices.

The District worked with targeted landowners in the headwaters of Dobbins to identify project opportunities and work alongside those landowners in the development of BMPs and projects. Understanding the challenge of scale in the watershed, the staff focused on the headwaters of Dobbins and targeted that neighborhood with practices and planning resources.

Staff invested in landowners meetings to hear about landowner goals for the farm and hear about how they manage their farm. This exercise demonstrated that the district was interested in fitting BMP's that worked for the overall farm goals of the farmer. It also built trust in the process and an understanding

that the project partners valued the overall success of the farm into the conservation methods. BMP's were selected by landowner and staff that fit the farming operation, equipment use and future plans for the farm. Designs were started in the headwaters where possible, often treating watershed areas of less than ten acres. Several sites were developed for extensive storage or treatment that were downstream. Those locations were selected based on upstream treatment in the headwaters. Contracting measures are also in place to assure routine spot checks and maintenance measures are taking place. This will assure the long term viability of the practice.

3.2 Watershed modeling and identification of priority areas

Previous SWAT modeling in the Dobbins Creek watershed has suggested focusing on the headwaters of the north branch of the creek. This focus was based on the goal of increasing storage in the upland areas of the watershed and reducing peak flows and sediment within the creek as the first part of the treatment train approach. The work carried out during this grant period focused on building landowner relationships and establishing projects in this area. This geographic focus can be seen in the placement of implemented practices in the project maps (Appendix).

The model we used for identifying targeted areas for BMPs for the 319 grant was The Agricultural Conservation Planning Framework (ACPF), also known as the 'Tomer Tool'. This approach uses a GIS-based model used for targeting conservation practices for field-scale watershed planning in agricultural settings. The intent for future work is to spread out from this original focus, using model outputs from ACPF for targeting of projects as it progresses.

Objective 3: Design 3-tier BMP treatment trains across targeted drainage areas.

Deliverables: BMP project plans.

Task A: Design standard, upland conservation BMPs to be used through 1) holding education/outreach events to discuss crop rotation and minimal tillage practices, and 2) develop upland management plans and specifics with landowners.

Task B: Following the outcomes of Objective 1 and Task A of Objective 3, design BMP treatment trains through 1) assessing site conditions at tiers two and three to tailor BMP designs for each location, and 2) prepare BMP designs, and 3) obtain necessary permits from MDNR and U.S. COE.

Within the timeline of the 319 project a majority of the BMPs were installed or implemented within the North Branch of Dobbins Creek (see maps in Appendix A, Table 2 in 1.0 Introduction, description of BMP types, water quality benefits, and landowner interest in section 3.0). All requisite permits were obtained prior to construction. We hope to continue the work started by filling in additional areas in the North Branch watershed as well as BMPs in the South branch watershed.

Objective 4: **Implement/construct BMPs.**

Deliverables: Both structural and non-structural BMPs.

Task A: Implement upland management plans by meeting with landowners to review field management activities.

Task B: Construct and oversee structural BMPs. 1) Select contractors, and 2) Oversee construction activity.

The project maps (in Appendix A) show that the adoption of practices in many of the parcels were located in the headwaters. This is due to the flexibility of funding and opportunity to cost-share assist at a high percentage of project cost. The multiple funding sources allowed for nearly 90% cost share. The flexibility for timing and practice implementation has also resulted in successful land treatment. Finally, the neighborhood approach showed those landowners how important the project was. As adoption started occur it was easier for neighbors to participate.

3.3 Best Management Practices (BMPs) Identified by the ACPF Model

The following is a description of the different BMPs with photographs (see Tables 2 and 3 for number of BMPs identified by the model for targeted areas and number of BMPs outside of targeted areas implemented or planned). Included below are the potential water quality (WQ) benefits and level of interest by crop-growers.

1. **Grassed Waterways**- A grass waterway is a designed drainageway with a specific slope that is designed to flow the computer 10 yr storm runoff. The bottom and side slopes are seeded to create a channel that flows water (where concentrated flows occur and cause erosion) safely without additional erosion or soil moving from that location due to the sod formed from the grass seeding (Figure 9). There were 31 grassed waterways implemented or in progress.

   WQ Benefits- Reduced gully erosion as well as increased catchment of sediment movement from upstream.

   Interest by crop-growers- In quite a few cases significant ephemeral gully erosion was occurring in the Dobbins Watershed. In most cases, grassed waterways were the best and most likely practice to solve the resource concern. Grassed waterways are very common in our area and so many landowners are familiar with working around them and do not see them as a significant obstacle. 10-20 new waterways were installed during this time. Another 6-10 waterways needed significant rehab to get them functioning properly again.

Figure 9. Photograph of erosion in a field (top) in Dexter Township before it became one of the first Targeted Dobbins projects for a grass waterway. Same field (bottom) after a grass waterway was established.

2. **Grade Stabilization** – Structures that reduce gully erosion. Typically earthen embankments located in or on the edge of fields to reduce the velocity of water leaving the site and/or protecting from scouring due to high velocities or gradient changes that often lead to erosion. There were 3 projects implemented or planned.

WQ benefits - Berms and bankments intercept locations on cropland where water starts to carry sediment and create gullies that enlarge and creep further upstream the land overtime. Through interception, in field gullies and edge of field stream bank ravines are stabilized so there is less sediment delivery to the stream.

Interest by crop-growers - While the berms and bankments take some land out of production and need to be navigated around with farming equipment, the structures halt the loss of farmable land. A few farmers were interested based on the severity of conditions on or adjacent to their croplands (Figure 11).

Figure 11. Gully near Dobbins Creek on Oelkers Property (Picture on Left) was addressed through the construction of a Grade Stabilization structure (Construction picture on Right)

3. WASCOB-Water and Sediment Control Basin-An earthen embankment often times built in series to slow water by causing temporary detention allowing time for sediment to settle out before transfer of the water to a downstream location. The water is moved downstream via a tile drainage system or main (Figure 10). There were 20 WASCOB projects completed or planned.

WQ benefits- Reduced sediment load downstream and reduced flows.

Interest by crop-growers - After grassed waterways, WASCOB's were the next most common practice. Many landowners were in favor of these because we are able to design the basins as farmable. Thus, this would allow the landowner to not lose any land of production due to grass. WASCOB's role is limited to smaller watersheds typically due to practice design standards. In rare cases, landowners did not prefer WASCOB's due to the amount of earth moving to complete them. The issue was moving the soil around loses some nutrients, occasionally or may cause compaction in isolated areas that lead to poorer crop yields in those areas initially.

Figure 10. A Water-and-Sediment Control Basin (WASCOB) in Dexter Township at the Tapp project in 2015.

4. **WASCOB Cleanouts** - Removing sediment that has accumulated in the WASCOB from erosion. There were 9 clean-outs completed or planned.

WQ benefits - Soil captured in the storage area is removed rather than entering downstream waterbodies.

5. **Saturated Buffer-** A practice that utilizes existing drain tile outlets and uses gravity and control structures to "inject" the water into the soil profile where microbes and vegetation (rooting) are able to utilize the "excess" nutrients instead of a direct point source into the waterbody (Figure 12). Only one saturated buffer was designed and built.

WQ benefits - The tile water is essentially treated via the vegetation and microbes to reduce Nitrates and other potential excess nutrients, such as dissolved phosphorus.

Interest by crop-growers - In order to deliver a project that is beneficial and reduces excess nutrients, many designs would not work with our current topography. "Injecting" the water into heavy clays or more impermeable soils was not something we wanted to do as the overall project would not deliver measurable differences in the form of nutrient reduction. Those sites were removed and other projects were sought after. Many of the saturated buffer sites simply wouldn't yield the results that seem to make sense to cost-share. Those handful of sites for saturated buffers were scrapped and other practices were sought as a better option for the funding.

Figure 12. Saturated buffer construction (top) at Tapp farm in Dexter Township. Completed saturated buffer (bottom) at Tapp farm.

3.4 Other BMP Projects completed or planned

1. **Grade Stabilization/Capital Improvement Projects (CIP)-** A feature that transfers water safely to an outlet area reducing the erosion or sediment transport from the location. Often times these structures reduce high water flow events as well, which reduces downstream erosion and catches some of the sediment in the storage area upstream of the structure. These projects typically involve some land coming out of production and a goal of slowing the water down by allowing the water to temporarily inundate areas of cropland. Capital Improvement Projects use earthen embankments that reduce stormwater runoff peaks at a more manageable rate (Figure 13). There were 12 CIPs completed or planned.

WQ Benefits- Reduced flooding, nutrient and sediment transport by slowing the water and temporarily storing it, reducing velocity. Protects downstream fields and streambanks from erosion during high flow events that are now becoming more frequent in the watershed. The structures also ensure the water is outleting into the downstream channel at a manageable rate and reducing water spilling out of the banks creating additional erosion and flooding of crop fields downstream. These projects may also protect infrastructure (roads) downstream from overtopping or washing out, thus protecting the public from dangerous situations that often times otherwise are uncontrolled.

Interest by crop-growers - Some landowners did not see the practice as advantageous to their operations and the projects would not move forward. However, with CIP projects a flowage easement would be paid to the landowner. Sometimes the payment would assist and the landowners would be agreeable to the terms and move ahead with the project.

Figure 14. Project Manager Cody Cox works with landowners in Dobbins Creek Watershed to discuss program opportunities and partnerships with landowners and local agricultural stakeholders.

8. Diversions- Earthen berms to funnel water into an adjacent area that is more stable and unlikely to erode (Figure 15). There were 3 diversions completed or planned.

The diversions are intended to dissipate energy on concentrated flows and route water through a controlled flow path, away from those concentrated areas. By designing the flow path, the energy of the water does not have an opportunity to collect at a central location and disrupt the integrity of the soil. Diversions are most effective when implemented with other practices such as waterways, dikes and berms.

Landowner interest is high for these practices because they are designed with the ag interests in mind. The project is laid out to efficiently move water in a manner that does not create erosion. It also moves it in a way that does not typically disrupt the agricultural ground more than necessary. Landowner implement versions of this in various ways on their land. It is a common practice for implementation, even when cost share assistance is not available.

Figure 15. Earthen berm under construction in summer 2018 on the Kiser farm in the headwaters of the Dobbins Creek Watershed.

2. Conservation Reserve Program (CRP) projects. CRP projects that were implemented in the Dobbins Creek watershed include Filter Strips (CP21), Pollinator Habitat (CP42), and State Acres for Wildlife Enhancement (CP38E). These practices help to filter sediment and nutrients out of runoff from rain before it reaches the stream, and also provide beneficial wildlife habitat. There were 11 projects completed.

3. **Cover crops**- Cover crops are a big step for many producers and that step just hasn't occurred in Dobbins quite yet. Most landowners are still skeptical and many are just not ready to change their operation this significantly. However, there was one set of field plots in the Dobbins Watershed that were

included in a Soil Health study that may demonstrate whether or not cover crops are effective at improving soil health and cropland conditions.

4. Stream bank restoration - Stream work was planned as part of the comprehensive treatment of practices. The Dobbins work started in the headwaters and addressed upland practices. We wanted to follow the flow path through the system and to the channels of the stream. This would also benefit the habitat needs for Dobbins, which have been degraded through years of altered hydrology. The bed and banks of Dobbins do not hold the biological values that it did historically. The project aimed to focus on a small reach, in the headwaters of Dobbins and restore this area. This project is not constructed at time of report. However it is planned for construction by the end of the Clean Water Fund Targeted Watershed Funding grant.

5. Saturated Buffer - Saturated buffers were a supporting practice, identified to assist in Nitrate reduction. Those projects presented technical challenges that became a barrier for design and construction in Dobbins Watershed. One project was implemented in cooperation with a grade stabilization structure. Many of the sites did not have topography that would lend itself to effective saturated buffers. Also, the maintenance issue of maintaining these areas in riparian landscapes became an issue, when identifying projects in riparian areas.

3.23 Future BMP options

In the future, the suite of BMPs available to farmers may also include new ideas and novel approaches. For, example, nutrient management strategies that better time the application of fertilizers to row-crops and inclusion of practices that enhance soil health ecology can both reduce the loss of nutrients to waterways while increasing yields and lowering costs.

3.3 Financial analysis of BMP implementation

Objective 6: Financial analysis of BMP costs and water quality benefits.
Deliverables: Report on the financial analysis results and presentations to selected groups.

Task A: Gather economic data related to pollutant reduction and habitat improvement, through 1) conducting a literature review to gather information on costs of addressing the effects of impaired waters, crop production loss due to poor soil health, etc., and 2) written report of findings.

