

M.L. 2015 Project Abstract

For the Period Ending June 30, 2019

PROJECT TITLE: Assessment of Irrigation Efficiencies in Benton County

PROJECT MANAGER: Gerry Maciej

AFFILIATION: Benton SWCD

MAILING ADDRESS: 14 2nd Avenue West

CITY/STATE/ZIP: Foley, MN 56329

PHONE: (320) 968-5300 extension 3

E-MAIL: gerry@soilandwater.org

WEBSITE: www.soilandwater.org

FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: M.L. 2015, Chp. 76, Sec. 2, Subd. 4h

APPROPRIATION AMOUNT: \$ 431,000

AMOUNT SPENT: \$ 431,000

AMOUNT REMAINING: \$ 0

Overall Project Outcome and Results

Several areas in Minnesota exist where groundwater use exceeds sustainable levels or is approaching a sustainability threshold. One those areas is Little Rock Creek in Benton and Morrison Counties. The overall goal of this project was to provide new tools and expertise to overcome sustainability issues in Little Rock Creek and provide these tools to others facing similar sustainability problems throughout many parts of Minnesota. This project successfully created an online, mobile-friendly, Conservation Irrigation Decision Support System and Irrigation Scheduling Assistant that increases irrigation efficiencies and confidence in irrigation water management. The major outcomes and results from this project include:

- 1.) **Real-Time Conservation Irrigation Decision Support System (CIDSS):** Three DNR monitoring stations on Little Rock Creek were upgraded with satellite telemetry equipment. The CIDSS illustrates real-time graphs of Little Rock Creek's stream flow and temperature along with their associated environmental thresholds. Conservation Irrigation Tips were developed for short- and long-term conservation measures that allows irrigators to make condition appropriate irrigation decisions.
- 2.) **Increasing Irrigation Efficiency:** An online, mobile-friendly irrigation scheduling assistant was created. Input was taken from a local stakeholder group to integrate GIS-based NEXAD daily rainfall estimates into the scheduler that improves field-by-field reliability. We had successful adoption of irrigation water management in the project area. Over the past four growing seasons, irrigation management was practiced on 9,728 acres. In 2018, the software was expanded to a 5-county area of East Ottertail instance, and has been used on 139 fields covering 27,258 acres.
- 3.) **Improving Soil Health:** Technicians provided expertise to producers on soil health practices to increase soil organic matter, conserve soil moisture, and to improve nutrient cycling on the sandy irrigated soils, as well as, reducing wind and soil erosion. A total of 454 acres of soil health practices have been implemented within the project area.

Project Results Use and Dissemination

This project was able to educate many people about new up-to-date irrigation water management tools. The irrigation scheduling tool and CIDSS for the Little Rock Creek Groundwater Area is available online at <http://ima.respec.com/>. The East Ottertail instance that include the 5-county expanded areas of Hubbard, Becker, Wadena, Ottertail and Todd Counties is also available online at <http://ima.respec.com/>. The project's new online irrigation management scheduler is highlighted on local SWCD's websites, such as www.soilandwater.org and <http://www.eotswcd.org/irrigation-scheduler/>. A online demo trial of the irrigation scheduler is available to the public to try and to see what the tool has to offer. Promotional banners of the Irrigation Management Assistance were made for the local SWCD's where the current software is offered. Weather station and evapotranspiration data is available at www.agweathernetwork.com. Water flow and

stream temperature for Little Rock Creek is currently available to the irrigators using the scheduling assistant within Little Rock Creek Groundwater Area.



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2015 Work Plan Final Report

Date of Report: June 28, 2019

Final Report

Date of Work Plan Approval: June 11, 2015

Project Completion Date: June 30, 2019

PROJECT TITLE: Assessment of Irrigation Efficiencies in Benton County

Project Manager: Gerry Maciej

Organization: Benton SWCD

Mailing Address: 14 2nd Avenue West

City/State/Zip Code: Foley, MN 56329

Telephone Number: (320) 968-5300 extension 3

Email Address: Gerry@Soilandwater.org

Web Address: WWW. Soilandwater.org

Location: Benton and Morrison

Total ENRTF Project Budget:

ENRTF Appropriation: \$431,000

Amount Spent: \$431,000

Balance: \$0

Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 4h

Appropriation Language:

\$431,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Benton Soil and Water Conservation District to develop and implement a decision support system to increase irrigation efficiencies and provide outreach on irrigation best management practices. Software developed with this appropriation must be available in the public domain. Project efforts should be coordinated with the Department of Natural Resources. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Assessment of Irrigation Efficiencies in Benton County

II. PROJECT STATEMENT: Several areas in Minnesota exist where groundwater use exceeds sustainable levels or is approaching a sustainability threshold. One of those areas is Little Rock Creek in Benton and Morrison Counties. The MPCA has determined that Little Rock Creek, a cold water trout stream, is impaired for its cold water fishery due to low dissolved oxygen levels and nitrates. A TMDL study determined that the impairment is related primarily to an increasing amount of groundwater use, primarily from irrigated crops, and reduced groundwater quality. The current tools available to manage irrigation and groundwater resources are outdated and no longer effective to meet current demands.

The goal of this project is to provide those tools and the expertise needed to overcome sustainability issues in Little Rock Creek and provide these tools to others facing similar sustainability problems throughout many parts of Minnesota. Additionally, the project will demonstrate that this can be accomplished while obtaining multiple benefits for producers, such as increased yield and reduced fertilizer and irrigation input costs, using proven conservation practices. Those tools and anticipated results include:

- 1) *Restoring stream conditions favorable for trout by maintaining critical stream flow and increasing dissolved oxygen above 7 ppm* by creating a real time decision support system that integrates creek flow, creek dissolved oxygen levels, soil moisture balance, forecasting and other variables. The decision support system will provide a condition appropriate tool irrigators can use to make conservation irrigation decisions.
- 2) *Increasing irrigation efficiency*, including use of irrigation scheduling has been shown to decrease water use by 30% while improving yields 5% and decreasing energy use up to 35%. To increase adoption of scheduling, an on-line/cell phone scheduling assistant will be developed and utilized by irrigators.
- 3) *Improving soil health*, such as increasing soil organic matter on sandy soils, reduces the need to irrigate and apply supplemental nutrients such as nitrogen. Reduced till methods when combined with cover crop practices can reduce irrigation needs by as much as 5" of water due to better infiltration, increased water holding capacity, and reduced evapotranspiration. This project will provide technical expertise and tools to increase adoption of soil health practices.

To develop the decision support system we will first assemble a stakeholder group who will be comprised of primarily irrigators, and secondarily resource professionals. The stakeholder group will have two primary responsibilities. 1) Determine criteria that will be used to make conservation irrigation decisions and 2) determine what those conservation irrigation activities are and where and when to deploy them. As the stakeholder group completes its work, a consultant will develop the real time decision support system. Since part of the criteria will be stream flow and water quality we will measure flow and collect water samples throughout the project.

To develop the on-line/cell phone scheduling assistant we utilize input from the stakeholder group, in addition to input from irrigators the SWCDs have provided scheduling assistance to in the past, to determine what irrigation scheduling variables are most appropriate for an assistant. We will then utilize the same consultant to develop the scheduling assistant and update it periodically after it is launched and used over the following two years. The assistant will be non-proprietary and will be made available to the public. Technicians will provide one-on-one assistance with irrigation scheduling and use of the new software.

To increase adoption of soil health practices we will provide technical expertise throughout the year to promote appropriate practices as determined by the NRCS soil health checklist and other appropriate strategies. Technicians will also promote these practices as they are providing farmers with irrigation scheduling assistance and decision support system assistance. The following are examples of soil health practices we anticipate farmers may implement:

- Conservation crop rotations – Increasing the diversity of crops grown over several years

- Cover crops – Increasing the diversity of crops grown in a field and increasing the length of time plants are living in the soil by planting a second, usually harvested, crop in a given year.
- Reducing tillage and mulching – Leaving the soil covered with unused plant matter that is left on the field after harvest.
- Nutrient management – Managing the amount and placement of supplemental nutrients to meet crop need and avoid over application.
- Pest management – Managing plant and animal pests using ecologically friendly methods.

Refer to the soil health checklist for additional information. The outcome of the project will be a voluntary producer led system of managing limited groundwater resources for Little Rock Creek that will be transferable to other parts of Minnesota.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of 1-30-16: We began developing this project during this reporting period by hosting two public stakeholder meetings and other outreach methods. The meetings introduced stakeholders to the project and provided an opportunity to guide the development of the project. We were able to obtain valuable input on the criteria that will be used for the Conservation Irrigation Decision Support System (CIDSS) and the irrigation scheduling assistant. We have also been coordinating activities with DNR staff to partner on data collection and use and identify ways this conservation program can dovetail into a regulatory program. During the growing season we provided irrigation scheduling assistance and promoted soil health principles and practices. And finally we have begun preparing for a winter outreach effort and are working with irrigators who will be utilizing the new software and making soil health changes during the 2016 growing season.

Project Status as of 7-30-16: For activity 1 (Increased adoption of conservation for environmental benefits), we have been very successful in getting buy in and adoption of conservation practices from irrigators. Approximately 135-145 acres are planned for cover crops this fall, and we are working with a farmer on being a soil health advocate for adopting soil health practices on irrigated ground. We are assisting with irrigation water management for 16 farms covering 3,106 acres, which nearly already meets our overall goal of 4,000 acres.

For activity 2 (Develop a decision support system and scheduling assistant), we were able to establish the scheduling assistant criteria through stakeholder participation, develop a beta version, and release it for testing by SWCD staff and irrigators. Initial reaction by irrigators has been very positive. For the decision support system, stakeholders requested examples of the environmental considerations so we are providing those examples in real time. We have rescheduled development of the decision support system as a result of their request. Coordination with the DNRs sustainable Groundwater Use Planning Project has not worked out as well as planned, and we are looking at other methods to coordinate with the DNRs advisory team to keep this project on schedule.

For activity 3 (Evaluate effectiveness and progress), we were able to set up telemetry and monitoring stations as planned and have begun collecting applicable water data. Soil monitoring equipment has been installed at select sites with irrigators and SWCD staff actively monitoring crop management.

For activity 4 (Outreach, promotion and sharing results), we have held an irrigation clinic, presented the project to several SWCDs, held a conservation tour, scheduled time to present to the DNRs planning project twice and requested time to present at the Minnesota Water Resources Conference.

Project Status as of 1-30-17: For activity 1 (Increased adoption of conservation for environmental benefits), Technicians continued to work with irrigators to integrate soil health practices. We assisted with selecting and planting cover crops and evaluated soil health with soil health tests. Technicians also provided weekly technical

advice for 3,106 acres of irrigation scheduling, bringing the 2 year total to 5,403 acres, which is already over the stated goal of 4,000 acres.

For activity 2 (Develop a decision support system and scheduling assistant) We were able to present the project to the DNR planning committee in November and now have scheduled a meeting with our consultant in January to select the criteria for the CIDSS and formulate the format. We successfully launched the beta version of the scheduling assistant software this spring and several individuals tested it.

