The 10% Solution in Minnesota's Chippewa River Basin

LAND STEWARDSHIP PROJECT

Closing Report: Why 10%? Context, Approaches & Impacts

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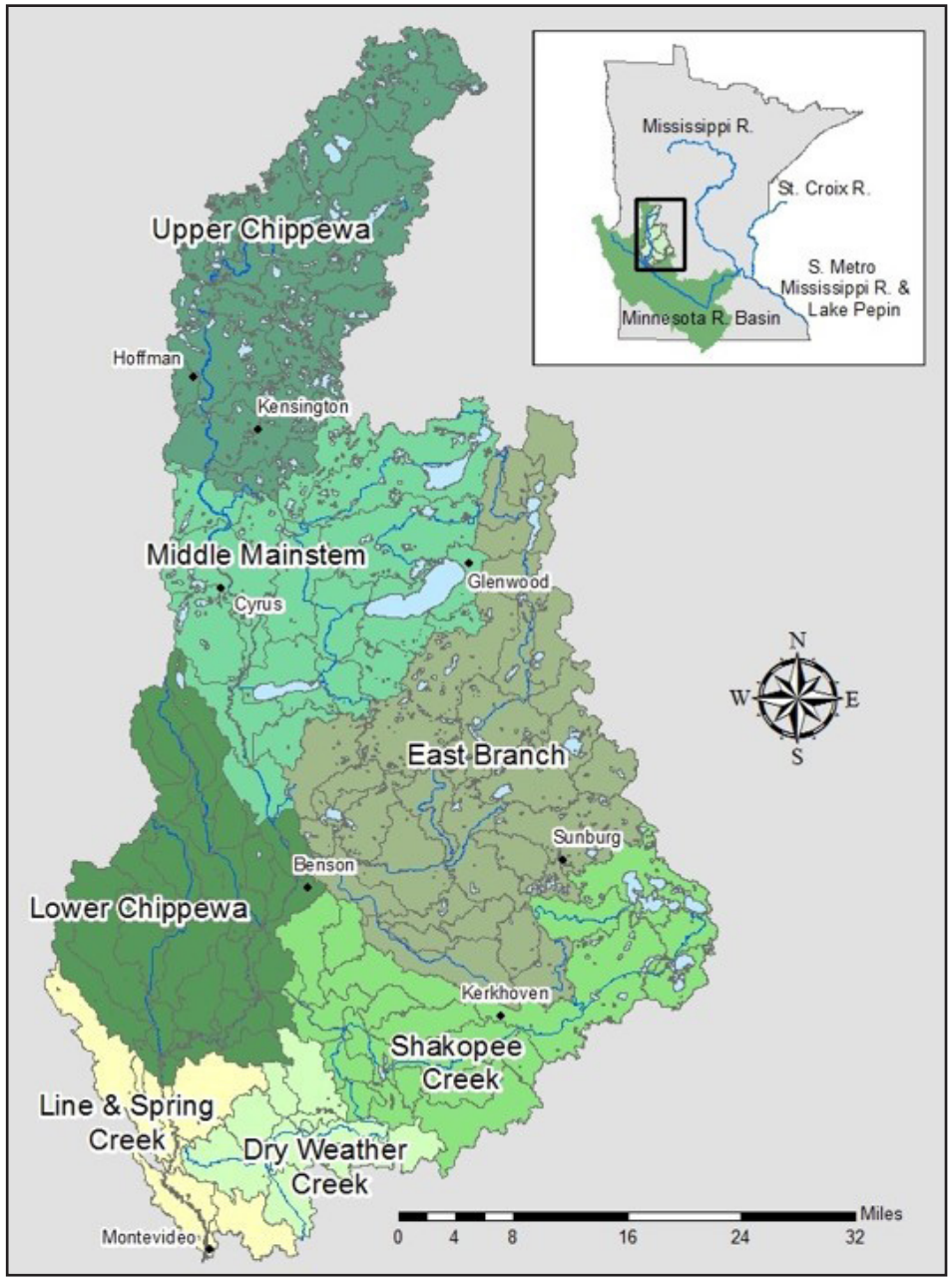


Figure 1: Map showing Chippewa River Watershed in western Minnesota. Seven sub-basins have continuous stream monitoring at the mouth, with the Chippewa River monitored by the Chippewa River Watershed Project or the Minnesota Pollution Control Agency since 1999. (*LSP graphic*)

Introduction

Dan Jenniges raises corn, soybeans, hay, small grains, and livestock in the heart of the Chippewa River watershed in west-central Minnesota's Pope County. He is one of the farmers who, through the Chippewa 10% Project, opted to integrate continuous living cover in the form of cover crops or managed rotational grazing to increase the resiliency of their farms' soils, while improving productivity. As a side benefit, Jenniges says, building soil health has decreased his farm's runoff. "Cover crops, or just the thought of having 10% cover on the land, makes a lot of sense to a livestock person, and I've used that with neighbors to get more cover crops and more grazing opportunities around me."