Task B: Conduct financial analysis and disseminate findings, through 1) running analysis scenarios, such as cost-benefit, evaluate, re-run scenarios, if needed, and 2) presenting results to landowners, water quality, and agricultural audiences.

A fiscal analysis report on BMP cost effectiveness was completed by the UMN and included in the Attachments (Dobbins BMP Econ Paper). Many projects in the Dobbins Creek watershed were recently implemented and so the true costs in long-term operation and management are not known. The cost-benefit analysis we conducted used literature sources to estimate the most cost and benefit for NPS interception and removal for phosphorus and nitrogen. The most cost-effective practices for TP reduction included constructed wetlands and improving riparian corridors through buffer strips and

prairie strips . These practices intercept soil bound and dissolved phosphorus through plant corridors that keep soil out of waterways and treat phosphorus that already entered and is traveling within waterways. In contrast, the most-cost effective practices for nitrogen removal included riparian buffers, constructed wetlands, bioreactors, controlled drainage, and saturated buffers, which aim to remove excess nitrates within subsurface pore water and draintiles by plant and soil microbial capture and treatment closer to the source instead of at downstream water treatment plants. Given the current status of BMP effort in Dobbins Creek, we are not able to fully document the effectiveness of BMPs recently installed. A future document will be produced that will analyze the effectiveness monitoring of Dobbins Creek.

While the structural BMPs selected and implemented in the Dobbins Creek watershed will aid in achieving some sediment reductions in Dobbins Creek, additional initiatives in managing the soil profile may be needed in order to achieve the water quality goal of delisting Dobbins Creek for turbidity/TSS. A presentation provided by Jim Solsted on the output from his work using the Gridded Subsurface Surface Hydrologic Analysis (GSSHA) model for the Minnesota River Basin (Attachment, Solstad, J. 2017) suggests that more non-structural BMP approaches should be considered that aim to increase short-term water storage in the soil profile to help reduce peak stream flows that cause river bank erosion. This could be done through watershed wide implementation of cover crops and other soil health measures (e.g., organic matter amendments and promoting soil ecology) on plowed and tiled lands. These non-structural BMP measures may be needed in order to reduce the degree of water erosion and gully formation on upland croplands, and reduce peak flows that are exacerbating stream bank erosion within the Dobbins Creek Watershed.

Prior to the project, there was a considerable amount of modeling data available for Dobbins. This provided broad input on targeting. After this project, we now have more comprehensive data on a field scale. We hope to follow up with landowners to gather input on how the projects have affected their operations and bottom line. We are also aware of barriers that are keeping landowners from moving forward with Soil Health practices, such as Strip Til and Cover Crops. We know that we need to develop data sets that will address yield loss concerns and timing for operations of those practices. In the future, adoption of these practices will have as much to do with education as it will with cost share assistance.

4.0 MONITORING RESULTS

4.1 Effectiveness monitoring design

Objective 2: Develop an effectiveness monitoring protocol.
Deliverables: A final report on findings and written SOP.

Task A: Define effectiveness monitoring scope and necessary components, through 1) conducting a literature review to determine expectations of monitoring results based on BMP specifics, and 2) determine acceptable error based on equipment, field conditions, etc., and coordinate with all related QA/QC and QAPP plans.

Task B: Finalize a protocol that can be used across MN for measuring and communicating BMP performance as related to physical, chemical, and biological parameters, by 1) preparing draft protocols and include QA/QC to develop standard operating procedure (SOP) document; submit to MPCA and others for peer review, and 2) finalize SOP and present it to MPCA and other interested parties.

A basic literature review of Effectiveness Monitoring was conducted and a draft of an effectiveness monitoring plan was developed by staff at CRWD and UMN.

Standard Operating Procedures (SOPs) for Water Chemistry and Flow were developed (Attachments:"SOP_WaterChemisrty_Dobbins Creek", "SOP_ISCO sampler", "SOP_Flow_Dobbins_Creek").

A Quality Assurance Project Plan [QAPP] was written and approved by the Minnesota Pollution Control Agency prior to any field scale monitoring activities (Attachment:"Effectiveness of Targeted Dobbins Creek BMPs 319 Project Quality Assurance Project Plan"). The QAPP was implemented through collaboration between the Cedar River Watershed District, University of Minnesota, Watershed Recovery LLC, Minnesota Testing Lab, and Barr Engineering in concert with the voluntary cooperation and partnership with landowner and local operators.

A guidance document is in development that outlines steps for future Watershed Effectiveness Monitoring Plans that incorporates the steps outlined by Me. The draft is included i the Attachments ("Watershed Effectiveness Monitoring (W-EM) Guidance Document: Lessons and Suggestions from the Dobbins Creek Experience"). The Dobbins work is ongoing, and more lessons and suggestions are anticipated, given that we are only within the Before and hope within 10 years to monitor the After of this work.

In order to track and measure outcomes, an effectiveness monitoring strategy was implemented to track physical, chemical, biological, and socio-economic metrics that would monitor and document the instream water quality response in Dobbins Creek to BMP treatment trains.

4.2 Water Quality - monitoring and reporting

Objective 5: Monitor BMP performance by assessing Dobbins Creek water quality.
Deliverables: Completed EQUIS forms and spreadsheets, and required semi-annual and final reports.

Task A: Measure BMP performance for pollutant removal in controlled and field scale systems year round from May through October for 3.5 years, by 1) measuring sediment (TSS) and nutrient (DOP) concentrations under controlled laboratory conditions. amd 2_ measuring turbidity, DO, pH, conductivity, temperature, water level, and clarity (Secchi tube) at field monitoring sites.

Task B: Process samples, assess and management data, and analyze results for reporting as defined by the QAPP where 1) samples are appropriately analyzed in an approved lab, following standard protocols and the QAPP, and 2) statistically analyze water chemistry data for watershed patterns and
processes.

Task C: Prepare EQUIS forms and spreadsheets and submit reports to the MPCA by December 1 of 2015, 2016, and 2017.

Water chemistry samples were collected at sites according to SOPs and samples were submitted to MVTL in New Ulm, MN from 2015 to June of 2018 and RMB Laboratories in Detroit Lakes, MN in July and August of 2018. Both are certified labs. The change in labs was made to reduce delivery and lab costs by having UMN students returning to the Twin Cities after sampling deliver samples to the RMB location in Bloomington, MN. Samples were then sent to the Detroit Lakes lab for analysis.

Annual reports were written and in the attachments ("Dobbins Creek-Water Chemistry Monitoring Technical Report 2015" and "Dobbins Water Quality Monitoring Report 2016-2018").

All water chemistry data was submitted yearly (2015, 2016, 2017) to EQuIS. The data collected in May to August of 2018 will also be submitted this fall.

2015 Water quality monitoring

Water chemistry was collected weekly at 14 sites between June and September of 2015 (Table 3). Instream samples were taken for analysis of E. coli and nitrate concentrations and instantaneous readings were taken using a YSI multiparameter sonde for water temperature, pH, dissolved oxygen, specific conductivity, and turbidity.

Table 3: Water quality monitoring sites in 2015.

Project_Id	Project_Station_ID	EQuIS_Location_ID	Location/Branch on Dobbins Creek
PRJ0101079	N-2.0	S007-236	NORTH BRANCH
PRJ0101079	N_0.07	S008-951	NORTH BRANCH
PRJ0101079	S_5.0	S008-952	SOUTH BRANCH
PRJ0101079	N_4.1	S008-953	NORTH BRANCH
PRJ0101079	S_1.9	S008-954	SOUTH BRANCH
PRJ0101079	S_0.04	S008-955	SOUTH BRANCH
PRJ0101079	S_2.3	S008-956	SOUTH BRANCH
PRJ0101079	S_5.5	S008-958	SOUTH BRANCH
PRJ0101079	N_8.0	S008-960	NORTH BRANCH
PRJ0101079	S_9.5	S008-959	SOUTH BRANCH
PRJ0101079	N_10.6	S008-960	NORTH BRANCH
PRJ0101079	N_14.3	S008-961	NORTH BRANCH
PRJ0101079	S_6.9	S008-962	SOUTH BRANCH
PRJ0101079	OUTLET	S008-963	MAINSTEM DOBBINS AFTER CONFLUENCE
PRJ0101079	N_10.5	S008-968	NORTH BRANCH

Analysis of 2015 data

Statistical analysis of 2015 data involved comparing datasets between branches to determine whether there was a significant difference between the Northern and Southern sites. The analysis did not yield a statistically significant difference between branches for any parameters; however, the branch comparison for E. coli returned a p-value of .053—close to the value needed for significance (less than .05). The nitrate dataset showed signs of corruption, thus no further analyses were performed on it.

In addition to comparing the sample parameters between Northern and Southern branches, it was important to compare the sites as individuals to determine whether one or more sites significantly differed from the others. The analyses showed two sites differed from the rest for dissolved oxygen (S_0.04 and N_0.07), four sites differed for specific conductivity (N_10.5, N_8.0, S_2.3, and S_9.5), two sites differed for turbidity (N_14.3 and S_9.5), and two sites diverged for E. coli (N_8.0 and N_2.0). Water temperature and pH levels showed consistency throughout the monitoring sites. The complete 2015 report and its appendices can be seen in the Attachments ("Statistical Analysis - Dobbins Creek Water Quality 2015" and "Dobbins Creek-Water Chemistry Monitoring Technical Report 2015").

These results were used to inform the longer-term stream stormflow and baseflow monitoring that took place in growing seasons of 2016-2018. It should be noted that concentrations, rather than loads, were compared within each site to identify outliers, and that median site concentrations were used to compare sites with one another. Therefore, any extreme concentration measures from a single event, such as a high concentration of E. coli or high turbidity readings, influenced results but were not used to identify exceedance of standards. This is in contrast to the storm sampling, below, where load duration curves were developed for comparison against a water quality standard.

2016 to 2018 Water quality monitoring

Stream samples were taken at four locations (Table 4) during storm flows by automatic samplers (Figure 16 below) and in the absence of rain events, during baseflows at least every two weeks between April and October of 2016 and 2017, and between May and August of 2018. Collection followed SOPs. Samples from these four sites were analyzed by certified labs for TSS, total phosphorus, nitrate and nitrite, and dissolved orthophosphate.

Table 4: Load monitoring stations (2016-2018).

Project ID	Project_Station ID	EQuIS_Location_ID	Location/branch Dobbins
PRJO1079	Golf Course	S009-281	SOUTH BRANCH
PRJO1079	N8	S008-958	NORTH BRANCH
PRJO1079	Outlet	S008-963	MAINSTEM
PRJO1079	250th	S015-023	NORTH BRANCH

Figure 16. James Fett, watershed technician for Cedar River Watershed District, checks monitoring equipment (SISCO sampler) on the North Branch of Dobbins Creek in Red Rock Township.

Annual Load Estimates

The 2016-2018 monitoring resulted in the development of annual loading estimates for each of the four parameters listed at the four monitoring sites. Loads were estimated using Flux 32 load estimation software (USACE, 2017). Concentration data were stratified into groups based on flows, and then loads were estimated using a flow-weighted average for each stratum (Method 2 in Flux32). Load estimates and associated coefficient of variation (C.V.) values are shown in Table 5. Higher C.V. values (> 0.2) indicate more uncertainty in the estimate made. It can be difficult to achieve lower C.V. values in smaller, flashy stream systems, such as Dobbins Creek (USACE, 2017) - this is evident in the uncertainty around the estimates made at the smallest, flashiest site, 250th. These estimated annual loads are meant to give baseline values at these points in the stream network that will allow for change over time to be shown in the future. The N8 loads appear to be greater than they should be, given the relative size of that drainage area against the entire watershed. These values are likely the result of an overestimation of flows – the coefficients of variation are not excessive, yet the load values for all constituents are unrealistically high. Future work in the watershed should include the refinement of the rating curve used to calculate flows at this site. The full 2016-2018 monitoring report with load duration curves can be found in the Attachments ("2016-2018 Water Quality Monitoring Report").

Table 5: Estimated Annual Loads

Site	Drainage Area (acres)	TSS (tons/yr)	TSS C.V.	NOx (lb/yr)	NOx C.V.	TP (lb/yr)	TP C.V.	P04 (lb/yr)	PO4 C.V.
Outlet	25,700	4,654.51	0.21	801,406	0.078	25,732.5	0.14	7,454.33	0.122
Golf Course	10,872	1,291.23	0.46	130,160	0.087	3,903.93	0.23	850.716	0.21
N8	6,350	4,410.85	0.21	1,218,660	0.093	17,580	0.18	6,340.93	0.15
250th	464	351.09	0.87	21,047.2	0.14	1,289.9	0.35	333.17	0.25

4.3 Data Analysis

The practice implementation volume suggests that there is enough adopted BMP's to start seeing change in the water chemistry, flows and biological indicators. Staff have identified soil loss savings and Phosphorus reduction numbers as part of the project development process. Anchor sites have been established to development baseline monitoring locations, in key areas of implementation. Ecoli will be tracked through stream monitoring specifically. While the reduction numbers are significant meaningful for the impacts on Dobbins Creek, we also recognize that water quality trends will need to be assessed over a period of time to assure confidence in those results.