For activity 3 (Evaluate effectiveness and progress) Rainfall was overall plentiful during the 2017 growing season resulting in a lower than average amount of irrigation needed. We did monitor stream flow and water temperature throughout the season and our preliminary analysis indicates the stream was able to meet the desired goal (as stated in the TMDL document) of a maximum weekly average water temperature of 19 degrees Celsius during dry and low flow conditions (when groundwater input are most important) and a maximum daily maximum of 24 degrees.

For activity 4 (Outreach, promotion and sharing results) Several outreach activities were completed. One noteworthy activity was the webinar we conducted to demonstrate the irrigation scheduling assistant and gauge interest in other areas of the state. We identified that there is major interest in the tool at the local and state levels and a desire to potentially expand its use and potential functionality beyond the current scope of this project. We are working with the consultant to identify long term strategies to potentially meet these needs.

Project Status as of 7-30-17: For activity 1 (Increased adoption of conservation for environmental benefits), During this reporting period an additional 20 acres of soil health practices were implemented, bringing the total for this project to 189 acres. Technicians are providing weekly site specific irrigation scheduling assistance on 13 farms covering 2,784 acres. This brings the total for the project up to 8,187 acres.

For activity 2 (Develop a decision support system and scheduling assistant) Stakeholders identified refinements to the software, the consultant made the required changes, and the new version was made available to irrigators in the entire project area. Additional software refinements are underway.

For activity 3 (Evaluate effectiveness and progress) The 2016 water quality report was completed by our consultant. The 2016 year, when compared to the 2006 – 2008 time period, showed a mixture of positive and negative comparisons. The period of record is insufficient to determine trends at this point in time. Water monitoring was initiated for the 2017 season and 30 soil moisture sensors were installed in irrigated fields.

For activity 4 (Outreach, promotion and sharing results) Several outreach activities were completed. A couple of examples include an irrigation clinic that was held where 36 people attended. Stakeholders were provided project updates. We initiated the process of identifying the second area for software development.

Project Status as of 1-30-18: For activity 1 (Increased adoption of conservation for environmental benefits), During this reporting period an additional 65 acres of soil health practices were implemented, bringing the total for this project to 254 acres. Irrigation scheduling assistance was completed on 13 farms covering 2,784 acres in 2017.

For activity 2 (Develop a decision support system and scheduling assistant), the software that was developed during previous reporting periods continued to perform well.

For activity 3 (Evaluate effectiveness and progress), The water monitoring season was completed, water quality data was submitted to the consultant, and a report is being worked on. Soil moisture monitoring sensors were deployed at 15 sites and used in conjunction with the irrigation scheduling assistant to evaluate water needs. We estimate 122 to 283 million gallons of water was saved this crop season as a result of the project.

For activity 4 (Outreach, promotion and sharing results) Several outreach activities were completed again including 30 cover crop/soil health demonstration plots planted, a cover crop field day held, planning for 2 irrigation clinic presentations made, a presentation at the Water Resources Conference was given and technology transfer to Hubbard, Becker, Wadena, Ottertail and Todd counties was initiated.

Project Status as of 7-30-18:

For activity 1 (Increased adoption of conservation for environmental benefits), Technicians are providing weekly site-specific irrigation scheduling assistance on 10 farms covering 1,541 acres in Benton and Morrison counties and 35 people have registered as users in the newly launched East Ottertail instance (5 county expansion area)

For activity 2 (Develop a decision support system and scheduling assistant) The software has been performing well, including in the new 5 county area.

For activity 3 (Evaluate effectiveness and progress) Monitoring continues this season and a new dissolved oxygen sensor was deployed. The 2017 water quality report was completed by our consultant. The 2017 year, when compared to the 2006 – 2008 time period, showed conditions have improved overall.

For activity 4 (Outreach, promotion and sharing results) Four outreach activities were completed including a co-sponsored irrigation clinic with the Upper Mississippi River Irrigators Association, an irrigators workshop in Perham, a cover crop workshop in Sauk Rapids and a user training event for SWCD and MDA staff who work in the expansion area.

Project Status as of 1-30-19:

For activity 1 (Increased adoption of conservation for environmental benefits), During this reporting period an additional 200 acres of soil health practices were implemented, bringing the total for this project to 454 acres. Irrigation scheduling assistance was completed in Benton and Morrison counties on 10 farms covering 1,541 acres and in Hubbard, Becker, Wadena, Ottertail and Todd counties on 139 fields covering 27,258 acres.

For activity 2 (Develop a decision support system and scheduling assistant), the software has been performing great, including the 5-county area.

For activity 3 (Evaluate effectiveness and progress), The new dissolved oxygen sensor that was purchased excelled in collecting the data on Little Rock Creek. For the year, a total of 17 water quality sampling events were completed with 37 individual water samples collected. The data from these samples show that when comparing the 2018 monitoring season values to the TMDL time period values of 2006–2008, conditions have improved for Little Rock Creek and Bunker Hill Creek. Nitrate values have improved for both Little Rock Creek and Bunker Hill Creek, DO values improved at Little Rock Creek and remained similar at Bunker Hill Creek, water temperatures dropped slightly at Little Rock Creek, and Little Rock Creek flow and regional groundwater levels have increased.

For activity 4 (Outreach, promotion and sharing results), Another great partnership with the Upper Mississippi Irrigators Association resulted in a co-sponsored irrigation meeting. Also, an outreach meeting is planned with East Otter Tail SWCD and roll up promotional banners were ordered.

Overall Project Outcomes and Results:

Amendment Request 06/07/2019

We are proposing to move \$134 in surplus funds from Activity 1, \$25 from Activity 2 and \$309 from Activity 3 to Activity 4. All outcomes will remain the same. These final adjustments provide an opportunity for each SWCD of the 8 SWCDs with the irrigation scheduling assistance to have a roll up banner to provide long term outreach opportunities on its use and other outreach expenses.

Amendment Approved by LCCMR **6/10/2019**.

Several areas in Minnesota exist where groundwater use exceeds sustainable levels or is approaching a sustainability threshold. One those areas is Little Rock Creek in Benton and Morrison Counties. The overall goal of this project was to provide new tools and expertise to overcome sustainability issues in Little Rock Creek and provide these tools to others facing similar sustainability problems throughout many parts of Minnesota. This project successfully created an online, mobile-friendly, Conservation Irrigation Decision Support System and Irrigation Scheduling Assistant that increases irrigation efficiencies and confidence in irrigation water management. The major outcomes and results from this project include:

- 1.) **Real-Time Conservation Irrigation Decision Support System (CIDSS):** Three DNR monitoring stations on Little Rock Creek were upgraded with satellite telemetry equipment. The CIDSS illustrates real-time graphs of Little Rock Creek’s stream flow and temperature along with their associated environmental thresholds. Conservation Irrigation Tips were developed for short- and long-term conservation measures that allows irrigators to make condition appropriate irrigation decisions.
- 2.) **Increasing Irrigation Efficiency:** An online, mobile-friendly irrigation scheduling assistant was created. Input was taken from a local stakeholder group to integrate GIS-based NEXAD daily rainfall estimates into the scheduler that improves field-by-field reliability. We had successful adoption of irrigation water management in the project area. Over the past four growing seasons, irrigation management was practiced on 9,728 acres. In 2018, the software was expanded to a 5-county area of East Ottertail instance, and has been used on 139 fields covering 27,258 acres.
- 3.) **Improving Soil Health:** Technicians provided expertise to producers on soil health practices to increase soil organic matter, conserve soil moisture, and to improve nutrient cycling on the sandy irrigated soils, as well as, reducing wind and soil erosion. A total of 454 acres of soil health practices have been implemented within the project area.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: *Increased adoption of irrigation and soil conservation practices to reduce water use, restore flow, and increase dissolved oxygen to 7ppm.*

Description:

Conservation technicians will target irrigation systems with the largest DNR appropriated volumes and potential to impact surface water flows when promoting conservation practices. Irrigation applications will be optimized through irrigation system calibration and irrigation scheduling. Calibrations will be completed with equipment that has been made available through the MDA. Scheduling assistance will be completed weekly, or at a frequency that is deemed necessary by the irrigator. The weekly assistance will include a site assessment of the irrigated field to estimate soil moisture and use of the online irrigation scheduling assistant, customized to each individual producer, after it has been developed. The Soil health practices will be integrated into production systems using the NRCS soil health checklist or other acceptable methods. NRCS staff will have a significant partnership in the soil quality initiative however SWCD technicians will take the lead role.

Summary Budget Information for Activity 1:

ENRTF Budget: \$66,341
Amount Spent: \$66,341
Balance: \$0

Outcome	Completion Date
1. Producers prioritized, technical team consulted, targeting strategy implemented	February 2016, February 2017, February 2018
2. Our goal is 4,000 acres of irrigation management and 1,000 acres of soil health practices installed. We estimate irrigation management will be practiced on 40 irrigation systems that typically cover 80 to 120 acres each.	June, 2019

Activity Status as of 1-30-16: Corrected budget numbers to align with the spreadsheet per a phone call with Susan on 1/8. Rainfall was plentiful during the early part of the growing season when calibrations are typically performed so irrigation was for the most part not necessary. As a result we were not able to complete any calibrations this crop season. Benton SWCD staff provided weekly irrigation scheduling assistance for 36 fields covering 2,297 acres in 2015. The on-line scheduling assistant has not been developed so we utilized the excel spreadsheet for this assistance. Soil health practices included 56 acres of new cover crops installed.

SWCD Technicians have started reaching out to irrigators for the 2016 crop season and have begun planning efforts for utilizing the new scheduling software.

Activity Status as of 6-30-16: Technicians began promoting and integrating soil health practices. There have been several landowner contacts and we have approximately 15 soil health practices planned or completed. Approximately 135-145 acres are planned for cover crop plantings this fall. We are working with an irrigator who is interested in becoming a soil health advocate for this project. He plans on setting up a test site on a 10-20 acre portion of a field and we are developing a cover crop mix to better suit the cropping rotations in sandy irrigated fields. This spring a site visit was done with Benton SWCD staff and NRCS Area Soil Scientist. We performed 3 manure spreader calibrations to ensure the field received the accurate rate of manure based on soil test results. We are assisting with irrigation scheduling for the 2016 growing season on 16 farms with 31 irrigation systems, 35 different crop fields covering 3,106 acres. We are using the beta, or test version, of the on line irrigation scheduling assistant for this assistance. The different crops this year include corn, soybeans, potatoes, edible beans and alfalfa.

Activity Status as of 1-30-17: Technicians continue to promote and work with producers who are voluntarily integrating soil health practices. Of the 135 acres that were planned for cover crop plantings during 2016, only 40 acres ended up being installed. The other landowners with 95 acres decided to cancel their conservation practice due to the short window of available aerial seeding applications in the area. Technicians continue to work with a soil health advocate that was thinking about diversifying his cover crop on a 10-20 acre portion of a 72 acre irrigated field. The field in the past received winter cereal rye after the fall harvest of the cash crop. We worked with NRCS Area Soil Scientist conducting a soil health assessments and designing a more diverse cover crop mixture to scavenge nitrogen, build organic matter, increase water holding capacity, and reduce soil erosion. We came up with a cover crop mix that added radish, crimson clover and purple top turnip. The irrigator decided to seed the whole 72 acre irrigated field after an early potato harvest. The field was seeded at the end of August. Soil samples were taken after the seeding and sent in for Health Soil Tests. We plan on taking additional soil samples in the spring before planting. We will continue to work with this producer in the future to find better mixes to scavenge nitrogen and build organic matter, while maintaining/maximizing return on investment, with increasing organic matter and the soils water holding capacity being the primary goal. To date approximately 168 acres of cover crops have been installed in the project area.