The Land Stewardship Project (LSP) and the Chippewa River Watershed Project (CRWP) came together to launch the Chippewa 10% Project (C-10) in 2010 to help curb the watershed's flow of polluted runoff. It was a new idea back then to set goals for acreage change that would address water quality and achieve other ecological impacts on a landscape scale, and to do so in a way that provided greater economic opportunity for farmers, especially small to mid-sized farmers on working farmland. Conservation dollars had flowed to the Chippewa River watershed, as it had other areas, for decades, and yet achieving water quality standards proved elusive. What could be done differently to move the needle?

Dan Jenniges and his cover crops.

The idea of 10% more living cover in the Chippewa River watershed focused on incorporating more continuous living cover into farming systems on working farmland. In a typical corn-soybean system, the land is only covered in vegetation for about 110 days during the growing season. With "continuous living cover" — cover crops during or after corn or soybeans, longer rotations with small grains and hay, improved grazing of livestock, or other perennial systems —vegetative cover or living roots are present year-round. To succeed would take partnerships, community involvement, farmer engagement and the integration of science by monitoring impacts, identifying sensitive fields in corn and soybeans, and predicting changes resulting from different options.

By the time the project concluded in 2018, we helped achieve significant impacts on people's lives, brought about positive landscape changes in the Chippewa River watershed, and helped spur changes in larger regulatory and political systems. This report describes the watershed, the context and approaches we used, impacts achieved, and what endures.

Chippewa River watershed mixed landscape in Pope County.

I. What was the Chippewa 10% Project?

The Chippewa 10% Project was a partnership effort that set measurable goals for engaging farmers to adopt more continuous living cover and landscape change based on monitoring, geographic information system (GIS) technology, and prediction of results. It began in a context of sky-high commodity prices and tension between farm organizations and the community.

A. The Watershed

- 1.3 million acres, the single largest tributary of the Minnesota River.
- Covers most of Pope, Swift, and Chippewa counties and splashes into five others.
- Six large sub-basins that have been sampled since 1999.
- Three-quarters of the land-use is agricultural, so farmer and landowner decisions are crucial.
- High value habitats include two state parks, and the Glacial Lakes core of remnant prairies and grasslands identified in the Minnesota Prairie Plan.
- Major lakes include Lake Minnewaska and smaller lakes such as Gilchrist Lake (a wide part of the East Branch tributary).
- Main tributaries are Shakopee Creek, Little Chippewa River, Dry-weather Creek, and East Branch Chippewa.
- Nineteen stream reaches impaired by sediment.[1]
- Although flow-weighted mean concentrations of sediments have been trending downward and are often below 65 mg/L river standard, exceedances above the standard occur frequently, causing impairments.[1]

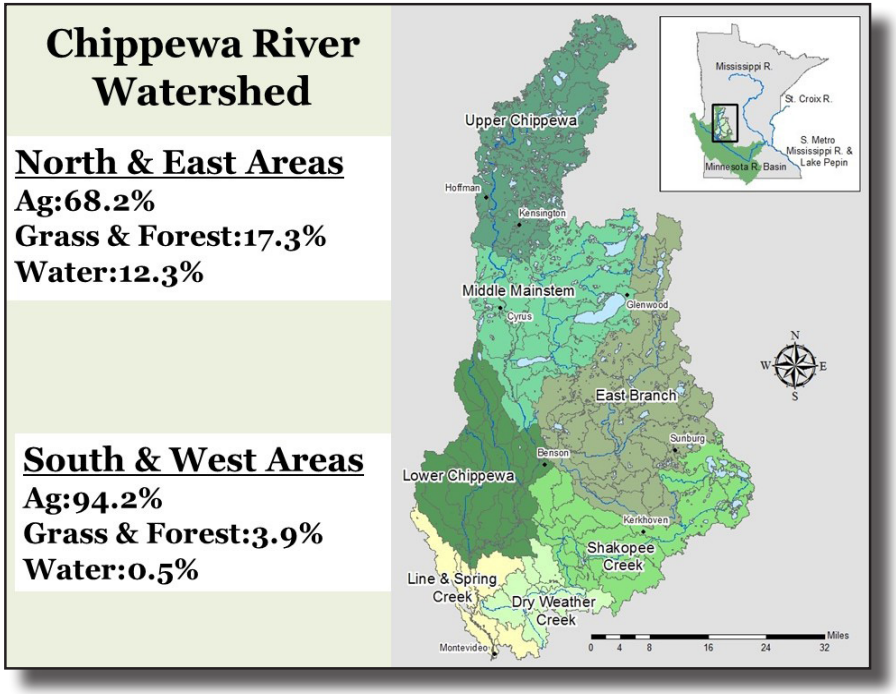


Figure 2: Corn and soybeans dominate throughout the watershed, especially in the south. In the eastern and northern sections, grazing livestock and longer crop rotations are more common. *(Pictures and GIS from LSP and map data from CRWP)*