4.4 TMDL implementation effectiveness

This has not been done for Dobbins Creek. Since the TMDL was developed, the Cedar River Watershed District has more of a prominent role in water resources work in Dobbins Creek and Cedar Watershed. This district is assuming more responsibility in the development of monitoring efforts into the future. The district will assure local connection to the Cedar River monitoring program long term. In addition, MPCA will conducting 10 year monitoring analysis on the Cedar and its tributaries, which include Dobbins Creek Watershed.

4.5 BMP effectiveness evaluations

With the timeline for BMP implementation and the inherent lag-time before downstream water quality improvements are likely to be observed (Meals and Dressing, 2008), the dataset collected within the timeframe of the grant should be considered "baseline" for effectiveness monitoring in the future. Our hope is to return to Dobbins Creek to remonitor within ten years (2025-2027) to compare and evaluate the effectiveness of these projects in improving surface water conditions in Dobbins Creek.

4.6 Surface water improvements

Analysis of surface water improvements were not completed for the current monitoring dataset (2015 to 2018). A comparison in the concentrations of water quality measures (sediment, phosphorus) of similar storm events was planned but not finalized during the duration of the grant. This type of analysis could be considered in the future as a way to evaluate BMP effectiveness for the Dobbins Creek 319 project.

4.7 Other monitoring

4.71 E. coli

Source tracking was completed on three locations on the North and South Branches of Dobbins Creek in 2018. The analysis is currently in process by Dr. Ping Wing, Researcher, Biotechnology Institute, University of Minnesota.

4.72 Fish and macroinvertebrates

Fish and macroinvertebrates were sampled by following MPCA protocols. the sampling took place over three years (2015, 2016, 2017) by UMN and Mower SWCD staff within North and South Branches of Dobbins Creek. Additionally, MPCA staff sampled fish and macroinvertebrates at four of these stations in 2014. Stream classification and IBIs were calculated by MPCA staff. FIBI and MIBI scores and reports are in the Attachments (FIBI Summary for Dobbins Creek (2014 - 2017), FIBI_Dobbins_2014-2017.xlsx, MIBI Summary for Dobbins Creek (2014-2017), MIBI_Dobbins_2014-2017.xlsx). Fish and macroinvertebrate data were submitted to MPCA in anticipation of the 2019 IWM round 2 revisit by MPCA to the Cedar River Watershed with assessments planned for 2020. Current results indicate that the fish and macroinvertebrate IBIs are near the impairment thresholds for their respective stream classes.

4.73 Nitrates

Total Nitrate samples were also collected and processed. While not part of the 319 impairment target, nitrate allows us to evaluate how nutrients are leaving the landscape and entering our surface waters. This information will aid in understanding background nitrate levels and seasonality of elevated nitrate concentrations in Dobbins Creek.

5.0 REPORTING

5.1 Quality assurance reporting

Monitoring efforts were consistent with the QAPP except more replicates/duplicates should've been collected. Some samples in 2015 were analyzed outside of the holding times for certain analytes (see 8.0). This was fixed for the most part for 2016-2018 data collection, although a few samples still exceeded the holding time for certain parameters. Water chemistry data was reviewed prior to submitting to EQuIS.

5.2 Results of BMP operation and maintenance (O&M) reviews

All practices recorded and documented as part of the project were required to have an operation and maintenance program in place. Its required in each contract, with assurances that those contracts that breach the O&M could stand to repay those payments by 150%. Spot checks were present during construction and certification of practice development was complete to verify construction met design specifications. Site inspections occurred during year one to determine practices were operating as constructed. Spot checks will occur on a portion of practices.

5.3 Fiscal and Administrative Reporting

All reporting, both fiscal and project administration were done by CRWD, with assistance from others as needed.

Objective 7: Fiscal management and administration.
Deliverables: A semi-annual narrative and expenditure report will be submitted each year of the contract; submit final report by August 31, 2018.

Task A: Administration and reporting, through 1) coordinate and track grant and matching funds and expenditures, 2) preparing information for reports, 3) Submitting semi-annual reports, including eLink requirements, and 4) submitting the final report.

6.0 COORDINATION EFFORTS

One important aspect for the Dobbins Project that makes it more successful, is the coordinated efforts of numerous levels of government, and the private sector. This means that ongoing work by local government (county, soil and water district, watershed district, townships and city), state government (BWSR, MPCA, and others), and private sector farms and agronomy suppliers – engages more people, increases awareness and ownership, which all translates into more actions and tangible results, over time.

6.1 Coordination from other agencies

The implementation funds came from the State of Minnesota for the purpose of Targeted Watershed Work. A grant was provided through this program and allowed for implementation, engineering and staffing capacity to move the projects forward and secure contracts and construction. The project also utilized Minnesota Department of Natural Resources staff who provided assistance with Streambank restoration projects and guidance on design of those projects. USDA was a significant partner and many of the projects were built through the Federal Farm Program practices. NRCS was a particular critical partner as they provided technical assistance and engineering assistance on portions of the projects.

6.2 Other state environmental program coordination

The program was heavily supported through Statewide Clean Water Land and Legacy Amendment funds.

6.3 Federal State coordination

The Natural Resources Conservation Service (NRCS) was a strong partner in this initiative. They staffed many of the programs from a technical and administrative role. SWCD staff were lead on many of the practices. However, NRCS played an integral role in contracting and follow through for the much of the work that was accomplished through Conservation Reserve Program (CRP) and Environmental Quality Initiative Program (EQIP) were the foundation for much of the work done in this watershed. They also provided engineering assistance on those practices.

6.4 USDA Programs

The federal NRCS and FSA has a significant impact on the program. The program utilized USDA funding, through initiatives such as Mississippi River Basin Initiative and National Water Quality Initiative to support the work being done through implementation. CRP and EQIP were the foundation for much of the work done in this watershed.

6.5 Accomplishments of agency coordination meetings

Annual meetings were held among stakeholders for local project managers to provide implementation updates and summary of work completed. Meetings were informal and minutes or transcripts were not maintained.

Several coordination meetings were held to better utilize watershed modeling efforts that were conducted in the Dobbins Creek watershed, and the larger Cedar River Watershed. While these meetings occurred before the official start of this 319 project, they are included in Appendix B because they both covered some of the initial modeling work in the Dobbins Creek subwatershed. The meetings included in the appendix took place on June 18, 2013 and January 15, 2015. These coordination meetings helped to improve the modeling products for the watershed.

6.7 Other sources of funds

The project had a unique partner providing financial assistance. The Hormel Foundation was committed to community improvement projects in and around the City of Austin. They committed $100,000 towards the implementation of projects. The use of those projects ranged between the practices, but were targeted in the headwaters of Dobbins Creek Watershed. This was a significant step for a private foundation to get involved like this. They were trusting in the process of watershed management and funding a project several miles away from the City of Austin, which was the target area for their funding. Since that time, the Foundation has also committed to other watershed projects in the Cedar River Watershed. The Cedar River Watershed District was also funding partner, utilizing local levy for projects.

7.0 SUMMARY OF PUBLIC PARTICIPATION

One of the great success stories of the project involves the participation of the public. Specifically, the landowners involved in adopting and implementing practices. Any success that came out of the project came through watershed community engagement and understanding of the work that was being targeted. This led to increased implementation and adoption. The community also embraced the project. We utilized education programs developed for different ages from schools, through college students and adults. This broad spectrum of outreach engaged the community and generated several local news stories on the work being done. This has resulted in good feedback from the public through public meetings, social media and interactions between staff.

8.0 ASPECTS OF THE PROJECT THAT DID NOT WORK WELL

While most of our overall objectives of the project were accomplished, there were a number of unforseen events and situations that limited the success of certain BMP types being implemented or affected our monitoring data collection and analysis:

- One of our biggest challenges was the lack of funding to be allocated for the purchase of new monitoring equipment at all of the monitoring sites. Because of these funding limitations we utilized used ISCO sampling equipment. The majority of the equipment was outdated and/or had been used over the years. This resulted in a large amount of malfunctions and breakdowns. Even after doing extensive maintenance on the equipment, malfunctions still occurred. A very important lesson learned in this study is that we need to be using new or lightly used monitoring equipment to conduct load monitoring in the future. It is very costly, but worth it to capture every necessary storm event.

- There were some very large storm events that occurred that caused flooding, inundation and loss of equipment with strong currents. Many data loggers and other instream monitoring equipment had to be reset or replaced, which caused a loss of data and higher equipment costs for the project.

- A key staff member broke her arm and was not available for water quality sampling and data analysis. An intern stepped in to do the sampling, but was not as familiar with the sampling SOPs so some of the data was collected during the late summer in 2015 was questionable given the issue of proper handling of some samples. Sample collection in later years was much better and more staff were trained in collection protocols to fill in on the fly if needed.

- Many water chemistry samples in 2015 were analyzed by the labs outside of the 24 hour QA/QC analysis window. This occurred primarily due to the time needed to travel from UMN to collect and deliver samples from multiple stations to the lab by closing, which then by the time the lab could analyze the sample, it was after the 24 hour period. Fewer sampling stations were sampled in later years as well as different labs that were closer to Austin were used for lab analysis.

- For load estimations, our Flux32 model used did not work well for such a small, flashy system. This model has been used traditionally for the outlets of larger (HUC-8) watersheds. Our Dobbins Creek outlet and north and south branch stations drain much smaller watersheds where the rising and falling limbs of storm events occur within hours or over a 24 hour period in contrast with typical HUC 8- watersheds where the rising and falling limb can be tracked and occur over days. Other applications may need to be considered in the future to better estimate loads.

- While not the focus of the sediment and ecoli reductions with the 319 grant, our overall Dobbins Watershed BMPs project goals were to also implement saturated buffers in mass over the landscape of the watershed. This was a new practice and had been proving effective for nitrate reduction benefits in locations near the Cedar River Watershed. Specifically, sites in Iowa have had success, along drainage ditches. In practice, the design of the buffers proved to be an impediment to implementation.

- While we realize that formal documentation of use of funds and reporting on efforts and lessons gained is important, the staff and resource time required to complete annual and final 3319 reporting was substantial and underestimated. Summer and fall sampling needs were still ongoing as the report deadlines were approaching. It was a challenge to try to meet both the needs of the report as well as the needs of our organization with monitoring and supporting our crop growers with their soil and water improvement questions. We view all three as critical for continual improvement. For sample, while writing the final reports, the watershed experienced a number of storm events late summer/fall after the peak growing season that we valued to complete the missing elements of our load monitoring and seasonal analysis. We also have gained considerable momentum and interest by crop growers in BMP practices that will aid sin soil and water health. We felt it was also important to answer their questions in a timely manner so that they can build upon the information we can provide now, so they have time to think about and adjust their crop management planning during the fall and winter. We also the importance of documenting the process to be accountable to the funds spent as well as share our experience for others to learn from. we now understand the reporting requirements for the

319 grants, and can better plan to coordinate this time in the future. We also hope that the reporting pieces could be simplified, where feasible, to better balance the time required for reporting while also attending to the other critical needs of our community and staff.

9.0 FUTURE WATER QUALITY ASSESSMENT AND ACTIVITY RECOMMENDATIONS

Through the 319 funding and support of additional funding, we achieved great momentum in the watershed to advance BMP installation and have seen some reductions in gully formation and sediment losses from fields. However, the timeline (3.5 years) was a very short-window to work within, given the time in planning, design, and implementation needed. We had hoped for more BMPs to be installed that would lead to real achievements in attaining our water quality goals for Dobbins Creek. Outside of the grant window (August 2018) we do have some ongoing conversations with a few landowners that are interested in WASCOB installations on their land in the near future. Additionally, some CIP projects are on the horizon as well. Landowners have been responsive to funding and supportive of the work being done. If there was an opportunity to extend the funding opportunities, there is significant opportunity to continue the work in the other sections of Dobbins Creek. Monitoring will also be critical. There is strong support for continuing the monitoring work on the new stations. There is also opportunity to expand the monitoring sites, as the implementation work migrates to other portions of the watershed. Funding will be key to maintaining continuity in the program. The district believes that Dobbins can be a replicated site for how conservation work can be done in an agricultural setting. The district also sees significant opportunity to build out the Soil Health program and build a strong network of farmers that can use district information to support cover crops and minimum tillage practices. If partnership support continues and funds are available, the momentum on Dobbins could be become a benchmark watershed for the State.