This summer technicians assisted with irrigation scheduling with 16 irrigators, for 31 irrigation pivots, covering 3,106 acres. We performed weekly site visits on the fields and in some cases installed soil moisture sensors and assisted with collecting sensor data. Over the past two seasons irrigation management was practiced on 37 fields, covering 5,403 acres. Rainfall was again plentiful during the early part of the growing season when irrigation systems are typically calibrated so we were not able to complete any irrigation system calibrations.

Activity Status as of 6-30-17: With the irrigation scheduling assistant prepared for full launch, we obtained an updated list of DNR issued water appropriation permit records for the project area and contacted the irrigators with the largest appropriated volumes. We informed these irrigators about the software and offered one on one assistance. We completed one irrigation system calibration and have 2 additional systems scheduled for later this summer (weather dependent). Technicians are providing weekly site specific irrigation scheduling assistance on 13 farms covering 2,784 acres. This brings the total for the project up to 8,187 acres.

Technicians are continuing to promote and integrate soil health practices with producers. Soil samples were collected on two fields for a producer and were sent in for soil health analysis. One sample was taken on an irrigated sandy soil field in which he is utilizing the online irrigation scheduler. The soil samples give a base line for overall soil health assessment and can be used to monitor how soil health practices improve the soil. The producer is planning on implementing a diverse cover crop mix possibly this fall or in 2018 on the 39 acre field to build organic matter, provide residue to conserve soil moisture, and to better recycle nutrients. The producer plans on applying for 2017 EQIP program. He is also planning on reducing is tillage. This year the producer planted 20.6 acres of an irrigated sandy soil field to wheat and under seeded to clover. He plans on no-tilling corn into the field next season. This is an excellent example of increasing crop diversity, in the past it has been a corn/soybean rotation. Planning has started with another producer on a cocktail cover crop mix to be seeded down after early potato harvest on potentially another 60-70 acres. To date 189 acres of soil health practices have been installed in the project area. Potentially another approximately 100 acres are being planned for this fall. A soil health presentation was also put on at the 2017 Irrigation Clinic put on by Benton SWCD.

Activity Status as of 1-30-18: Technicians are continuing to promote and integrate soil health practices with producers. Two soil health samples have been taken this fall with a producer who is interested in integrating cover crops into his rotation. One sample was taken on his irrigated field and another taken on a field that is in alfalfa to compare soil health assessments on the two fields. There were two new producers who planted cover crops in fall of 2017. One producer broadcasted 50 acres of cover crops when they applied their N on their corn. They planted a mixture of winter cereal rye, oats, turnips and radishes on 7/21/17. Their goals are to improve soil health, help with moisture next spring, and possibly supplemental grazing. The second producer seeded 9 acres into a radish mixture to improve soil health. Working with a previous producer, instead of planting a 60-70 acre field to a diverse cocktail cover crop mix after early potato harvest, we decided to develop cover crop demonstration plots with the goal of hosting a field day. A total of 6 acres were planted to various cover crop plots. The demonstration plots were planted to roughly 30 individual plots that showcased different seed mixes for over-wintering cover crops and winterkill cover-crops. The two sets of plots (over-winter and winterkill species) had a basic cover crop mix, n scavenger mix, n producer mix, compaction mix, grazing mix along with a couple of single species plots. Soil nitrate samples were taken at the time of seeding and then later in the fall on select plots with the goal of looking at residue soil nitrates and cover crop scavenging. The producer seeded the rest of the field into winter cereal rye that the producer normally seeds down after potatoes and kidney beans. To date 254 acres of soil health practices have been installed in project area.

This summer technicians assisted with irrigation scheduling assistant, with the full launch of the system technicians provided weekly site visits on 13 farms covering 2,784 acres. Over the past three seasons irrigation management was practiced on 8,187 acres. Looking into 2018 we are already adding more farms into the irrigation scheduling assistant.

Activity Status as of 6-30-18: For the 2018 growing season Benton SWCD is assisting with irrigation scheduling for 10 farms covering 1,541.39 acres in Benton and Morrison Counties. Additionally, 35 users have registered for the 5-county area of the East Ottertail instance. Technicians are continuing to promote and integrate soil health practices with producers. Soil sampling is being planned for fall of 2018 with 4 irrigation producers. These samples will be tested for overall soil health assessments to provide them a base line and to monitor their productive soils. Currently we have 1 producer planning to aerial seed cover crops this fall on 19.5 acres which would bring the total to 273.5 acres of soil health practices in the project area.

Activity Status as of 1-30-19: Soil Health – Crop planting in 2018 started out well behind the normal pace due to cool weather and snow cover. The combined late start and wet conditions last fall pushed back harvest of most crops in the area to late October to early November. As a result, technicians were only able to collect soil health samples for 3 irrigation producers. The samples were sent to Midwest Laboratories for soil health assessments and the results will provide irrigators with base line indicators for their fields. All 3 farmers are interested in

applying various soil health practices to their fields and crop rotations. Meetings are planned to discuss the results of the assessments and to help plan alternative soil health practices that will benefit their operation and fields. To date a total of 9 soil health tests have been taken for 5 producers plus soil nitrate sampling taken fall/spring on cover crop demonstration plots for analysis of N scavenging of cover crops. An additional 200 acres of cover crops were seeded in 2018, bringing the total of soil health practices implementing in project area to 454 acres.

This summer technicians assisted with the irrigation scheduling assistant, working directly with the farms. In total we assisted farmers in Benton and Morrison counties on 10 farms covering 1,541 acres. Over the past four seasons, irrigation management was practiced on 9,728 acres in this area. The software was also used on 139 fields covering 27,258 acres in the five counties of Hubbard, Becker, Wadena, Ottertail and Todd. Corn, Soybeans, Alfalfa, Potatoes and Edible Beans were irrigated with guidance from the assistant in both areas.

Final Report Summary:

- Increased adoption of irrigation practices – A list of DNR issued water appropriation permit records for the project area was obtained and Benton SWCD staff contacted the irrigators with the largest appropriated volumes via direct mailings. We informed these irrigators about the project's new irrigation scheduling software and offered them one on one irrigation water management assistance. Calibrating irrigation system often need to be done early in the growing season prior to the crop becoming too tall and canopying over the calibration equation. During this project, rainfall was plentiful during the spring/early summer the last 4 growing seasons. This resulted in a limited window for completing irrigation system calibrations. We only were able to complete one system calibration during this project. However, local irrigators did show interest by contacting our office to plan calibrations on an additional five to six irrigations systems but were unable to get them completed during the grant period.
- We had successful adoption of irrigation water management with irrigators in the project area. Over the past four growing seasons, irrigation management was practiced on 9,728 acres in this area. Technicians supported irrigators with the online irrigation scheduling assistant. This consisted of a variety of help ranging from weekly site-specific irrigation management, to helping with soil moisture sensor installations and data collection, to answering any questions that farmers had with the online irrigation scheduler. The software was also used on 139 fields covering 27,258 acres in the five counties of Hubbard, Becker, Wadena, Ottertail and Todd. Crop production included: Corn, Soybeans, Alfalfa, Potatoes and Edible Beans were irrigated with guidance from the assistant in both areas.
- Since January 2019, farmers made plans to install an additional 23 acres of cover crops using USDA conservation programs. A total of 454 acres of soil health practices have been implemented within the project area. Technicians provided expertise to producers on soil health practices to increase soil organic matter, conserve soil moisture, and to improve nutrient cycling on the sandy irrigated soils, as well as, reducing wind and soil erosion. We were able to get one irrigator on board as a soil health advocate. This soil health advocate proved to be an asset for this project. The irrigator offered us a portion of his field in 2017 to plant a 6-acre soil health cover crop demonstration on his field. This led to a 6-acre demonstration plot that showcased a variety of different cover crop mixes and objectives. Technician's also coordinated with NRCS Area Soil Scientist on 3 soil health assessment site visits that included infiltration tests, field observations, soil health samples and recommendations. A total of 9 soil health tests were taken for 5 producers that developed discussions on potential soil health practice recommendations for their farm.

ACTIVITY 2: *Development and utilization of a Conservation Irrigation Decision Support System (CIDSS) and an on line / cell phone application irrigation scheduling assistant.*

Description: A decision support system will be developed that provides daily information on condition appropriate conservation irrigation methods. Recommended methods will be delivered via web or other appropriate technology. We will hire a consultant to develop the CIDSS software. To define the system a stakeholder committee, whose members will be primarily local irrigators, will be developed. The committee will develop the decision point criteria for implementing the specific conservation measures that optimize crop production and stream health at various flow levels. Some potential criteria are shown in blue in the attached diagram. Simple indicators of irrigation categories, such as a stoplight approach (green = standard rate/standard conservation measures; yellow = conservation rates/additional conservation measures; red = deficit irrigation rates/highest level of conservation measures) will be developed to inform producers on the appropriate strategies to be implemented.

The same stakeholder committee will define the appropriate variables for the irrigation scheduling assistant. Some possible variables are shown in brown on the attached diagram. The scheduling assistant will be linked to new weather stations that are currently being installed in cooperation with the MDA. We will hire a consultant to develop the irrigation scheduling assistant software. The consultant will be available to make modifications to the software for three years as the users and stakeholder group make recommendations for improvements.

Summary Budget Information for Activity 2:

ENRTF Budget: \$158,732
Amount Spent: \$158,732
Balance: \$0

Outcome	Completion Date
1. <i>Stakeholder group established and initial decision point criteria developed for CIDSS, Irrigation scheduling assistant variables defined.</i>	March 2016
2. <i>Conservation Irrigation Decision Support System program and Irrigation scheduling assistant developed, beta tested, and implemented with training and full launch</i>	May 2016
3. <i>Stakeholder group meets to refine CIDSS and irrigation scheduling assistant software two additional times (Winter 2016/17 and Winter 2017/2018)</i>	January 2018
4. <i>CIDSS and Irrigation scheduling assistant software updated as needed</i>	October 2018

Activity Status as of 1-30-16: In cooperation with our consultant we held two public stakeholder meetings in Royalton, MN and additionally met individually with stakeholders to begin developing the CIDSS and scheduling assistant. The initial criteria for the CIDSS and scheduling assistant have been defined and the consultant has been developing the software over the last couple of months. The primary CIDSS decision criteria will be stream water quality and flow data which will be obtained from DNR established monitoring sites and grab sampling. There are numerous variables for the scheduling assistant that were identified by the stakeholders. Many of those principles were presented at the second public stakeholder meeting by the consultant through a presentation involving “wire framing”. During that interactive presentation additional variables were identified and are being integrated into the software. In addition to some data being automatically integrated into the scheduling software, stakeholders identified numerous data that will have a manual override function.

Activity Status as of 6-30-16: Our stakeholders established the irrigation scheduling assistant variables during the stakeholder meetings and through follow up phone calls. They recommended a higher level of data quality for the variable rainfall. As a result our consultant was able to integrate GIS based NEXRAD daily rainfall estimates into the irrigation scheduling system. The rainfall estimates are customized for each field based on a 4 kilometer resolution grid system available through NEXRAD 24 hour rainfall estimates. This additional data greatly improves the field by field reliability of the scheduling assistant and improves the irrigator’s confidence level in the software. The scheduling system software was designed during the spring months and we began

beta testing it in May. The assistant was launched to irrigators in the Little Rock project area in June and we are working directly with those irrigators to set up fields and provide training and support.

The stakeholders had a difficult time developing the decision support criteria for the decision support system during our stakeholder meetings. They requested we provide real time examples of the variables before beginning discussions about establishing thresholds. As a result the final development of the decision support system has been rescheduled until the stakeholders have a chance to review the criteria. In order to provide them with this opportunity we created graphs that show stream flow and water temperatures in real time and established links to these data directly in the scheduling assistant. Those data examples are now available to the irrigators each time they log into the scheduling assistant software.

Additionally we have made efforts to coordinate this project with those of the DNRs Little Rock Creek Sustainable Groundwater Use Planning Project. Our vision is that, to the extent possible, the decision support system and the voluntary conservation that irrigators self-identify what they would like to apply at each threshold dovetails with the DNRs planning project. Unfortunately our efforts to coordinate activities with the DNR have stalled. We were recently removed from the July 27th Project Advisory Team meeting agenda (for the second time) where we had planned to present the project to the team and identify team interest in this concept. Given our timeline for developing the decision support system (already have rescheduled development once), the timeline the DNR has given for their plan (our understanding is that a draft plan will be completed by early this fall, leaving little opportunity to integrate the decision support system), the timeline needed for our consultant to design the software and time needed to roll out the decision support system with the irrigation community, we may look towards other opportunities to work with advisory team members.

Activity Status as of 1-30-17: We were able to present this project to the DNR's project team in November. With that presentation now completed we plan to select the decision support criteria in January and ask the consultant to finish development of the Conservation Irrigation Decision Support System this winter. The launch of the beta version of the online irrigation scheduling assistant was very successful this past summer. In addition to SWCD staff utilizing the software with our clients throughout the summer, a total of 6 irrigators were trained. They tested the software on 18 fields, covering 1,796 acres and 4 crops. The software had a failure rate of 0% throughout the season, meaning it performed throughout the entire season without unscheduled interruption. After the growing season, the consultant and SWCD staff held face to face meetings with three of these irrigators to identify any problems they encountered and identify any software changes they recommend. The irrigators were very pleased with the functionality and performance of the software. Our next step is a meeting with the consultant, scheduled for January, to determine what refinements to make before this spring.

Activity Status as of 6-30-17: The following refinements were agreed to, developed and release before the spring planting system.

1. Revised soil moisture prediction following saturation to more closely match what our infield soil moisture estimates were showing us in 2016.
2. Added the ability to reuse a previous years field, while retaining the records for the previous year.

Additional refinements were agreed upon and are currently in the testing phase by SWCD and consultant staff.

1. Adding alfalfa as a crop.
2. Copying and maintaining all user overrides when changes to the crop, planting date or maturity date are made.
3. Changing the individual soil moisture charts and user override feature to display in percent field capacity instead of inches.
4. Manual user adjustment/override for crop maturity

Activity Status as of 1-30-18: The additional refinements performed well over the summer.

Activity Status as of 6-30-18: The Benton and Otter Tail instances have been performing well this summer. The MDA made changes to how their weather stations collect and distribute data over the spring, so our consultant made the corresponding changes to the software.

Activity Status as of 1-30-19: The software continued to perform well during this reporting period.

Final Report Summary:

- In cooperation with our hired consultant, RESPEC, two public stakeholder meetings were held that kicked off the beginning stages of developing the CIDSS and Irrigation Scheduling Assistant. A stakeholder group was established and the initial criteria for the CIDSS and the irrigation scheduling assistant variables were identified and defined. The scheduling system software was designed in spring 2016 with the beta testing being done in May. The Irrigation Scheduling assistance was launched to irrigators in the project area June of 2016 and over that growing season, we worked directly with 6 irrigators training them on the irrigation scheduling assistant.
- Online Irrigation Scheduling Assistant - One of the recommendations that was taken under consideration from the stakeholder committee was for a higher level of data quality for the variable rainfall. Our consultant integrated GIS based NEXRAD daily rainfall estimates into the irrigation scheduling system. This additional data improves the field by field reliability and improves the irrigator's confidence in the software. The software had a 0% failure rate the first growing season. The irrigator's provided positive feed back and were pleased with the functionality and performance of the software.
- Conservation Irrigation Decision Support System - The stakeholders had a tough time developing the criteria for the decision support system. Efforts were made to coordinate this project with the DNRs Little Rock Creek Sustainable Groundwater Use Planning Project. Benton SWCD and our consultant gave a presentation to the DNR's project team on the project. With the stakeholder group input, the criteria for the CIDSS was set in 2017. The CIDSS will include graphs to illustrate Little Rock Creek temperature and flow with the associated thresholds for each. Conservation Irrigation Tips were developed for short- and long- term conservation measures for the CIDSS.

ACTIVITY 3: *Evaluation of effectiveness and progress towards project goals*

Description: There will be several types of monitoring and evaluation throughout this project. Reports on program effectiveness will be developed and communicated to various audiences.

- Stream monitoring. The MNDNR has several monitoring sites set up in Little Rock Creek. They will be keeping three of them on a permanent basis. We will be using LCCMR funds to upgrade the sites to include satellite telemetry so the data is made available real time. We will integrate this with the CIDSS to help evaluate conservation irrigation decisions. Additionally water quality samples will be collected bi-weekly, analyzed and utilized in the CIDSS as well. The actual flow in Little Rock Creek and water quality (i.e. dissolved oxygen levels) will be used as one measure of the effectiveness of the project.
- Groundwater monitoring wells. The MNDNR has already replaced some of the long term groundwater monitoring wells in the area and added data loggers to the new wells. The Benton SWCD will be downloading data routinely for the DNR. The DNR plans to install additional new wells in the project area, including a nest of wells that can be used to evaluate groundwater levels in the project area. Activities associated with the monitoring well network are outside the scope of LCCMR funding. We are including them in this work plan for informational purposes only because they are integral to the project.
- Soil moisture sensors and automated rain gauges. Sensors and gauges will be installed at select irrigation sites, the criteria for selecting sites will be set by the stakeholder committee, to be utilized as a tool for the irrigation scheduling software. The sensors will be compared to the weekly in-field estimates. Additionally,

two weather stations are being installed by the Benton SWCD through a partnership with the MDA and will be used to collect all of the information required to calculate evapotranspiration in real time. The installations of the weather stations are outside the scope of LCCMR funding. We are including them in this work plan for informational purposes only.

- Monitoring cropping management. During years 2 and 3 we will monitor and report changes to the management of cropping systems. Items will include parameters such as acres of soil health practices, acres of cropland utilizing the scheduling assistant, acres or number of irrigation systems evaluated for uniformity and any improvements made to the irrigation system. NRCS plans to utilize soil quality testing to track soil quality progress. We will track crop yield to evaluate crop production improvements.

Summary Budget Information for Activity 3:

ENRTF Budget: \$104,509
Amount Spent: \$104,509
Balance: \$0

Outcome	Completion Date
1. Satellite telemetry purchased and installed, stream flow and water quality monitoring begins.	November 2015
2. Soil moisture sensors and rain gauges installed and activated at select sites.	May 2016, May 2017, May 2018
3. Annual reporting on program effectiveness, working with the technical team to adapt program implementation strategies based on effectiveness results	January 30, 2016, January 20 2017, January 30 2018
4. Data analysis and report on stream flow and water quality	January 30 2016, January 20 2017, January 2018

Activity Status as of 1-30-16: Corrected budget numbers to align with the spreadsheet per a phone call with Susan on 1/8. In addition to numerous phone calls to DNR monitoring section staff, Benton SWCD and consultant staff met with DNR staff in St. Paul in November to coordinate efforts related to monitoring and other activities. SWCD staff has since received price quotes for materials needed for satellite telemetry hook up and will be purchasing the materials and coordinating installation with DNR staff soon. SWCD staff have continued to collect groundwater level data and recently completed the last download for the calendar year.

Activity Status as of 6-30-16: The satellite telemetry was installed at three DNR monitoring stations on April 13th. Water flow, temperature and dissolved oxygen measurements began immediately. Stream flow and monitoring equipment was purchased and some equipment was provided by the MPCA for other sites. Gaging stations were established with MPCA assistance on April 7th. Grab sampling and flow monitoring at these sites began on April 27th, and we have been collecting data on an established schedule since.

Two weather stations were maintained during the reporting period and groundwater levels were measured and the data uploaded to the DNR website.

Our consultant RESPEC provided on-site training on the installation of soil moisture sensors on May 5th. Several sensors were installed that day, and we have continued to install them through this growing period for irrigators that are migrating to the on-line scheduling assistant. The irrigators are using them to monitor soil moisture at different soil depths. Based on the recommendations of the stakeholders we chose to utilize radar estimates for rainfall data therefore automated rain gauges are not expected to be needed any longer. We plan to make the final decision about automated rain gauges during the winter stakeholder meetings.

Activity Status as of 1-30-17: The radio telemetry installed at the DNR monitoring stations performed well this summer and provided good flow and temperature data however we did run into some problems calibrating the dissolved oxygen sensors and replacing membranes during the first part of the summer. As a result we only have reliable dissolved oxygen data for part of the season. Although the monitoring and flow report is currently being assembled, we have reviewed the provisional data. Our preliminary analysis indicates the stream was able to meet the desired goal (as stated in the TMDL document) of a maximum weekly average water temperature of 19 degrees Celsius during dry and low flow conditions (when groundwater input are most important) and a maximum daily maximum of 24 degrees. More analysis will be performed over the coming months.

Thirty four soil moisture sensors were installed at 14 sites. The data from the sensors was compared to in-field soil moisture estimates to evaluate the effectiveness of the scheduling assistant. The sensors performed well at most sites and will be used again next summer to calibrate the calculations that are utilized by the irrigation scheduling software.

As previously mentioned, 3,106 acres of irrigation scheduling was completed this summer through this project. Studies published by Steele et al. in 2000 and Melvin and Payero in 2003 suggest a 13 – 30 percent reduction in irrigation inputs is likely in a typical year, which equates to an estimated 137 to 316 million gallons of water savings for the acres covered this year.

Activity Status as of 6-30-17: Our consultant completed the 2016 water quality monitoring report. The report is available on our website or by clicking the following link:

<http://www.soilandwater.org/images/SWCD/pdf/reporting/grants/2016%20-%20BentonSWCD-LittleRockCrWater%20Quality%20Report%202016-Final.pdf>

A single year of monitoring data is certainly not a long enough period of time to estimate statistically significant trends. The report instead compares the 2016 year to data from the 2006 – 2008 time period. In 2016 no samples exceeded the water quality standard for nitrate, 38% of the samples failed to meet dissolved oxygen standards (an increase), and water temperatures never exceeded the critical threshold for Brown Trout but did regularly exceed the threat threshold during parts of the summer. There was a significant increase in stream flow, although the cause is undetermined. Using provisional groundwater data, observation well 5005 indicates levels have increased since 2008. Thirty soil moisture sensors were installed at 15 sites.