9.1 Future Water Quality Assessment of Dobbins Creek

The next formal assessment round by MPCA is planned for 2020 that may inform the current condition of Dobbins Creek for delisting for Aquatic Recreation (bacteria) and/or Aquatic Life (TSS). If not delisted then, we hope to revisit the same water chemistry collection stations to compare results before (2015-2017) and after BMP implementation (2025-2027) to evaluate how well the cumulative efforts within the entire Dobbins Creek watershed are working toward the end goal of delisting Dobbins Creek for the current as well as possible future impairments (i.e., fish and macroinvertebrate IBIs). The CRWD is actively pursuing other grant sources to build upon the monitoring that has already been completed.

9.2 Future effectiveness monitoring of Dobbins Creek BMPs

We hope to evaluate the effectiveness of the Dobbins Creek project within a minimum of a 10 year timeframe to determine how well the cumulative efforts within the North and South Branch subwatersheds are working toward the end goal of delisting Dobbins Creek. At this point, the North Branch has many more installed BMPs than the South Branch. This allows us to compare the pollutant contributions from both watersheds in a paired-watershed design as a trend analysis at the outlet station for the entire Dobbins Creek HUC-12 watershed. The CRWD hopes to leverage grant dollars to be able to continue the monitoring on Dobbins in the future.

9.3 Considerations for additional effectiveness monitoring

Through additional funding and the planned IWM round 2 revisit to the Cedar River watershed by the MPCA in 2019, we hope to continue to monitor both the water quality and biological quality in the mainstem of Dobbins Creek, as well the two tributaries (North and South Branches). In the near future we also hope to establish more localized water quality monitoring locations in the upper part of the watershed where BMPs have been installed as part of this 319 grant or are planned to be installed in the near future. Now that the locations of actual on the ground BMPs have been installed or soon will be, more localized monitoring will help communicate how well the BMPs are delivering the anticipated benefits from field to stream. These may include: a tighter nested monitoring approach of the sources of sediment and bacteria within the two tributaries as well as more targeted "end-of-field" or "end-of-pipe" monitoring of subsurface tile drainage. Additionally, at this stage, non-water quality measurements or visual monitoring of actual pollutant sources with photographs should be considered (e.g., bank erosion pins, measuring bank slumps growing, staying the same, or getting moved downstream during high flows), among others. This more targeted monitoring near the highest sources of pollutants, will hopefully provide information and feedback sooner on how well the BMPs are working with local partners to keep them invested in the process in the interim. The information gathered will also benefit watershed predictive models by providing real data on how well the BMPs are working to provide better estimations on what can be accomplished with the current BMPs and if and where more work is needed.

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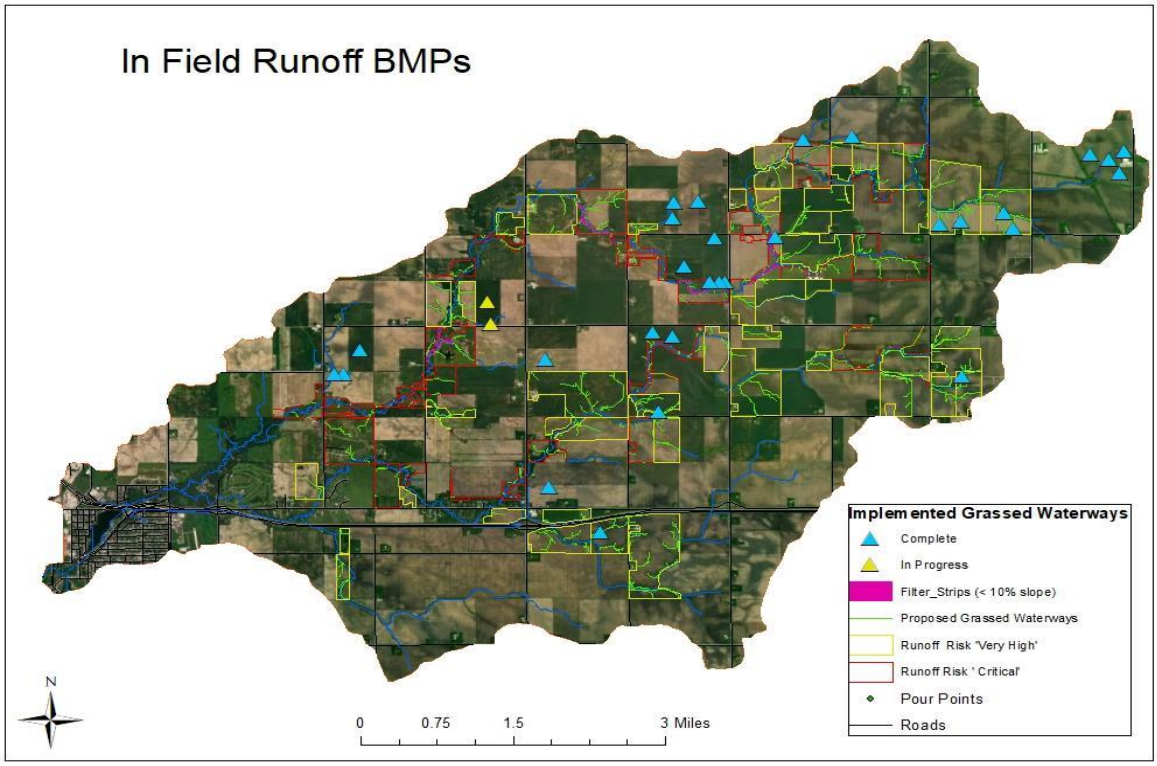
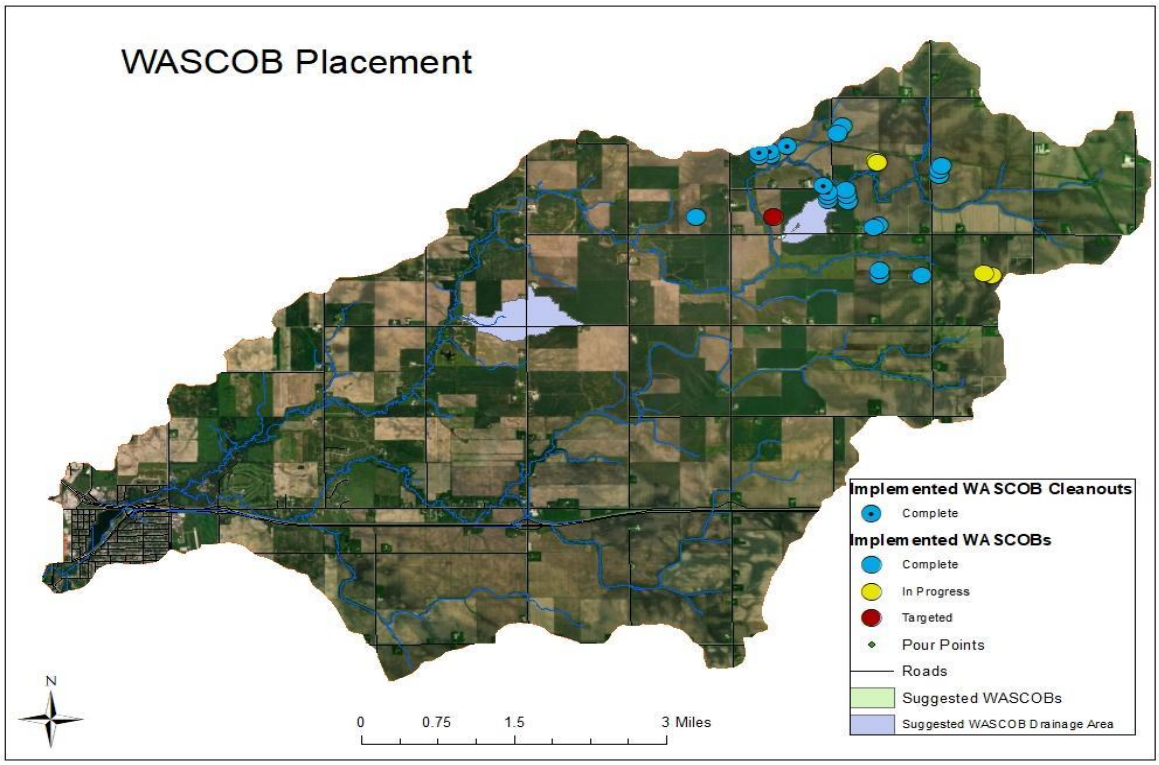
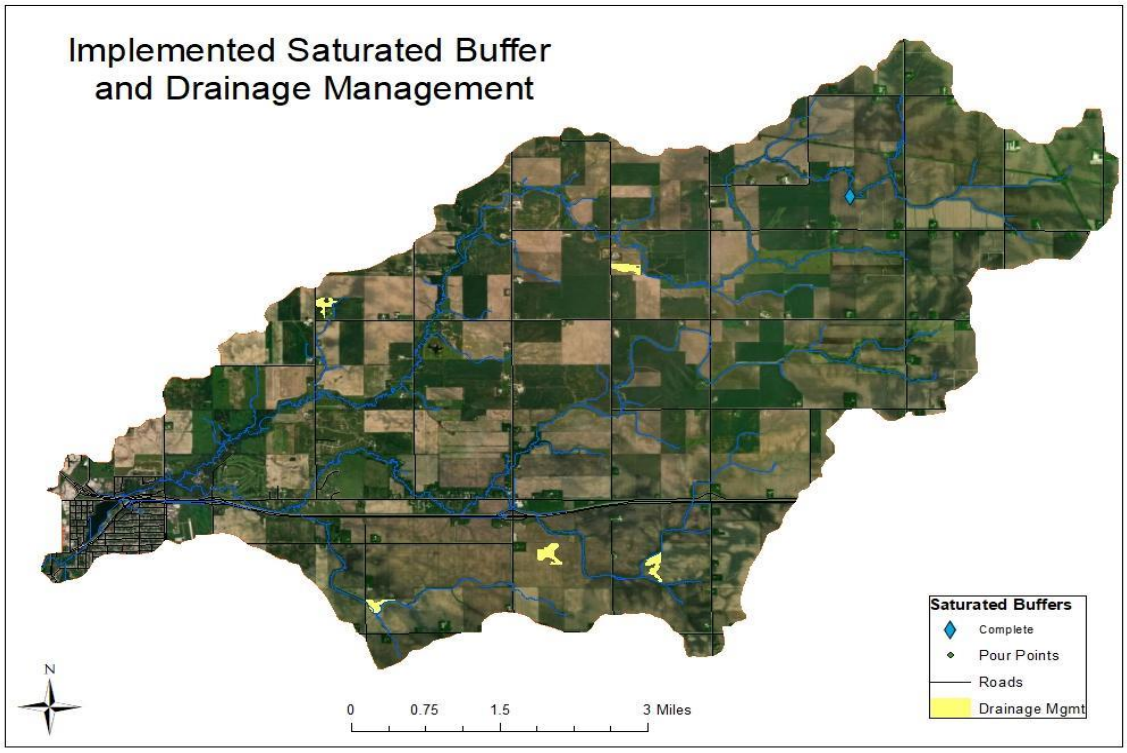
APPENDICES