Activity Status as of 1-30-18: The Benton SWCD website was updated so the location of the 2016 water quality report was moved to here <https://www.soilandwater.org/little-rock/>. The 2017 water monitoring season has concluded. During the 2017 monitoring season, Benton SWCD technicians collaborated with MPCA monitoring staff on modifying/strengthening the Monitoring Plan for the project. MPCA provided Benton SWCD a monitoring sonde that collects Dissolved Oxygen, Temperature, and Conductivity bi-weekly on Little Rock Creek and on the 2 sites on Little Rock Lake tributaries (Sucker Creek & Bunker Hill Creek). Continuous Dissolved Oxygen was collected during the 2017. Benton SWCD is working with MN DNR on coming up with a solution to be able to collect continuous dissolved oxygen throughout the summer months. The current DO sensor that was purchased cannot collect reliable data without having extensive bi-weekly maintenance and calibration. MN DNR monitoring staff visit the station for maintenance once a month, so we are looking into other solutions to collect reliable continuous DO data that requires less maintenance. Water quality data was sent to consultant and a second water quality report will be available by the next reporting period. Data from the DNR groundwater monitoring wells was last downloaded on 12-4-17 and is available through the decision support system and a link on the Benton SWCD website.

We continued to maintain two weather stations during the reporting period. Thirty soil moisture sensors were installed at 15 sites. The data was compared to the in-field soil moisture estimates throughout the growing season to evaluate the effectiveness of the scheduling assistant and monitor crop management. The sensors will be used again next summer to calibrate the scheduling software. Irrigators using the scheduling software indicated an equal to slight increase in the yield during harvest this fall.

As previously mentioned, 2,784 acres of irrigation scheduling was completed this summer through this project. A two year total of 5,890 acres of irrigated land have used the [irrigation scheduling assistant and participated in weekly scheduling assistance by the SWCD](#) to date with this project. Using the same calculations as last year, we estimate 122 to 283 million gallons of water savings for the acres covered in 2017 with this project and a 2 year total estimate of 259 to 599 million gallons. We already have a list of new farms signed up for next year.

Activity Status as of 6-30-18: The 2018 monitoring season is underway, and technicians have been collecting water samples on Little Rock Creek, Bunker Hill, and Sucker Creek. A new optical dissolved oxygen sensor was purchased and installed in coordination with the MN DNR on the Little Rock Creek Monitoring site. This new sensor was selected to resolve the issue of the previous attempt to monitor real-time dissolved oxygen data. The new probe uses optical sensors to collect dissolved oxygen levels instead of a membrane over the sensor. This will allow the sensor to maintain better calibration in turbid waters. This sensor also has a quick disconnect from the DNR's permanent monitoring station that allows our technicians to calibrate the sensor without hooking up to the DNR's station. The new sensor has been successfully calibrated once this summer and is planned on being calibrated on a bi-weekly basis to ensure accurate data is being collected. The real-time data is available to be viewed online at https://hads.ncep.noaa.gov/cgi-bin/hads/interactiveDisplays/displayMetaData.pl?table=dcp&nesdis_id=D5501D94.

Our consultant completed the 2017 water quality monitoring report. The report is available on our website or by clicking the following link:

<https://static1.squarespace.com/static/5991a4db4c0dbfafa10384f8/t/5b15ab4e8a922d0c6b2f3785/1528146775082/2017+Water+Quality+Report.pdf>

Two years of monitoring data is a very small sample size to estimate trends, so the report is best reviewed as a comparison to the 2006-2008 time period. Comparing the 2017 monitoring season values to the TMDL time period values of 2006-2008 indicates that conditions have improved for Little Rock Creek and Bunker Hill Creek. Specifically, nitrate values have improved for both Little Rock Creek and Bunker Hill Creek, DO values improved at Little Rock Creek and remained similar at Bunker Hill Creek, water temperatures dropped slightly at Little Rock Creek, and flow and groundwater levels have increased because of regional precipitation increases at Little Rock Creek.

Thirty-eight soil moisture sensors were installed at 19 sites and are being used by irrigators to monitor soil moisture levels at various depths in conjunction with the irrigation scheduling assistant.

Activity Status as of 1-30-19: The new In-Situ RDO Pro-X Dissolved Oxygen sensor that was purchased last year excelled in collecting continuous dissolved oxygen data on Little Rock Creek throughout the 2018 monitoring season. This sensor allows SWCD staff to monitor the sensor online and calibrate it efficiently without needing access to the DNR's monitoring station. We ran into a problem in the second year of the grant with the sensor we originally purchased. The original sensor we purchased and deployed the first monitoring season used a membrane to collect dissolved oxygen levels. This membrane needed to be changed weekly due to the environment of Little Rock Creek, and the DNR's monitoring crew performs monthly checks on the station. The new sensor uses different technology than the original one that allows Benton SWCD technicians to disconnect the sensor without needing to access the inside of the DNR's station. The SWCD is planning on purchasing an individual data logger that will still allow the SWCD to utilize the original dissolved oxygen sensor on other streams within the project area and collect data for 1-2 weeks at a time. We will be able to calibrate the sensor on a routine basis. In 2018, a total of 17 water sampling events were collected on Little Rock Creek, Bunker Hill and Sucker Creeks. A total of 37 individual water samples were collected and sent into the lab for water quality analysis.

Our consultant completed a 2018 water quality report. This is the final water quality report for this grant period and it is available on our website at www.soilandwater.org or by clicking on this link.

<https://static1.squarespace.com/static/5991a4db4c0dbfafa10384f8/t/5c3ce6a70e2e72aee0ffec26/1547495088373/2018+Water+Quality+Report.pdf>

Like previous reports, three years of monitoring data is a very small sample size to draw conclusions about trends in a groundwater impacted stream. Data from 2016 – 2018 were compared to the 2006 - 2008 time period to detect changes and the report shows this data in graphical form. Comparing the 2018 monitoring season values to the TMDL time period values of 2006–2008 indicates that conditions have improved for Little Rock Creek and Bunker Hill Creek. Specifically, nitrate values have improved for both Little Rock Creek and Bunker Hill Creek, DO values improved at Little Rock Creek and remained similar at Bunker Hill Creek, water temperatures dropped slightly at Little Rock Creek, and Little Rock Creek flow and regional groundwater levels have increased. These are all encouraging signs and with additional years of monitoring that may include weather conditions that mimic the 2006 – 2008 seasons we hope to analyze water quality trends.

As the crop growing season went on, we added more soil moisture monitoring sensors to irrigated fields for a total of 55 soil moisture sensors at 25 sites. Throughout the growing season the data from the sensors was compared to the in-field soil moisture estimates and the prediction of the scheduling assistant and used to make decisions about irrigation and crop management. All three methods correlated well, increasing the confidence in the scheduling assistant and resulting in improved irrigation decisions. We will continue to use the soil moisture monitoring sensors next year.

Final Report Summary:

- Stream Monitoring – In cooperation with our consultant and the DNR’s monitoring staff, three permanent water monitoring stations on Little Rock Creek were upgraded with satellite telemetry equipment that now provide real-time data for the Conservation Irrigation Decision Support System (CIDSS) and to the DNR. In addition to the DNR’s stream temperature and flow monitoring equipment, a continuous dissolved oxygen sensor was purchased and installed at one of the monitoring sites to incorporate into the CIDSS. Due to the length between the station maintenance from the DNR’s water monitoring staff, the dissolved oxygen sensor the was used proved to be unreliable in the stream’s aquatic environment. The sensor required to be calibrated on a much more frequent basis than the monthly maintenance that occurred. With suggestions from our consultant and the MPCA, a different dissolved oxygen sensor was purchased that used different technology to gather dissolved oxygen data and came with a quick disconnect on the wire from the sensor to the monitoring station. This allowed Benton SWCD staff to conduct maintenance on the Dissolved Oxygen Sensor without needing to access the DNR’s monitoring station dataloggers. Benton SWCD coordinated with MPCA on developing a water quality sampling plan with the project area and collected bi-weekly water quality samples. Our consultant, RESPEC, completed three water quality monitoring reports for 2016, 2017, and 2018. They are located on our website at <https://www.soilandwater.org/little-rock>. Three years of monitoring data is a small sample size to draw conclusions about trends in a groundwater impacted stream. Data from 2016 – 2018 were compared to the 2006 - 2008 period from Little Rock Creek TMDL to detect changes. The water quality reports show this data in graphical form. Comparing the 2018 monitoring season values to the TMDL time values indicate that conditions have improved for Little Rock Creek and Bunker Hill Creek. Specifically, nitrate values have improved for both Little Rock Creek and Bunker Hill Creek, DO values improved at Little Rock Creek and remained similar at Bunker Hill Creek, water temperatures dropped slightly at Little Rock Creek, and Little Rock Creek flow and regional groundwater levels have increased. These are all encouraging signs. We hope that with additional years of monitoring, that we may analyze water quality trends that will include weather conditions that mimic the 2006 – 2008 seasons.

- Groundwater Monitoring Wells –Technicians routinely collected data for the DNR’s groundwater monitoring wells throughout the grant period. The data was uploaded to the DNR’s groundwater monitoring website. Technicians also maintained two weather stations in the project area for the MN Dept of Agriculture that were used in the Ag Weather Network for the online irrigation scheduler.
- Soil Moisture Sensors and Automated Rain Gauges – Our consultant, RESPEC, provided on-site training to our technician on installing soil moisture sensors. 40 soil moisture sensors along with digital meters to collect data were purchased. Soil moisture sensors were placed in fields that irrigators were utilizing the online irrigation scheduling assistant. On average, 18 fields a year had soil moisture sensors placed in them. Throughout the growing seasons the data from the sensors was compared to the in-field soil moisture estimates and the prediction of the scheduling assistant and used to make decisions about irrigation and crop management. All three methods correlated well, increasing the confidence in the scheduling assistant and resulting in improved irrigation decisions. A total of 9,742 acres of irrigation scheduling was completed through this project. Studies published by Steele et al. in 2000 and Melvin and Payero in 2003 suggest a 13 – 30 percent reduction in irrigation inputs is likely in a typical year, which equates to an estimated 429 to 990 million gallons of water savings for the acres covered for this project. This would estimate a 2.8 – 6.2 percent savings on water usage in the project area during that time.
- Based on the recommendations of the stakeholder group to utilize NEXRAD GIS based daily rainfall estimates for rainfall data in the online irrigation scheduling assistant, purchasing automated rain gauges were no longer needed.

ACTIVITY 4: Outreach, promotion, and sharing results throughout the state

Description: Project partners will demonstrate the benefits of conservation practices to producers through multiple channels including irrigators and crop growers associations, farm visits, field days, websites, and traditional mailings. We will utilize input from the stakeholder committee to prioritize outreach activities.

Project results will be shared statewide at conferences (potentially the BWSR Training academy, Water Resources Conference, etc.), and through project reports, websites, and other channels as appropriate.

The Conservation Irrigation Decision Support System and the irrigation scheduling assistant will be made available statewide. Sharing the results and products (technology transfer) will be a significant component of this project for both the consultant and the Benton SWCD. To accomplish this we will link the system up to other existing available data (i.e. other weather stations, other critical streams with flow data) and share the system to other areas of the state. Our consultant will perform this task by working with other government agencies directly (i.e. other SWCDs, DNR, MDA) and installing the systems on agency websites as appropriate and if necessary. The consultant will also be responsible for training and technical assistance to these agencies and will require a significant commitment. Additionally SWCD staff will work with the other agencies to train and provide assistance on the products and procedures.