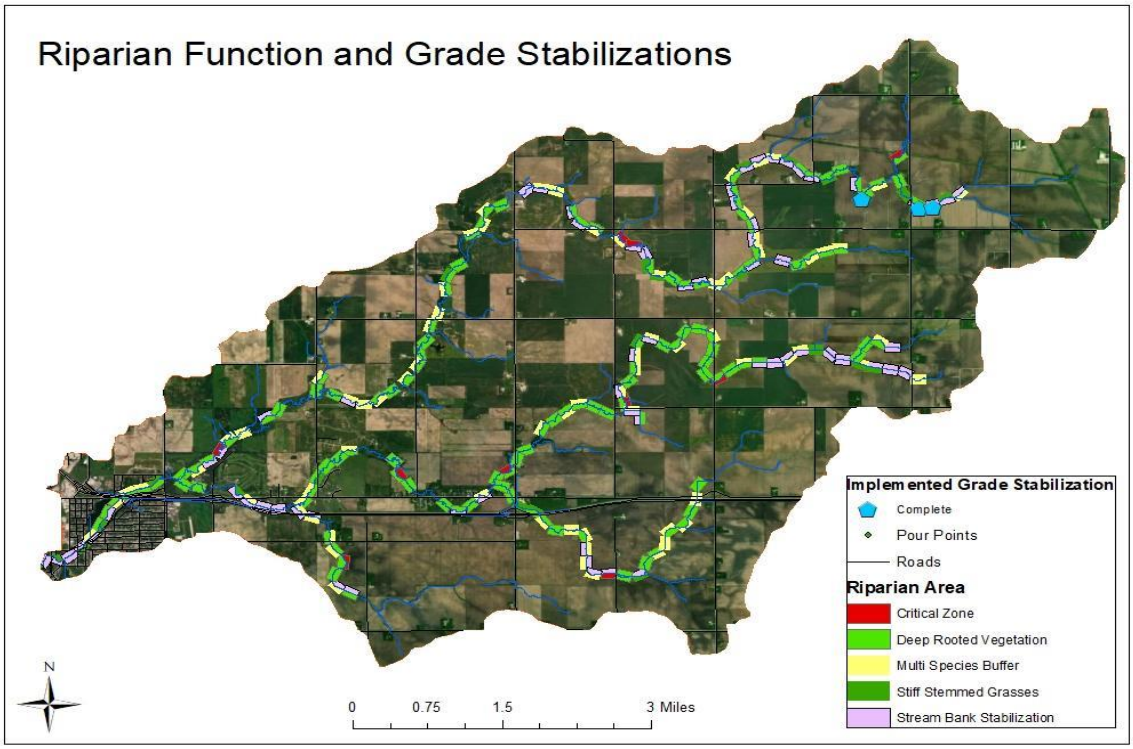
Appendix A: Maps of BMP Implementation

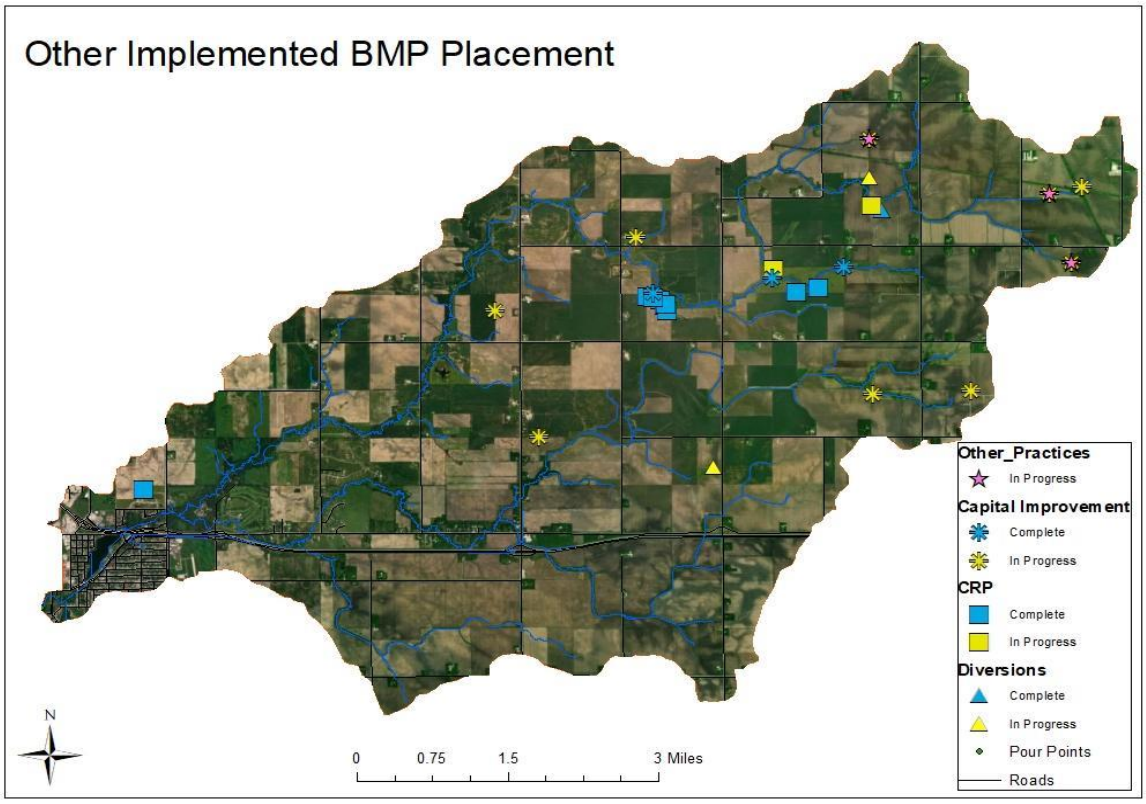
Appendix B: Modeling Coordination for Dobbins Creek and Cedar River Watershed


In Field Runoff BMPs
Implemented Grassed Waterways
Complete
In Progress
Filter_Strips (< 10% slope)
Proposed Grassed Waterways
Runoff Risk 'Very High'
Runoff Risk ' Critical'
Pour Points
Roads
N
0
0.75
1.5
3 Miles


WASCOB Placement
Implemented WA SCOB Cleanouts
Complete
Implemented WA SCOBs
Complete
In Progress
Targeted
Pour Points
Roads
Suggested WASCOBs
Suggested WASCOB Drainage Area
N
0
0.75
1.5
3 Miles


Implemented Saturated Buffer
and Drainage Management
Saturated Buffers
Complete
Pour Points
Roads
Drainage Mgmt
N
0
0.75
1.5
3 Miles


Riparian Function and Grade Stabilizations
Implemented Grade Stabilization
Complete
Pour Points
Roads
Riparian Area
Critical Zone
Deep Rooted Vegetation
Multi Species Buffer
Stiff Stemmed Grasses
Stream Bank Stabilization
N
0
0.75
1.5
3 Miles



Appendix B: Modeling Coordination for Dobbins Creek and Cedar River Watershed

Cedar Watershed Modeling Meeting Summary
Meeting date: Jan. 15, 2015 1:30-3:30 MDNR St. Paul office
Meeting participants:

In-person attendance:

Jim Solstad; Nick Gervino; Greg Wilson; Suzanne Jiwani; Herb Manifold; Tim Gillette; Bill Thompson.

Telephone:

Todd Kolander; Jon Lore.

Handouts and/or materials used in the meeting:

List of 9 discussion items, that served as an agenda.
Table – Cedar River Basin in Minnesota – Water quality and watershed modeling projects and efforts, 1990-2013.
Dobbins Creek – DNR GSSHA model status – January 15, 2015

Model 1: Dobbins Creek watershed map @ gage station (200 m grid cell size)
Model 2: 1.2 square mile catchment map (20 m grid cell size)

Flow hydrograph showing modeled vs. observed data for model 1, June 2009 – October 2010.
Dobbins Creek Tomer Maps

Dobbins Creek General Land Use
In-Field runoff BMPs
Drainage Water Management
Pothole treatment
Nutrient removal wetlands
WASCOB placement
Riparian Assessment

Short narrative description of the Tomer Maps, with statements about how the following practices were located (grass waterways; contour filter strips; tile drainage; drainage water mgt.; pothole identification)
Impoundment siting table (for nutrient removal wetlands; WASCOB; and farm pond)
Shallow water table width, 3 x 3 matrix, for framework.
Tile drainage models: an inventory. (brief narrative, list of references, and a table of computer simulation models incorporating tile drainage).
Large format map of Dobbins with Barr's SWAT 2, BMPs added – with terrain analysis and SPI

Summary notes of discussion items:

1. Introductions (all) and overview/meeting purpose (Bill)
2. GSSHA modeling status (Jim)

a. Focus of calibration efforts is on soil parameters (SOM highlighted) and precipitation data.
b. Learning from current efforts of modeling on some Discovery farm sites, which Salam is doing with a 10-m grid cell format.
c. Dobbins creek base flow at gage is about 5 cfs, and when Q is 100 cfs, tile flow is making a contribution to that overall stream flow.
d. GSSHA will provide output flow data. Sediment could also be done, and in-channel processes would need to be checked on further.

3. Tomer maps (Herb)

a. Herb handed out packets of the colored maps, and each map was discussed.
b. Land use came from 6 years of cropping data (2008-13). There were some questions on what "conservation rotation" and "extended rotation" meant.
c. Field boundaries were provided by the ISU folks involved.
d. Drainage water management appears to have limited application, based on the criteria that the largest 1 m contour in the field must occupy >40% of the field. About 5 areas were identified for DWM. The general land slope in the watershed is enough to limit this practice, based on the defined criteria.
e. The pothole treatment map had potholes identified with three depths (cm): 5-46 cm; 47-125 cm; and 126-360 cm. Many if not most of these were located behind roads and driveways, which are actually drained by culverts.
f. Water storage in the floodplain was brought up as an important item, especially where some berms may have been placed along stream channels in the upper watershed, which reduce floodplain connectivity.
g. Nutrient removal wetlands were identified on a map, along with an adjacent buffer area.
h. Two (2) potential WASCOBs were identified, along with a freeboard zone and contributing watershed.
i. More detailed, higher resolution maps will be printed for the Mower SWCD staff to use.

4. Gridded SWAT in Roberts and Otter subsheds (Greg)

a. General description of this modeling effort done by Barr for MPCA. This was at a 30-m resolution, and was not calibrated, as there was no available stream gage data at such small subwatershed scales. BMP scenarios for restoration (Roberts) and protection (Otter) were done.

5. Monitoring data…need for ongoing Q and chemistry/sediment
a. The need for such data, for model calibration, as well as other uses, was discussed.

6. Modeling applications for 2015
a. A general direction to assist with the targeted implementation project was agreed to.
b. The development of specific modeling scenarios will depend on what are most feasible, and where those practices can be installed.
c. Model comparisons, adjustments, and/or adaptations was mentioned, but nothing was determined.

7. Tile drainage model – inventory. This handout was passed out, and briefly explained as something for a more general, non-modeler audience.

8. Large-format map of Dobbins with BMPs and subcatchments (Greg).
a. 70-80 of the subcatchments on this map could be targeted, and these cover multiple farms (i.e. not just fields).
b. The fact that the ag BMPs are displayed, from survey data collected by the SWCD, allows field staff to determine which areas targeted by terrain analyses already have some type of conservation treatment/practice in place.
c. This tool is currently being used by the local conservation office and WD staff.

9. Dobbins Creek – More general "Kickoff' type meeting – is being planned by project leaders for March.

Follow-up Items:
Bill:
__ Meeting summary – to all involved
__ Rick Moore's, MSU-M, report – make available to anyone interested (Evaluation of artificial drainage in altering hydrology, August 2013, Final report for 319-funded project 07098).
__ Provide crop residue survey data to modelers

All:
__ Participate in the general Dobbins meeting in March, if possible.

Modeling Tools – Cedar River Watershed Summary

Large Scale Models

Model Name	Contractor	Cost	Scale	Purpose	Year	Primary User
SWAT	Barr	$75,000	75,000 ac.	Cedar TMDL	2012	MPCA
H&H Model	Barr	$377,520	536,000 ac	Flow Goals	2013	CRWD/TCWD
HSPF	RESPEC	$65,000	582,400 ac	WRAPS	2014	MPCA

Small Scale Models

Model Name	Contractor	Cost	Scale	Purpose	Year	Primary User
AgNPS	Bonestroo	$18,000	24,000 ac.	E. Side Lake	1993	SWCD
SWAT	HDR	$109,000	24,000 ac	Dobbins WQ	2010	CRWD
GSSHA	DNR	NA	24,000 ac.	Dobbins WQ	2008-2018	CRWD
Gridded SWAT	Barr	$21,000	<1,000 ac.	BMP ID	2014	MPCA

Cedar River Watershed (in MN) – Modeling Technical Meeting Meeting Summary

Meeting Date: June 18, 2013 (10am – 3pm)
Meeting Location: Minnesota Pollution Control Agency, St. Paul
Webinar and audio-teleconference options provided
Ten-page Meeting Summary completed and emailed: August 19, 2013

This meeting summary was completed by Bill Thompson, Minnesota Pollution Control Agency (MPCA) – Cedar Basin [in Minnesota] Project Manager, with the assistance of some notes generously supplied by several participants. The three presenters have kindly made their PowerPoint files available, to add to our meeting record.

Meeting Context:

Watershed management and water quality improvement efforts are an ongoing effort in Minnesota's portion of the Cedar River Basin. Over the past 4 or 5 years, several watershed modeling efforts have been initiated in Minnesota. The general direction of this meeting is to allow some time for professional watershed modelers and practitioners to learn from/question/critique each other, to communicate with conservation implementation staff and managers, and to momentarily "step back" and attempt to assess our overall watershed modeling effort.

Meeting Objectives (from 06.10.2013 email):

1. Continue with process started with H & H (Hydrologic and Hydraulic) rollout meeting held in Austin, and provide more technical modeling specifics;
2. Include all models done in the past 3-4 years....in particular, XP-SWMM, SWAT, and GSSHA. (Also, acknowledge and improve understanding of other modeling efforts that are pertinent).

3. Compare model results by scale, what inputs are needed, how those data were collected, and how can a model be maintained and revised?
4. Complete work plan Objective A, Task 5 (model transfer) and Task 6 (Model training). This "training" event is more in line with explaining how critical elements were set up, and is aimed at watershed professionals and/or staff familiar with watershed modeling.
5. Assess the overall results of these modeling efforts in the Cedar River Watershed (CRW). Can we consider areas where we have agreement and more confidence in the modeling results? Are the longer-term monitoring sites we have in good locations to support predictive modeling efforts?
6. Are we able to communicate and apply the modeling results to our common work? (or, to very specific efforts?). How can we help each other in these communication efforts?
7. Were some of these modeling efforts redundant? If so, justified, or in need of reductions?

Meeting Agenda (from 06.17.2013 email):

A. Introductions, review meeting purposes, and background - Bill Thompson, MPCA and Bev Nordby, Mower County SWCD and Cedar River Watershed District.
B. Cedar River Watershed SWAT - Greg Wilson, Barr
C. Cedar River Watershed XP-SWMM - Rita Weaver, Barr
(lunch break planned about here)
D. Dobbins Creek Subwatershed GSSHA - Jim Solstad, MDNR
E. Overall review and assessment

1. Can different models, built at different scales, be integrated into our larger watershed (8-digit HUC) efforts?
2. How should we view the relative utility of each model?
3. How about strengths, weaknesses, and credibility (with audience/stakeholder A, B, or C.....and overall)?
4. What recommendations can be put forward for future modeling work in the CRW (maintenance of existing model; or - another model?)?

F. Thank you, and wrap-ups.

Participants (initial list provided by Ann Banitt):

At meeting room in St. Paul:

- Eggers, Greg. Minn. Department of Natural Resources, Drainage Engineer (MN River Integrated Watershed, case study Shakopee Cr, Dobbins Creek-Cedar (GSSHA) 651.259.5726 greg.eggers@state.mn.us

- Fett III, James. Watershed Technician and Cedar River watershed, water monitoring lead, Mower County SWCD, Austin. 507.434.2603 james.fett@mowerswcd.org

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- Gillette, Tim. Minn. Board of Water and Soil Resources, St. Paul. Conservation Drainage Engineer 651-297-8287 Tim.Gillette@state.mn.us

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- Klein, Steve. – Barr Engineering, VP. Principle Engineering for Cedar, Shell Rock River Watershed. 952.832.2809 SKlein@barr.com

- Nordby, Bev. Cedar River Watershed District and Mower Co. SWCD, Administrator/Manager, Austin. 507.434.2603 Bev.nordby@mowerswcd.org

- Solstad, Jim. Minn. Department of Natural Resources, St. Paul. Hydrologist. 651.259.5711 james.solstad@state.mn.us

- Thompson, Bill. MPCA, Rochester, MN. State project manager for Cedar Basin in MN. 507.206.2627 bill.thompson@state.mn.us [Meeting coordinator and scribe]

- Weaver, Rita. Senior Water Resources Engineer. Barr Hydrologic Modeling, XP-SWMM, rweaver@barr.com 952.832.2844

- Wilson, Greg. Senior Water Resources Engineer. Barr Eng. Cedar Basin TMDL and SWAT, gwilson@barr.com 952.832.2672

On teleconference / webinar:

Jason Smith, USACE, Rock Island, Study Manager/Planner/ Civil Engineer. 309.794-5690 Jason.T.Smith2@usace.army.mil

- Greg Karlovits, USACE, Modeler from MVR Gregory.S.Karlovits@usace.army.mil
- Ann Banitt, USACE St Paul Ann.M.Banitt@usace.army.mil
- Jim Noren, USACE St Paul James.B.Noren@usace.army.mil
- Charles Ikenberry –Iowa DNR Des Moines Charles.Ikenberry@dnr.iowa.gov
- Laurel Foreman, Hydrologist, USDA- NRCS Des Moines Laurel.Foreman@ia.usda.gov
- Unknown Staffer – USGS, IA
- Nick Thomas
- 6-Other Unidentified Call-Ins
- Sorry if we missed you….respond if you wish to be in the final record, otherwise you will continued to be classified as an “Other.”

Handout: Cedar River Basin in Minnesota - Table of Water Quality and Watershed Modeling Projects and Efforts, 1990-2013. (Included at the end of this summary)

Meeting Overview:

Agenda Item A – Intros, review meeting purposes, and background –
Bill Thompson, MPCA and Bev Nordby, Mower County SWCD and Cedar River Watershed District.

Bill Thompson and Bev Nordby highlighted the objectives for the meeting. Bill described the needs to assess our modeling efforts in this watershed, and work with Iowa-based staff on common issues in the larger Cedar Basin. Bev stressed the need to use the modeling tools for conservation implementation and water storage projects.

Agenda Item B - Cedar River Watershed SWAT - Greg Wilson, Barr Engineering Co., Minneapolis.

(see attached .ppt file) SWAT = Soil and Water Assessment Tool

Presentation Title: SWAT Modeling for Cedar River Watershed

Greg provided background information on the Soil and Water Assessment Tool (SWAT) model that is supported by USDA, used widely in the US and around the world, and handles Ag BMPs well. Since this model was developed to assist the sediment (turbidity) TMDL in the CRW, Greg showed both flow duration and sediment duration curves for 2008-2010 data. The flow duration curve (FDC) for the TMDL timeframe was contrasted against the FDCs for the CR @ Austin (USGS gage) for the longer 1981 to 2010 period, as well as the entire period of record for the gage. This showed the higher discharges for the more recent timeframes, with changes in precipitation, landuse, drainage, and cropping all contributing factors. A suggestion was made to examine timeseries results, as duration curves do not reveal the antecedent moisture conditions under which the flow is generated (e.g., snowmelt, saturated, dry). The SWAT model input parameters were discussed. Row crops accounted for about 76% of the landuse in the Cedar River and Turtle Creek watersheds, with that figure split evenly between fields with tile, and fields without tile. Fields with tile were estimated using a technique employed by staff at the Minnesota State University-Mankato's Water Resources Center, which merges soil drainage classes with row-crop land cover. The soil drainage classes used were poorly drained and very poorly drained, which are soils that would benefit from artificial drainage. The presence of tile drainage creates preferential flow paths that are simulated using the SWAT crack flow option.

Observed vs. modeled flows for three sites (Turtle Creek, Upper Cedar, and the Cedar River below Austin) were shown, and calibration issues with snowmelt were noted. The initial SWAT model runs did not have the inventoried Ag BMPs incorporated, and the modeled sediment outputs were very high. To compensate for this, without attempting a higher level of model calibration steps, a watershed-wide calibration factor was used - a 5m buffer used on all cropland HRUs (Filter-W parameter). A channel degradation factor was also activated, based on field survey data of stream channels, which showed that near-channel sediment sources are important.

The next step for this Cedar SWAT is to incorporate data from about 500 points in the watershed where BMPs are in place that affect sediment and/or flow. These BMPs were inventoried by county conservation staff, and include many waterways and filter strips, as well as about 55 wetlands. Many of these wetlands will be placed explicitly into the model.

Greg Wilson concluded his presentation with several slides on terrain analysis and critical source identification, for erosion and sediment. A combination of terrain analysis with field identification work is proving useful.

Agenda Item C - Cedar River Watershed XP-SWMM - Rita Weaver,
Barr Engineering Co., Minneapolis

(see attached .ppt file) SWMM = Storm Water Management Model

Presentation Title: The New Cedar River and Turtle Creek Hydrologic and Hydraulic Model

Rita Weaver's presentation was included because this is the most recent, existing conditions watershed modeling project to take place in the Cedar River Watershed in Minnesota, and it is the only watershed-wide hydrologic and hydraulic model of the two watershed districts. On January 10, 2013, a larger meeting was held in Austin to describe the Cedar Watershed XP-SWMM model to a more general audience. At that January meeting, both Rita and Steve Klein of Barr Engineering, as well as Bev Nordby of the Cedar River WD, provided presentations. The objective of that meeting was to increase general awareness of this new watershed model, and to inform stakeholders and local professionals about future modeling applications.

For this June meeting, Rita covered model setup, displaying watershed maps with delineation of 646 subwatersheds. These subwatersheds were on average 1 square mile each, and were determined by flow control structures such as culverts and bridges. The majority of the structures in the watershed were surveyed and photographed, with the data and picture stored on a web-based application. Data for the remaining structures came from plan sheets. Field survey work was completed by the Mower SWCD, the NRCS, or Jones-Haugh-Smith consultants of Albert Lea. LiDAR with 2 foot resolution was used to delineate watersheds, to determine watershed slopes, and to create channel cross section geometry. Soil hydrologic groupings (A,B, C, D) from the SSURGO dataset were used to assign Horton infiltration rates.

Two rain events, one in September 2004, and the other in September 2010, were used to calibrate the model. The selected storms utilized NEXRAD rainfall data to approximate the precipitation depths and rainfall intensities. Data from three stream gages were used for calibration: one located on the Upper Cedar River, one located on the Cedar River in Austin, and one on Turtle Creek. Model calibration began with the use of published hydrologic parameters (ex. Infiltration rate of 3"/hr.; depressional storage and vegetation interception of 0.2"), and these parameters were modified during the calibration process.

A ground water module within the XP-SWMM software provided a means to simulate tile in the watershed. However since the location of all tile throughout the watershed was unknown, the final model did not incorporate the groundwater module. Measured stage and modeled stage were compared on several plots, with and without the tile simulation module. Measured and modeled flow was evaluated by Barr, but not included in the presentation, since the calculation of the gage rating curve can introduce error into the flow measurements.

The applications for this model include evaluating wetland restoration effects, assessing bridge and culvert replacement options, evaluating flood elevation changes from upstream water management and conservation implementation, and evaluation of floodplain management techniques. An example of a project involving wetland restorations was presented, where the restoration of 4 basins in close

proximity to each other resulted in a reduction in peak runoff rate of 40 cfs (10%), and an overall volume reduction of about 8% from the watershed. The cost to adjust the model for these restorations, and arrive at the reduction estimates, was just over $3,000.

Current modeling results can be viewed with an XP-SWMM viewer license. However, to accomplish model updates/revisions, an XP-SWMM modeling agreement with XP Solutions is required. Model maintenance actions are anticipated on a yearly basis, including data on altered culverts and bridges, water storage areas, and land use changes.

Because a SWAT model was developed for the watershed on a slightly earlier timeframe to evaluate water quality and the TMDL, no water quality simulations were completed using the XP-SWMM model. The reason for this is due to the understanding that a SWAT model is more useful in rural watersheds than the water quality module of XP-SWMM.

Agenda Item D – Dobbins Creek GSSHA Model, Jim Solstad, MDNR

See attached .ppt file GSSHA = Gridded Surface Subsurface Hydrologic Analysis

Presentation Title: Dobbins Creek GSSHA Model – Chapter 2

Jim Solstad began his presentation with a note that "Chapter 1" for Dobbins Creek GSSHA modeling was done by his co-worker Greg Eggers, about 2 years ago, whose work had focused on culvert sizing. This "Chapter 2" is part of a broader effort by the MDNR to address a strategic goal of healthy watersheds and to help define a phrase heard frequently nowadays – "altered hydrology." Jim described a human tendency to routinely use increased conveyance as the answer to the vast majority of our water problems.

The GSSHA model is a continuous, distributed parameter and physically-based model developed by the Hydrologic Systems Branch of the U.S. Army Corps of Engineer's Costal and Hydraulics Lab.

Jim further placed this type of modeling effort into our current context by referencing several recent reports, and an initiative:

> Schottler, Shawn P. etal. 2013. Twentieth century agricultural drainage creates more erosive rivers. Hydrologic Processes. (published online at Wiley Online Library).
>
> Sands, Gary R. 2013. Developing optimum drainage design guidelines for the Red River Basin. University of Minnesota, Department of Bioproducts and Biosystems Engineering.
>
> Soil health initiative – increasing soil organic matter to help improve water holding capacity. (USDA nationally, and Board of Water and Soil Resources in MN).

The Dobbins Creek watershed is a flashy tributary stream to the Cedar River at Austin, with a drainage area of about 25,000 acres. Some differences were noted between Dobbins Creek watershed, and the Bear Lake watershed in neighboring Freeborn County (also GSSHA modeling effort by MDNR) – the Bear

lake watershed has more rolling topography and more dispersed depressional storage areas, where the Dobbins Creek watershed is flatter, with fewer water storage opportunities outside of the flood plain, and very highly drained cropland acres.