Summary Budget Information for Activity 4:

ENRTF Budget:	\$101,418
Amount Spent:	\$101,418
Balance:	\$0

Outcome	Completion Date
1. Outreach team established; SWCD staff and project partners develop and update materials regularly with new information and messages.	On-going throughout the project
2. Up to 4 field days, events, conferences/year for target audience and stakeholders	On-going and as determined by the stakeholder committee.
3. Annual reporting on program effectiveness, working with the technical team to adapt program implementation strategies based on effectiveness results	January 30 2016, January 30 2017, January 30 2018
4. Demonstration and transfer of technology and program results. The outcome will be the successful launch of the software on the websites of other interested entities including training staff of those entities.	December 2018

Activity Status as of 1-30-16: To solicit stakeholder participation and provide outreach for this project the SWCD completed two direct mailings to irrigators and other interested groups in the Little Rock project area. We are currently identifying outreach team members. We are also currently planning an irrigation clinic for February 4th and sent out 211 direct mailing invitations to stakeholders.

We are also coordinating our activities with DNR staff to match this project up with the DNRs permitting program to the extent possible. We have held conference calls to identify areas the two projects may overlap and continually strive to develop the CIDSS to meet project goals with DNR permitting program goals.

Activity Status as of 6-30-16: An irrigation clinic was held on February 4th, 44 people attend the clinic. Soil health best management practices for irrigated soils, the on-line irrigation assistant and the decision support system were all discussed during the presentations.

The project was scheduled to be presented to the DNR project advisory team twice but was later removed from the agenda by the DNR. We are considering other options to work with the project advisory team members.

RESPEC and SWCD staff made a presentation to 56 attendees at the Minnesota Association of Soil and Water Conservation Districts Area 2 meeting held in Foley, MN. The presentation introduced SWCDs to the project and began discussions about transferring the technology to other parts of Minnesota.

The SWCD held a tour of conservation projects on June 14th. Forty two people attended the tour, including individuals representing county, state and federal elected officials. A presentation was made regarding the project in addition to stops in the field to demonstrate certain aspects of the project including soil health practices, irrigation scheduling, soil moisture sensors, water quality monitoring and the decision support system.

We have submitted a project abstract for consideration for the October 18 & 19 Minnesota Water Resources Conference and are awaiting a decision.

Activity Status as of 1-30-17: The following outreach activities were completed during this reporting period:

- Requested a training session at the 2016 BWSR training academy but were unsuccessful. However in conjunction with this initiative, on August 19th we completed an on-line demonstration of the software to Megan Lennon, BWSR Technical Training and Certification Coordinator. We plan to coordinate training and outreach activities in the future as a result.
- Completed three webinars (Oct 31, Nov 1 and Nov 3) with the consultant to demonstrate the irrigation scheduling tool and gauge the level of interest in the tool throughout the state. The webinar included an optional survey for participants.

- Wrote and submitted an article to Joshua Stamper, University of Minnesota Irrigation Extension Specialist, on November 4th for inclusion in a new Irrigation BMP publication.
- On November 15th we held individual conferences with irrigators who began using the software this summer to solicit their input on the software and promote the project to others.
- On November 16th SWCD and consultant staff gave a presentation at a DNR “Sustainable Use of Groundwater in the Little Rock Creek Area: A Planning Project” Project Advisory Team Meeting.
- We sponsored a booth at a December 15th irrigation clinic held by the Douglas, Kandiyohi, Pope, and Stearns SWCDs and MDA. We demonstrated the scheduling tool to interested irrigators and agency staff.
- We started planning for a Benton/Morrison irrigation clinic to be held on February 28th.

The webinars represent a significant step towards technology transfer. We will be using the survey results from the webinars, along with other information, to determine how and where to develop and transfer the scheduling tool to another area in Minnesota beyond Little Rock Creek. With the high interest level in the tool at the local and state levels and the desire to potentially expand its use and function beyond the current scope of this project, we are working with the consultant to identify long term strategies to potentially meet these needs and the needs of this grant simultaneously.

Activity Status as of 6-30-17: The following outreach activities were completed during this reporting period:

- An irrigation clinic was held on February 28th, 36 people attend the clinic. Soil health best management practices for irrigated soils, the on-line irrigation assistant and the decision support system were all discussed during the presentations.
- Benton SWCD supervisor continues to participate in the DNR project advisory team meetings for the sustainable use project, two meetings were attended.
- We held an individual conference with a crop consultant whose primary work area includes the project area. He will be promoting the software to irrigators he works with.
- We have requested (twice) time to meet with interagency groundwater teams to discuss this project and its potential expansion to a broader area.
- A project update was completed and e-mailed to the agency stakeholder group. Members were invited to try the software out. As of this report there are 34 registered users for the software (irrigators and other stakeholders combined).
- SWCD staff and an irrigator in the project area were interviewed by the Sauk Rapids Herald. An article was published in the Benton Ag section on July 6th. It can be viewed at the newspaper’s website and a link has been established on the front page of our website (www.soilandwater.org).
- A survey was developed to further gauge interest in expanding the irrigation scheduling software to the second project area. The survey was sent out to the stakeholder group. Survey results were gathered and reviewed. Respondents whose answers do not fit as well with the intention, need and abilities of the project were set into a lower priority list. Plans to work with the consultant to identify potential short term and long term project groups have been set. A draft map of future software “clusters” has been developed for discussion and planning purposes. We are scheduled to select the second project area and begin software migration/technology transfer by the next report.

Activity Status as of 1-30-18: The following activities were completed:

- In August, Benton SWCD worked with a producer, who is very active with the irrigation scheduling software, to utilize a field that was being harvested for early potatoes to plant a 6 acres of demonstration cover crop plots. The 6 acre demonstration plots were divided in half, one half used

species that would over-winter and the other half would be species that would winterkill. Within the 2 halves a total 30 plots were planted. The plots showcased basic cover crop mixes, n scavenger mixes, n producer mixes, compaction mixes, grazing mixes, and a couple of single species. On October 31st, Benton SWCD partnered with NRCS and the U of M Extension Service to host a cover crop field day. The field day had a good turnout with roughly 20 people attending. The field day spurred good conversation with producers, agronomists, and agency staff.

- We were contacted by the Upper Mississippi Irrigators Association to partner on a combined irrigation clinic. Plans are underway for a January 17th clinic in conjunction with their annual meeting. One of the many great topics that will be covered is the Irrigation Management Assistant with our consultant RESPEC as a presenter alongside Benton SWCD. We have also been invited to do a short presentation of the irrigation scheduling software and set up a booth for individual demonstrations at the February 8th irrigation clinic that is sponsored by the East Ottetail SWCD. The software was demonstrated to the Clay County SWCD through the internet in October.
- Benton SWCD and our consultant gave a presentation of the project at the October 18th Water Resources Conference. A few dozen individuals, primarily with a water resources background, attended the presentation.
- We continued with the technology transfer portion of the project. Cluster counties were interviewed over the phone or in person in Perham and Glenwood in August and September. The five county area of Hubbard, Becker, Wadena, Ottetail and Todd was selected to transfer the irrigation scheduling technology. The consultant has started developing the software for that five county area and it will be available for use during the 2018 crop season.

Activity Status as of 6-30-18: The following outreach activities were completed during this reporting period:

- Seventy-seven people attended the combined irrigation clinic was held on January 17th. The on-line irrigation assistant and decision support system were among the presentations.
- On Feb 8th the East Ottetail SWCD hosted an irrigators workshop where 75 people attended. We unveiled the irrigation management assistant at the clinic and as a result registered several users that day.
- On March 4, 2018, Benton SWCD in partnership with the University of Minnesota Extension Service (UMES), held a Cover Crop Workshop. The Cover Crop Workshop had presentations from UMES staff on “Integrating Cover Crops and Manure” and “Herbicide interaction with cover crop establishment and termination, along with weed control benefits of cover crops.” The highlight of the workshop was having a farmer panel discussion that included 4 local farms engaging with the audience on their innovative ways of integrating cover crops within their farm system. The event drew in over 20 people consisting of local farmers, landowners, and soil and water conservation professionals.
- On April 5th Benton SWCD staff provided training on the use of the irrigation management assistant to staff from SWCDs in the East Ottetail instance and Minnesota Department of Agriculture staff. The training was held in Perham and included a demonstration to the group followed by one on one assistance.

Activity Status as of 1-30-19:

- We were again contacted by the Upper Mississippi Irrigators Association to partner on a combined irrigation clinic. On January 16th the clinic was held in conjunction with their annual meeting and we covered the Irrigation Management Assistant. 70 people attended.
- East Otter Tail SWCD has an Irrigation Clinic scheduled for February 7th and the Irrigation Management Assistant will be talked about at this Irrigation Clinic.

- Roll up banners ordered have been ordered for Benton, Morrison, Becker, Hubbard, East and West Otter Tail, Todd and Wadena SWCDs.

Final Report Summary:

- Update since last reporting period: East Otter Tail SWCD held an Irrigation Clinic February 7th, 2019 that had a good turn out of 68 people and the Online Irrigation Management Assistant was discussed as a topic of the clinic. The eight SWCDs in the five-county area that the irrigation assistant is available, received their roll up banners that promote the online scheduling assistant.
- To solicit stakeholder participation and provide outreach for this project the SWCD completed two direct mailings to irrigators and other interested groups in the Little Rock project area. Presentations were given at a wide variety of events, workshops, and conferences. Presentations highlighting the on-line irrigation assistant and the decision support system, and soil health best management practices for irrigated soils were given to the annual irrigation clinic in 2016, 2017, and 2018 in Benton and Morrison County. Through these efforts, we began a partnership in 2018 with the Upper Mississippi Irrigators Association, which led to a combined irrigation meeting. These presentations reached a total of 227 people. Some other highlight promotion efforts include: RESPEC and SWCD staff presentation to 56 attendees at the Minnesota Association of Soil and Water Conservation Districts Area 2 meeting in 2016. The presentation introduced SWCDs to the project and began discussions about transferring the technology to other parts of Minnesota; Three webinars were completed (Oct 31, Nov 1 and Nov 3) with RESPEC to demonstrate the irrigation scheduling tool and gauge the level of interest in the tool throughout the state. The webinar included an optional survey for participants. RESPEC and Benton SWCD staff also gave a presentation at a DNR “Sustainable Use of Groundwater in the Little Rock Creek Area: A Planning Project” Project Advisory Team Meeting. We held an individual conference with a crop consultant whose primary work area includes the project area. The crop consultant found value in the irrigation scheduling assistant and has promoted the software to irrigators he works with. News articles have been published by local newspapers. Sauk Rapids Herald published a story highlighting the Online Irrigation Scheduling Assistant, which included interviewing SWCD staff and an irrigator in the project area. It can be viewed at the newspaper’s website. Benton SWCD worked with a producer, who is highly active with the irrigation scheduling software, to utilize a field that was being harvested for early potatoes to plant a 6-acre cover crop demonstration plot. On October 31st, 2017, Benton SWCD partnered with NRCS and the U of M Extension Service to host a cover crop field day. The field day had a good turnout with 20 people attending. The field day spurred good conversation with producers, agronomists, and agency staff. On March 4, 2018, Benton SWCD in partnership with the University of Minnesota Extension Service (UMES), held a Cover Crop Workshop. The Cover Crop Workshop had presentations from UMES staff on “Integrating Cover Crops and Manure” and “Herbicide interaction with cover crop establishment and termination, along with weed control benefits of cover crops.” The highlight of the workshop was having a farmer panel discussion that included 4 local farms engaging with the audience on their innovative ways of integrating cover crops within their farm system. The event drew in over 20 people consisting of local farmers, landowners, and soil and water conservation professionals.
- The Online Irrigation Scheduling Assistant expanded to a 5-county area in 2017/2018. Local SWCDs within the project area began promotional efforts on the scheduling assistant that included presentations at their annual irrigation clinics that reached 143 people, and through direct mailings to their local irrigators in the project area. In spring of 2018, a news article made the Minnesota Irrigator, a publication of the Irrigators Association of Minnesota, that highlighted the Minnesota Irrigation

Management Assistant (i.e. online scheduling assistant). Project Banners highlighting the Scheduling Assistant were made for the SWCDs in the project area to for promotion at various events.

V. DISSEMINATION:

Description: Weather station data formatted to evapotranspiration (from the MDA provided weather stations), water flow, water quality and ground water levels will all be made available either directly from our website at www.Soilandwater.org, or from a link on the website. The CIDSS and irrigation scheduling assistant will also be available through our website and we anticipate that other entities (i.e. SWCDs, Irrigation Association of Minnesota) will have it established on their websites also by the end of the project. The software itself will be available for the public. Interim and final reports will be posted on the Benton SWCD website.

Status as of 1-30-16: The monitoring, CIDSS and scheduling assistant have not been developed to the point that they can be made available on the internet. The interim report will be posted on the Benton SWCD website after it is approved.

Status as of 6-30-16: Weather station and evapotranspiration data is available at www.agweathernetwork.com. Water flow and stream temperature is currently available to the irrigators using the scheduling assistant. Links will be made available to others through our website after beta testing is completed and updates are made to the software.

Status as of 1-30-17: The beta testing period concluded this year. The consultant will be making software changes this winter. After those changes are made and tested we will make it available through our website (before the spring planting season).

Status as of 6-30-17: The software was made available to any user on our website in April. Reports are available on our website in the legislative reporting section.

Status as of 1-30-18: The items previously reported remain available.

Status as of 6-30-18: The irrigation scheduling technology was transferred to Hubbard, Becker, Wadena, Ottertail and Todd counties and is available through this link: <http://ima.respec.com/>.

Status as of 1-30-19: The updated report is posted on the website and the previously reported items are current.

Final Report Summary:

This project was able to educate many people about new up-to-date irrigation water management tools. The irrigation scheduling tool and CIDSS for the Little Rock Creek Groundwater Area is available online at <http://ima.respec.com/>. The East Ottertail instance that include the 5-county expanded areas of Hubbard, Becker, Wadena, Ottertail and Todd Counties is also available online at <http://ima.respec.com/>. The project's new online irrigation management scheduler is highlighted on local SWCD's websites, such as www.soilandwater.org and <http://www.eotswcd.org/irrigation-scheduler/>. A online demo trial of the irrigation scheduler is available to the public to try and to see what the tool has to offer. Promotional banners of the Irrigation Management Assistance were made for the local SWCD's where the current software is offered. Weather station and evapotranspiration data is available at www.agweathernetwork.com. Water flow and stream temperature for Little Rock Creek is currently available to the irrigators using the scheduling assistant within Little Rock Creek Groundwater Area.

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	\$ Amount	Overview Explanation
Personnel:	\$123,796	<ul style="list-style-type: none"> • District Manager, 0.3 FTE cumulative total throughout the project (689 hours), assisting with stakeholder group meetings, facilitation, development of CIDSS and irrigation scheduling assistant, soil quality promotion, monitoring data review and reporting, outreach and technology transfer and overall project management. • Technician(s), 1.5 FTE cumulative total throughout the project (3027 hours), assisting with all aspects of the project and will be the lead for increased adoption of practices. • Administrative Assistant, 0.1 FTE cumulative total throughout the project (124 hours), performing administrative tasks.
Professional/Technical/Service Contracts:	\$256,000	Contractor to be determined through a competitive bid process. We will be seeking a contractor in the natural resources field, with experience with GIS, irrigation management principles, software design and working with the public (in particular farmers and irrigators). Contractor will be responsible for CIDSS and irrigation scheduling assistant development, maintenance and upgrades for both systems throughout the project; water quality/flow analysis and reporting, soil moisture equipment/rain gauge installation; web presentations, on-line conferences, field days, public events and transfer of technology.
Equipment/Tools/Supplies:	\$37,033	We purchased soil/soil quality tests for the soil quality initiative (\$866), satellite link/hook up for 3 DNR stream monitoring stations (\$9,630), 3 years of water quality testing and two instruments (\$15,460), soil moisture monitoring sensors (\$7,092) and automated rain gauges (\$0), and various items needed for outreach efforts (\$3,985).
Travel Expenses in MN:	\$14,171	All expenses were for travel with a vehicle.
TOTAL ENRTF BUDGET:	\$431,000	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation: 1.9 FTE

**Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF
Appropriation: 1.1 FTE**

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			
USDA EQIP, CSP and other conservation programs	\$75,000	\$112,000	Federal farm bill program funds directly to landowners implementing conservation practices.
State			
FY14 BWSR CWF Grant	\$25,000	\$37,400	Staff expense to promote practices.
MN Department of Agriculture Irrigation Joint Powers Agreement	\$15,000	\$62,000	Staff expense for irrigation assistance, management of two weather stations and outreach activities.
TOTAL OTHER FUNDS:	\$115,000	\$211,400	

VII. PROJECT STRATEGY:

A. Project Partners:

The following partners are participating on the planning team. None of the partners will receive ENRTF funds. MPCA (Kevin Stroom), NRCS (Mike Walczynski, Pat Gehling), Morrison SWCD (Helen McLennan), East Ottertail SWCD (Darren Newville), MDA (Jennifer Gallus), U of M (Josh Stamper), DNR (Dan Lais, Greg Kruse). Additionally NRCS will assist with soil quality promotion and DNR is providing stream monitoring stations and access to monitoring well data.

B. Project Impact and Long-term Strategy:

Currently irrigators in areas where sustainability is a concern have no way of knowing or predicting when ground water use is reaching or exceeding sustainability thresholds and as a result do not apply enhanced or emergency remediation practices. The Conservation Irrigation Decision Support System fills that need. It will be developed so that it can be easily adapted for systems outside of Little Rock Creek that have the same need. The irrigation scheduling assistant will be provided to others at no cost and used throughout Minnesota in irrigated areas. Benton SWCD has made it a priority to assist irrigators in the Little Rock Creek watershed since the TMDL study began and it will continue to be a priority in the future. We will be providing assistance to irrigators on the use of the software and continue to promote soil quality practices that reduce water use and reduce nitrogen input to the creek in the future.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	\$ Amount
BWSR Clean Water Fund grant, Funds used to hire staff to promote irrigation best management practices in the Little Rock Creek area.	FY 2014	\$44,400 (est.)
MPCA, Little Rock Creek TMDL study	2010 - 2013	\$75,000
BWSR Clean Water Fund Accelerated Implementation grant, Working with the poultry industry to make changes to animal feed that result in reduced nitrogen and phosphorus export to the watershed.	FY 2012	\$55,410
BWSR Clean Water Fund Restoration Technical Assistance grant, Funds used to hire staff to promote irrigation best management practices in the Little Rock Creek area.	FY 2011	\$84,211

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS:

A. Parcel List: N/A

B. Acquisition/Restoration Information: N/A

IX. VISUAL COMPONENT or MAP(S): See attached graphic, project map and project banner.

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than 1-30-16, 7-30-16, 1-30-17, 7-30-17, 1-30-18, 7-30-18, and 1-30-19. A final report and associated products will be submitted between June 30 and August 15, 2019.

**Environment and Natural Resources Trust Fund
M.L. 2015 Project Budget - FINAL**



Project Title: Assessment of Irrigation Efficiencies in Benton County

Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 04h

Project Manager: Gerry Maciej

Organization: Benton SWCD

M.L. 2015 ENRTF Appropriation: \$431,000

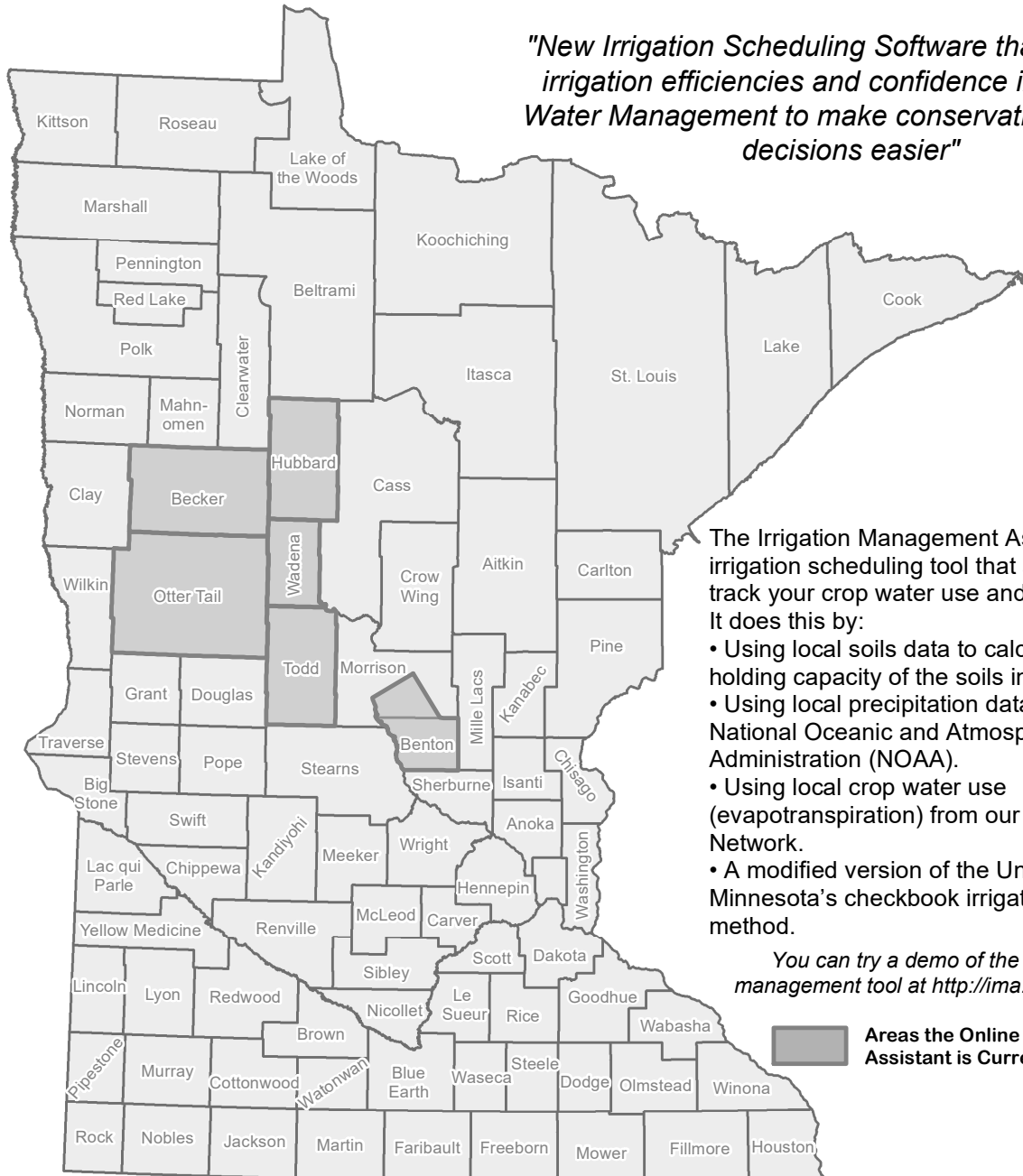
Project Length and Completion Date: 4 Years, June 30, 2019