Since GSSHA allows the specific placement of tile, it can illustrate tile effects such as higher base flows and the sponge-effect. This was demonstrated with modeled flow data for a 25 sq. mile drainage area in the Red River basin, both with and without tile.

GSSHA's rigorous overland flow and groundwater routing equations provide the opportunity to better understand the relationships between rainfall, ET, tile drainage and surface runoff, within the context of seasonal cropping patterns and natural vegetation.

In Dobbins Creek, the well-defined flood plain (about 200' wide) has a very large storage potential associated with it, and it is likely it would have a larger effect than selected culvert manipulations. Under one scenario, a change in Mannings n for the floodplain itself accounts for about a -30% reduction in flows. A method to look at culvert resizing higher in the watershed is recommended, as resizing at lower sites can lead to channel degradation, and more channel instability.

While modeling other BMP scenarios has not been completed for Dobbins Creek, the GSSHA modeling project for the Straight River (an important tributary to the Cannon River in Minnesota) Watershed has shown decent flow reductions from both conservation tillage and water/sediment control basins. A suite of BMPs is really called for in these watersheds.

Jim concluded his presentation by asking how modeling efforts could help everyone focus on issues such as tiling, channel instability, and hydrograph timing.

Agenda Item E - Overall review and assessment

This agenda item provided some excellent discussion, comments and questions, from participants in St. Paul and on the webinar. Also, some of the questions during the presentations also addressed this need. Therefore, this will simply be a listing of those items, rather than a series of solid statements that had group consensus. We simply did not have adequate time available to seek a higher level of consensus. However, each person who makes it to this point in the meeting summary ("congratulations!") may decide to add something that they have thought about, or have run across, that might help the corporate effort in the Cedar.

There is also a brief assessment of how we addressed each stated meeting objective – i.e. did we address an objective completely, partially, or not at all? And while this is fairly subjective, it can help us continue to consider these issues, as we proceed.

Do the models used in the Cedar show some of the same "hot spots," or logical areas for prioritization/targeting? (this had not been systematically completed)

> Jason Smith mentioned the "scaling issue." A project in the Indian Creek watershed of Iowa , is using GSSHA, SWAT and HMS, in a comparative manner, to help tackle this issue (see Smith etal. 2013). The COE and USDA-FSA are also working on a CRP component to this effort.

There was some agreement that we should learn from this Iowa-Indian Creek effort, and see if the three models discussed today could be used in a similar fashion. For example, Jason mentioned that HMS poorly simulated soil moisture conditions, but was better than SWAT and GSSHA at simulating peak runoff. It was noted that SWAT was underestimating the peaks with a daily time step. As a distributed model, SWAT does not track eroded materials from cell to cell (although SWAT that is run in grid mode could perform this simulation). The modeling effort in Indian Creek is using GSSHA to better understand the spatial significance of BMPs on water quantity. However, GSSHA's intensive data input process may preclude its wider use at larger scales.

Can various levels of modeling be coordinated, so that data is appropriately used to inform the next level of effort, and confidence in our overall modeling results is increased? (While there was some general level of agreement that this can and should be done, no specific plan on how to accomplish this was developed.)

The conservation implementation folks who attended the meeting asked about how can the modeling products and results be made more useful for the implementation of conservation practices? Bev Nordby expressed a commitment to use the XP-SWMM model, now that it is developed and paid for - and one of the main uses will be for CRWD permitting and the assessment of culvert replacements.
Another reoccurring question was how do we best get down to the farm scale? If a neighborhood approach to implementation is to be developed, having solid farm scale data for representative operations is critical. Some possible farm scale modeling options are using SWAT in a gridded mode, AnnAGNPS, or APEX.

Greg Wilson noted that a current project on defining priority management zones is looking at the combination of terrain analysis tools with modeling. This project will develop the necessary field protocols to verify model results, and to work directly with landowners.

Charles Ikenberry stressed the importance of pollutant transport pathways, and how problematic it can be to simulate BMPs. He noted their disappointment with the use of SWAT in regards to NO3-N leaching and transport. Charles also noted the limitations of FDCs, which don't take into account when the flows occur. He suggested using time series results in addition to FDC, especially in regards to snowmelts, and variable antecedent moisture conditions.

Nick Gervino noted the clear need to use the Cedar modeling tools to run scenarios, including background conditions, subwatershed loading, and BMP scenarios. Our suite of current conditions models need to be used for predicting flow and pollutant loading changes resulting from adoption / maintenance of BMPs.

Bev Nordby noted that 90% cost share for ponds that detain water for 24 hours are popular with farmers, as they can plow through the pond when dry. Grassed waterways are not as popular, as they cannot be tilled.

Assessment Table of stated meeting objectives.

Abbreviated Objective	Accomplished	Noted	Not Addressed	Revisit
Continue model "roll-out"	X			
Include models in past 4 years	X			
Compare results by scale		X		
Complete work plan tasks	X			
Overall assessment of models		X		
Model communication to others			X	X
Model redundancy		X		X

A few selected Web Links to check out:

Cedar Basin, in IOWA
www.iowacedarbasin.org

Mark Tomer, 2011. "The Challenge of Understanding Watershed Processes through Monitoring, Observations/Lessons from the CEAP in Iowa."

http://sentinel.umn.edu/home/establishing-sentinel-watersheds-workshop/

Cedar River Watershed District, Austin,MN
http://www.cedarriverwd.org/

Minnesota Department of Natural Resources, Healthy Waters
http://www.dnr.state.mn.us/conservationagenda/goals/02.html

A few selected references, to also check out:

References

Barling, Rowan D., Ian D. Moore, and Rodger B. Grayson. "A Quasi–Dynamic Wetness Index for Characterizing the Spatial Distribution of Zones of Surface Saturation and Soil Water Content." Water Resources Research, Vol. 30, No. 4, pp. 1029–1044, April, 1994.

Smith, Jason etal. 2013. Climate modeling and stakeholder engagement to support adaptation in the Iowa-Cedar Watershed. Draft Final Report. An FY 12 Responses to Climate Change Pilot Study. U.S. Army COE – Rock Island District.

Wilson, John P., and John C. Gallant. Terrain Analysis. Principles and Applications. Wiley and Sons, New York, 2000.

HUC 12 Subwatersheds in Minnesota and Minnesota-Iowa border areas

HUC_12	HU_12_NAME	ACRES	STATES
70802020107	Goose Creek-Shell Rock River	13835	IA,MN
70802010202	Little Cedar River-Cedar River	13930	MN
70802010301	Upper Rose Creek	16927	MN
70802020103	Peter Lund Creek	18380	MN
70802010104	Turtle Creek	18700	MN
70802010103	Judicial Ditch No 24	18850	MN
70802010701	City of Adams	19081	MN
70802010101	Deer Creek	19913	MN
70802010501	Orchard Creek	20402	MN
70802010402	Headwaters Deer Creek	22128	IA,MN
70802020102	County Ditch No 77	22183	MN
70802010702	Village of Meyer-Little Cedar River	22768	IA,MN
70802010505	Town of Otranto-Cedar River	22890	IA,MN
70802010502	Judicial Ditch No 77-Cedar River	23891	MN
70802010205	Dobbins Creek	24585	MN
70802010203	Roberts Creek	25040	MN
70802020104	Albert Lea Lake	25770	MN
70802010302	Lower Rose Creek	26508	MN
70802010503	Woodbury Creek	26882	IA,MN
70802020101	Bancroft Creek	27682	MN
70802020105	County Ditch No 16-Shell Rock River	28626	MN
70802010703	City of Stacyville-Little Cedar River	29170	IA,MN
70802010204	Green Valley Ditch-Cedar River	31028	MN
70802010201	Headwaters Cedar River	32252	MN
70802010206	City of Austin-Cedar River	35030	MN
70802010504	Otter Creek	39946	IA,MN
70802020106	County Ditch No 55	40075	IA,MN
70802010102	Geneva Lake	40456	MN

--- General Model Descriptions ---

SWAT: Soil and Water Assessment Tool

SWAT is a physically based watershed model developed by Dr. Jeff Arnold for the USDA Agricultural Research Service (ARS) in Temple, Texas. SWAT was developed to predict the impact of land management practices on water, sediment, nutrients, dissolved oxygen, and agricultural chemical yields in large watersheds with varying soils, land use, and management conditions over long periods of time.

- Explicitly simulates crop management practices.
- Lumps soil type, vegetation, and hydrology into hydrologic response units.
- Incorporates climate generator.
- Uses SWMM functions for urban impervious runoff.
- Daily timestep (subdaily for urban ponds).
- Simple channel and reservoir routing.

SWMM: Storm Water Management Model

SWMM is a continuous rainfall-runoff simulation model developed for EPA at the University of Florida. The original primary application of SWMM was to urban watersheds for the analysis of surface runoff and flow routing through urban sewer systems. Watersheds are divided into subcatchments which are further divided into pervious and impervious areas. Flow routing is performed for surface and sub-surface conveyance and groundwater systems, including the options of nonlinear reservoir channel routing and fully dynamic hydraulic flow routing. In the fully dynamic hydraulic flow routing option, SWMM simulates backwater, surcharging, pressure flow, and looped connections.

- Universal Soil Loss Equation used to predict pervious surface erosion.
- Simulation of storage and treatment ponds.
- Simulates sediment–adsorbed nutrients, metals, toxics.
- Detailed hydraulic routing with EXTRAN block.
- Simplistic groundwater component, but has been linked to the USGS MODFLOW model.

GSSHA: Gridded Surface Subsurface Hydrologic Analysis

GSSHA is a continuous, distributed-parameter, two-dimensional, hydrologic watershed model developed by the Hydrologic Systems Branch of the U.S. Army Corps of Engineers' Coastal and Hydraulics Laboratory. The watershed is divided into homogeneous square grid cells. Surface and subsurface hydrology within each grid are routed through the flow network and integrated to produce the watershed output. GSSHA offers the capability of determining the value of any hydrologic variable at any grid point in the watershed at the expense of requiring significantly more input than traditional approaches.

- Rigorous 2 dimensional overland flow and groundwater routing algorithms and dynamic 1–D channel routing.
- Simulates vadose zone and groundwater flow and interactions with surface flow.
- Simulates sediment, nutrients, and biochemical oxygen demand.
- Wetland simulation capabilities added due to USACOE delegated wetland regulation.
- Requires use of the proprietary Watershed Modeling System.

ATTACHMENTS

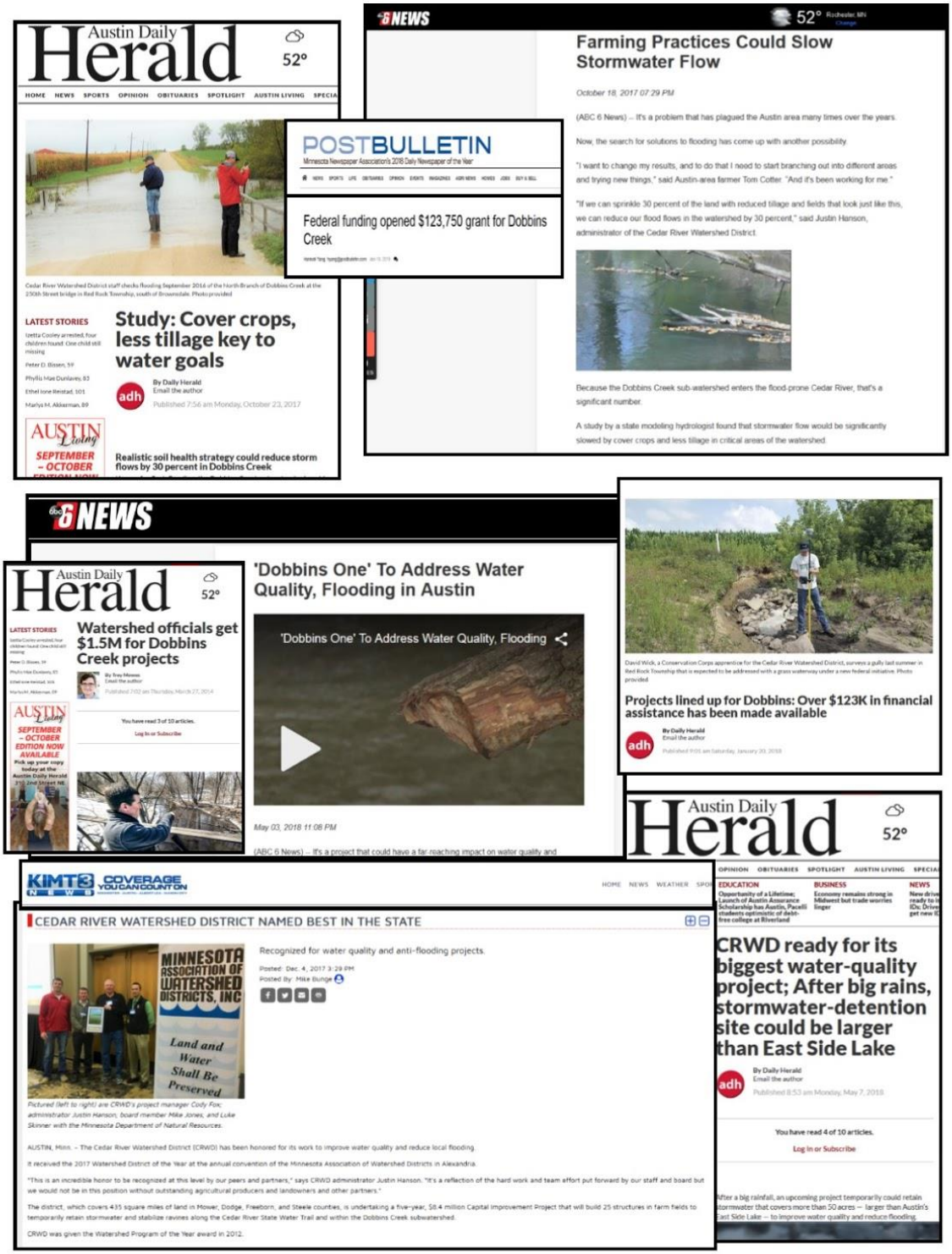
Articles and Presentations

- Lien, E., and J. Magner (2017). Engineered biosystem treatment trains: A review of agricultural nutrient sequestration. Invention Journal of Research Technology in Engineering and Management 1(11):1-1.
- Mclellan, et al., (2018). Mclellan, E., Schilling, K.E., Wolter, C.F., Tomer, M.D., Porter, S.A., Magner, J.A., Smith, D.R., and L.S. Prokopy. (2018). Right practice, right place: A conservation planning toolbox for meeting water quality goals in the Corn Belt. Journal of Soil and Water Conservation. 73(2):29A-34A.
- Solstad, J. (2017). Altered Hydrology: Going Beyond Best Management Practices (BMPs) to Clean Water. Presentation given to the Cedar River Watershed District (October 16, 2017). Minnesota Department of Natural Resources, St Paul, MN: Division of Ecological and Water Resources.

- Smith, L. (2014). BMP Nutrient and Sediment Reductions and Implementation Strategies for the Prioritization, Targeting, and Measuring Water Quality Improvement Application (PTMA). MS Thesis, University of Minnesota. Joe Magner, Advisor.

Newspaper Articles and Public Outreach Materials

Community Outreach and Media Coverage for Dobbins Work



Austin Daily Herald

Study: Cover crops, less tillage key to water goals

Realistic soil health strategy could reduce storm flows by 30 percent in Dobbins Creek

6 NEWS

Farming Practices Could Slow Stormwater Flow

October 18, 2017 07:29 PM

POSTBULLETIN

Federal funding opened $123,750 grant for Dobbins Creek

'Dobbins One' To Address Water Quality, Flooding in Austin

Watershed officials get $1.5M for Dobbins Creek projects

Projects lined up for Dobbins: Over $123K in financial assistance has been made available

KIMT3 COVERAGE YOU CAN COUNT ON

CEDAR RIVER WATERSHED DISTRICT NAMED BEST IN THE STATE

Recognized for water quality and anti-flooding projects.

CRWD ready for its biggest water-quality project; After big rains, stormwater-detention site could be larger than East Side Lake

Dobbins Creek. History of Water Resource and Local Support for addressing issues with stream.

1964

DAILY HERALD
Area News Page

Tuesday, Jan. 21, 1964 AUSTIN (Minn.) HERALD—9

DOBBINS CREEK:

Too Thick to Drink, and Too Thin to Plow

By BOB LEE
Herald Staff Writer

Officially, the long - awaited East Side Lake-Dobbins Creek Pollution Report confirms what people in Austin have known for years — the waterways are polluted and unfit for recreational use.

The 14-page report, complete with tables and maps, was made by the State Department of Health at the request of the city on August 20 and 21 of last year. "To more clearly define the general level of pollution and the sanitary quality level of the waters with regard to their recreational use." The city requested it following the urging of the Austin Clean Water Association (Grit Club).

Eight sampling stations were set up on Dobbins Creek and 29 on East Side Lake to determine a bacteriological count, a chemical analysis, and an algae count. No attempt was made to determine the amount of pollution from the Hormel Institute, Austin Country Club, Nicollville residents, King's House, and Dobbins Crest Addition residents.

Summing up its bacteriological data, after comparing the 1963 survey with others made in 1949 and 1954, the Health Department said, "All factors being considered, these data reveal little significant change in the bacteriological quality of the water in Dobbins Creek since the 1954 survey."

Later, in an analysis and comparison of precipitation during the 1954 survey and the 1963 one, the survey states, "From the data collected during the latter survey, (made in 1963) it would appear that bacteriological contamination of Dobbins Creek may be more serious at present than was the case in 1954.

It should be noted, however, that the statement made above is based primarily on an evaluation of coliform group organisms found and stream flow

the lake.

"It is interesting to note, and probably significant, that the coliform counts were significantly higher along the north shore which, unlike the south shore, is developed as a residential area," the report said.

The report added the high phosphorus and nitrogen content of the lake indicated a high degree of fertility and a capacity to produce heavy growths of algae. Surfactant was not detected but the chloride content was high enough for the Department to "suspect some possible additions from sewage."

"Algae blooms may occur in this lake at any time during the open water season but the most troublesome algae, the blue-greens, are more likely to bloom during the summer and fall. Because of the abundance of available nutrients, East Side Lake will almost certainly be

Council Sets Special Water Pollution Meet

A report on pollution in the East Side lake will be discussed at a meeting to be held probably next month, Mayor Roger Svejkovsky announced at the City Council meeting Monday night.

The mayor said the date of the meeting will depend on when representatives of the Minnesota Department of Health, which made the survey, can attend. He said Mower County Commissioners, the Grit Club, and any others interested, will be asked to attend.

this will also be considered by the Council.

The Council was notified by the Austin Township Board that it plans to hold a hearing on Jan. 27 as the result of claims that the city's dry dump, south of Austin, is offensive and a nuisance. The Council's ordinance committee and city attorney, plan to attend the hearing.

Alderman - at - Large Fayette Sherman reported on a meeting held with the Austin Utility Board on the question of whether the present power

extending the street lighting system.

A hearing was set for March 6, on a petition to vacate a part of 8th Drive SE, between 15th Ave., SE, and 7th St. SE.

The city engineer and Alderman Robert Enright were asked to meet with the Park and Recreation Board to discuss the possibility of setting up a trailer court in one of the city parks, a project the board has been considering.

Resolutions were adopted to set up voting places and select

1964

Creek Polluters Getting Copy of Report

The County Planning Commission will send the pertinent parts of the recent Dobbins Creek, East Side Lake Survey to the persons "named in the complaint" together with notice of a joint meeting sometime in January, it was decided Tuesday night in a joint meeting with City Council representatives.

Representing the city were Aldermen Art Vogel, Denver Dailey, Robert Enright, S. H. Wellman, city sanitarian; Roger Nelson,,city engineer; his assis-

agreed to send out the report and organize an informational meeting in January to explain the alternatives. A representative from the Council will be present to give the facts about annexation.

Abridged reports and invitations to the January meeting will be sent to the Hormel Institute, Hangge Addition residents, Austin Country Club, Nicholville residents, King's House, and Dobbins Crest Addition residents.

The County and City also

1970

Jaycees to continue study of East Side Lake pollution

The Austin Jaycees report that the current and future condition of East Side Lake warrants further investigation into its potential as an improved source of recreation for the community.

The 1964 Dobbins Creek-East Side Lake survey designated the major sources of pollution in East Side Lake. To eliminate these sources of pollution the City of Austin extended the sewer line to the area North and East of the lake in the fall of 1967.

Discussions with persons directly involved with the 1964 report as well as other city and county agencies revealed that each of the designated sources of pollution within the City limits of Austin are connected to the sewer line or will be connected to it this summer.

The Jaycees have arranged to sample and test Dobbins Creek this summer. The tests will determine whether the elimination of these source pollution has improved the ity of water entering East Lake to a level that is tent with the quality of desired in the Lake.

The introduction to the report states that the pu of the report was to deter the sources and extent of lution in East Side Lake report did not evaluate th tent to which the Lake be used by the community cussions with city and c agencies disclose a diffe of opinion as to its potenti community recreational us

The third phase of the cees' study of East Side will examine the limnolo and recreational potentia the Lake. This third phas also review regulations could be enacted to limi Lake to its highest and use or to set aside portion it for specific uses.

1969

Pollution in Dobbins Creek

The pollution problem continues to plague the Dobbins Creek and East Side Lake area in Austin. Dobbins Creek, with an area of 23,616 acres, increased the water level by three inches with recent rains picking up silt from farmland upstream.

The silt along with wastes from individual and industrial sewers have caused a vast polution problem in Dobbins Creek and East Side Lake, the settling base for the Creek, according to Norman Nellen, U.S. Soil Conservationist. Nellen said it costs

20 times more to remove the silt, than it would cost farmers to keep this soil on the land. Nellen emphasized planning of soil and water management practices in watershed and upperland areas among groups of farmers to remedy the problem.

Project Plans

- **Effectiveness of Targeted Dobbins Creek BMPs 319 Project Quality Assurance Project Plan.** Prepared by Cedar River Watershed District and approved by MPCA.

Reports

- Do**bbins Creek-Water Chemistry Monitoring Technical Report 2015.** By UMN staff.
- **Dobbins Water Quality Monitoring Report 2016-2018.** By Chris Kucek, UMN.
- **Statistical Analysis - Dobbins Creek Water Quality 2015**. "Statistical Analysis of Dobbins Creek Effectiveness Monitoring Protocol." By Alex Van Kirk, edited by Emily Deering and Chris Kucek, UMN.
- **Dobbins BMP Econ Paper (2018)**. "Economic Analysis of 8 Nutrient-Reduction Management Strategies for the Dobbins Creek Watershed" by Yantes and Magner, UMN.
- **Watershed Effectiveness Monitoring (W-EM) Guidance Document: Lessons and Suggestions from the Dobbins Creek Experience.** (Draft 9/30/2018). By Brenda DeZiel, UMN James Fett, CRWD and other UMN staff (Emily Deering, Joe Magner, Chris Kucek).

Standard Operating Procedures and User Manuals

- **Porter et al., (2018).** Porter, S., M.D. Tomer, D.E. James, and J. D. Van Horn. Agricultural Conservation Planning Framework ArcGIS® Toolbox User's Manual Version 3.0. Date of Release: 08/2018. Ames, Iowa: National Laboratory for Agriculture & the Environment, USDA-ARS
- **SOP_Water Chemistry_Dobbins Creek.** Collecting water quality samples of TSS, Nitrate-Nitrite-N, Total Phosphorous, and Dissolved Organic Phosphorous at Dobbins Creek. By Emily Deering, UMN
- **SOP_Flow_Dobbins Creek.** Taking Flow Measurements with the Hach FH950 Portable Velocity Meter. By Emily Deering, UMN.
- **SOP_ISCO_Sampler**. Collecting water quality samples of TSS, Nitrate-Nitrite-N, Total Phosphorous, and Dissolved Organic Phosphorous at Dobbins Creek using ISCO samplers. By Leslie Gerberding, UMN.

Spreadsheet, Summaries, and Tables

- **Cedar River WRAPs_Appendix C_Upper Cedar R_Dobbins_Ck**
- **Dobbins Flux32 Load Estimates**

- **Dobbins_LDC_TMDL Allocation Tables**

- **EOR_Cedar River WRAPS Strategy Table_6-1-2017_Final.xlsx**

- **FIBI Summary for Dobbins Creek (2014 - 2017).** Summary of Dobbins Creek Fish Community Sampling and FIBI scores with Recommendations for Baseline Stations. By Brenda. DeZiel, UMN.

- **FIBI_Dobbins_2014-2017.xlsx** - Summary of FIBI scores between 2014 and 2017.

- **MIBI Summary for Dobbins Creek (2014-2017).** Summary of Dobbins Creek Macroinvertebrate Index of Biotic Integrity Study, 2014-2017. By Kara Fitzpatrick, UMN.

MIBI_Dobbins_2014-2017.xlsx - Summary of MIBI scores between 2014 and 2017.