Date of Report: June 30, 2019 - FINAL

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Activity 1 Balance	Budget	Amount Spent	Activity 2 Balance	Budget	Amount Spent	Activity 3 Balance	Budget	Amount Spent	Activity 4 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM														
Personnel (Wages and Benefits)	\$58,000	\$58,000	\$0	\$7,502	\$7,502	\$0	\$13,462	\$13,462	\$0	\$44,832	\$44,832	\$0	\$123,796	\$0
<i>Gerry Maciej, District Manager, \$35,550 (78% salary, 22% benefits), 0.38 FTE total</i>														
<i>Technicians, \$84,084 (79% salary, 21% benefits), 1.5 FTE total</i>														
<i>Administrative Assistant, \$3,680 (79% salary, 21% benefits), 0.08 FTE total</i>														
Professional/Technical/Service Contracts														
<i>TBD (competitive bid) Consultant for CIDSS development, irrigation scheduling assistant and maintenance and upgrades for both systems throughout the project.</i>				\$151,230	\$151,230	\$0							\$151,230	\$0
<i>TBD (competitive bid) Consultant for water quality/flow analysis and reporting, soil moisture equipment/rain gauge installation</i>							\$53,290	\$53,290	\$0				\$53,290	\$0
<i>TBD (competitive bid) Consultant for web presentations, on-line conferences, field days, public events and transfer of technology to other entities</i>										\$51,480	\$51,480	\$0	\$51,480	\$0
Equipment/Tools/Supplies														
<i>Water testing (\$12,310), soil testing (\$1,000), satellite telemetry for 3 DNR monitoring stations (\$12,056), soil moisture probes (\$7,180), rain gauges (\$6,000), expenses for outreach efforts (for example facility expenses for workshops, direct mailing expenses, newsletter, field day expenses, \$4,000)</i>	\$866	\$866	\$0				\$32,181	\$32,181	\$0	\$3,986	\$3,986	\$0	\$37,033	\$0
Travel expenses in Minnesota														
<i>Travel for weekly irrigation scheduling assistance, water monitoring, and outreach events</i>	\$7,475	\$7,475	\$0				\$5,576	\$5,576	\$0	\$1,120	\$1,120	\$0	\$14,171	\$0
Other														
COLUMN TOTAL	\$66,341	\$66,341	\$0	\$158,732	\$158,732	\$0	\$104,509	\$104,509	\$0	\$101,418	\$101,418	\$0	\$431,000	\$0

Online Irrigation Management Assistant Project Area

"New Irrigation Scheduling Software that increases irrigation efficiencies and confidence in Irrigation Water Management to make conservation irrigation decisions easier"



The Irrigation Management Assistant is an irrigation scheduling tool that allows you to track your crop water use and irrigation needs. It does this by:

- Using local soils data to calculate the water holding capacity of the soils in your field.
- Using local precipitation data from the National Oceanic and Atmospheric Administration (NOAA).
- Using local crop water use (evapotranspiration) from our Ag Weather Network.
- A modified version of the University of Minnesota's checkbook irrigation scheduling method.

You can try a demo of the irrigation management tool at <http://ima.respec.com/>

Areas the Online Irrigation Mgmt Assistant is Currently Available

The expansion of the Irrigation Management Assistant tool is a collaborative effort between Benton and East Otter Tail SWCD's. The RESPEC consulting firm originally developed the tool for the Benton SWCD and has continued working with local partners to expand the project. Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

IRRIGATE SMARTER NOT HARDER!

Irrigation Management Assistant.

A web-based, mobile-friendly, irrigation-scheduling app with plenty of benefits.

- Protect crop yields.
- Reduce irrigation costs
- Access to soil moisture data.

IMA.RESPEC.COM



Funding provided by the Minnesota Environment and Natural Resources Trust Fund ...as recommended by the Legislative-Citizen Commission on Minnesota Resources

INITIATIVES

1 IMPROVE IRRIGATION EFFICIENCIES



- CUSTOM FIELD IRRIGATION SCHEDULING VIA WEB
- CALIBRATING IRRIGATION EQUIPMENT
- OUTREACH ON IRRIGATION BMPs

2 IMPROVE SOIL HEALTH



- COVER CROPS, REDUCED TILL PRACTICES
- INCREASE SOIL ORGANIC MATTER
- IMPROVE SOIL WATER HOLDING CAPACITY
- REDUCE RUNOFF AND IRRIGATION DEMANDS

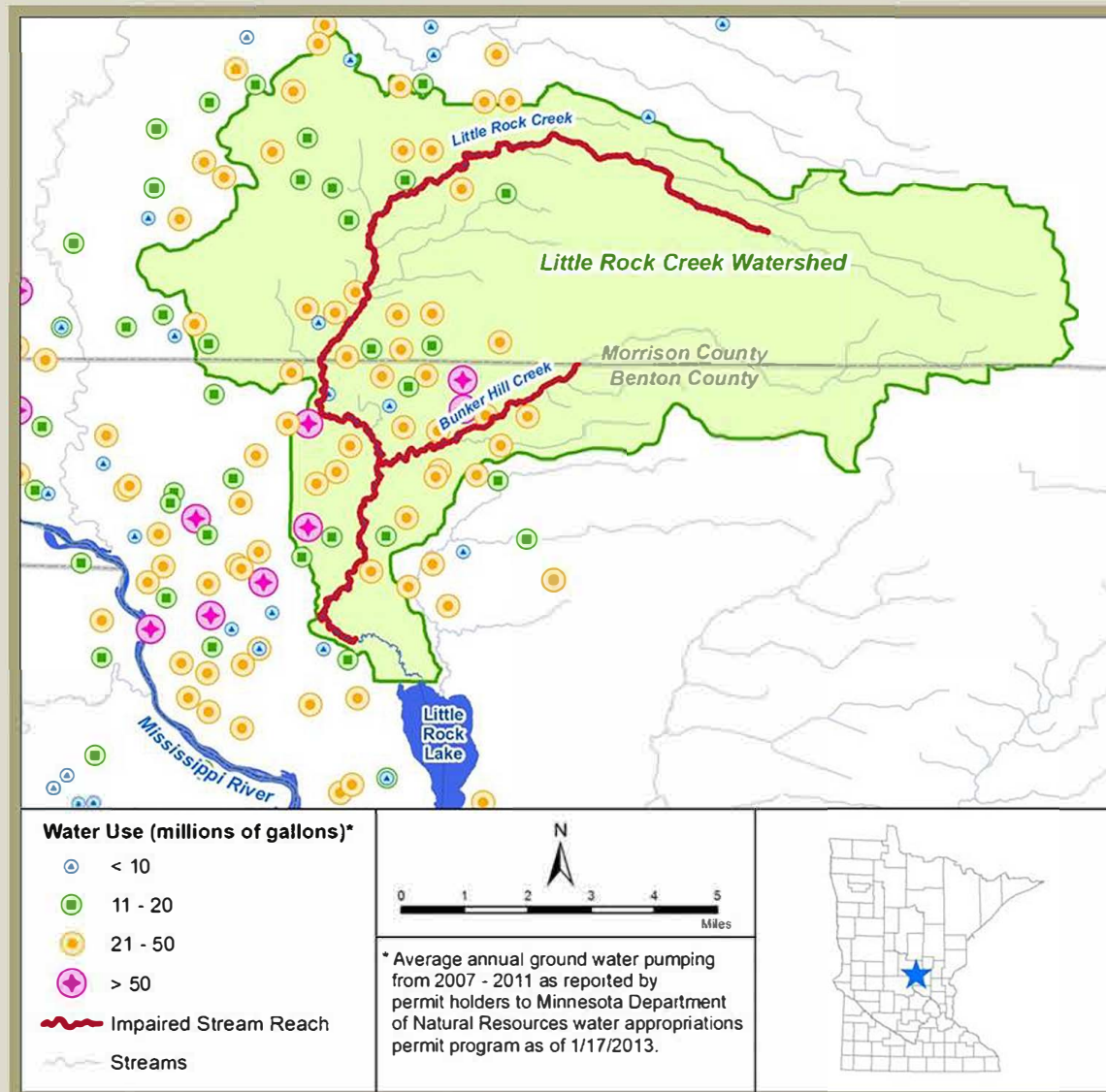
3 IMPLEMENT DECISION SUPPORT SYSTEM



- INTEGRATED FLOW, SOIL MOISTURE, FORECASTING
- REAL-TIME CONDITION APPROPRIATE IRRIGATION METHODS
- METHODS DETERMINED BY PRODUCERS

ACHIEVING MINNESOTA'S GROUNDWATER SUSTAINABILITY THROUGH IRRIGATION EFFICIENCIES

THROUGH VOLUNTARY ADOPTION OF IRRIGATION
AND SOIL CONSERVATION PRACTICES



OUTCOMES

INCREASED GROUNDWATER

- REDUCED IRRIGATION DEMANDS
- PRODUCER-DRIVEN VOLUNTARY PROGRAM

IMPROVED TROUT STREAM CONDITIONS

- REDUCED GROUNDWATER INTERFERENCE
- INCREASED STREAM FLOW
- DECREASED STREAM TEMPERATURE

IMPROVED WATER QUALITY

- LESS IRRIGATION REDUCES RUNOFF
- IMPROVED SOIL HEALTH REDUCES NUTRIENT APPLICATION AND SOIL EROSION

IMPROVED PRODUCER PROFITABILITY

- LESS IRRIGATION REDUCES ENERGY COSTS
- IMPROVED SOILS REDUCE NUTRIENT APPLICATION
- INCREASED YIELDS FROM IMPROVED SOIL HEALTH



IRRIGATE SMARTER NOT HARDER!

Irrigation Management Assistant.

A web-based, mobile-friendly, irrigation-scheduling app with plenty of benefits.

- Protect crop yields.
- Reduce irrigation costs
- Access to soil moisture data.

IMA.RESPEC.COM



**ENVIRONMENT
AND NATURAL RESOURCES
TRUST FUND**

**BENTON
SOIL & WATER**



CONSERVATION DISTRICT
(320) 968-5300
www.soilandwater.org

Funding provided by the Minnesota Environment and Natural Resources Trust Fund
...as recommended by the Legislative-Citizen Commission on Minnesota Resources”