Figure 3: Poor buffering in 2010, high flow and steep banks, exposed soil prone to runoff and cattle with continuous access to streams. (*Pictures from LSP and CRWP*)

B. Why 10%?

- Stream monitoring through 2006 by the Chippewa River Watershed Project showed that where at least 34% of the land in sub-basins was covered in plants year-round, the water met state standards for turbidity (water clarity) and total suspended sediments (soil, algae fueled by excess nitrogen and phosphorous in the water) and other contaminants[3] (Figure 4).
- Adding 10% more continuous living cover could tip the balance toward meeting clean water standards because 24% of the Chippewa River watershed was already in grass or hay, trees, other perennials, or water.
- This would help meet multiple ecological goals.
- Farmers would have more diverse crops and become more resilient in the face of economic forces and climate change impacts.

C. C-10 Goals

- Engage farmers/landowners to transition 10% of fields from annual row crops to continuous living cover (CLC) in profitable ways.
- Meet water quality standards for total suspended solids, with a 25% reduction in sediment load to 53 mg/L (p 31) and 32% of total phosphorous to 0.15 mg/L.[1]
- Enhance existing grasslands and achieve 5,380 more acres of grass in Minnesota Prairie Plan local corridor[2].

D. Partners

The Chippewa 10% Project was co-led by LSP and CRWP, with strong partnerships on the ground and the support of funders (Figure 5).

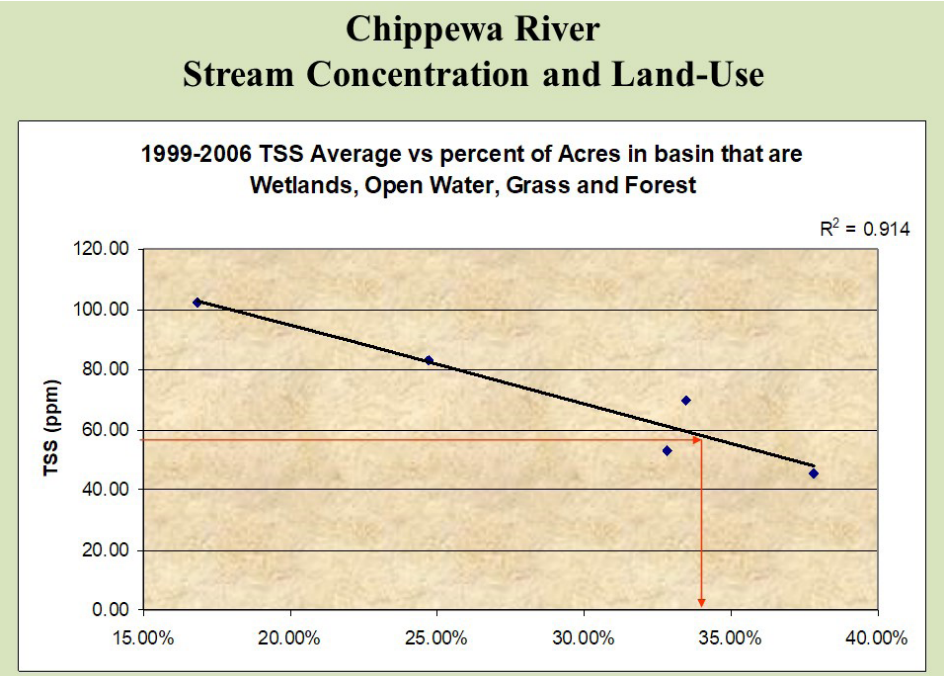


Figure 4: Correlation of stream monitoring data in 2007 report compared to perennial land cover in sub-basins, indicating that 10% more perennial cover, totaling 34%, could meet standards for total suspended solids (TSS), assuming exceedance limits also met.

Figure 5: Chippewa 10% Project Major Partners

Footnotes: 1. *Chippewa River Watershed Restoration and Protection Strategy (WRAPS) Report.* Minnesota Pollution Control Agency. Pages 25-35 wq-ws4-24a.
2. Minnesota Prairie Conservation Plan. Minnesota Department of Natural Resources.
3. Wymar, Paul. *Chippewa River Watershed Monitoring Summary 2007.* Chippewa River Watershed Project.

II. Context

The C-10 started during a time of extraordinarily high prices resulting from corn-based ethanol markets and exports focusing on corn and soybeans. Land prices were booming. The assurance of revenue via crop insurance fueled large-scale land purchases and concentration during a time of already high prices. Genetically modified crops contributed to the trend of replacing alfalfa, pasture, and small grains with corn and soybeans. Corporate agribusiness profits soared on the sales of seed, chemicals, fertilizer, and machinery as consolidation into fewer firms occurred. Commodity groups and the Farm Bureau were on the defensive as a result of agricultural pollution and the amount of food crops that were being used to produce ethanol. Common refrains we heard were that farmers "feed the world" and "it's only about the economics."

A. Agronomic Practices, Political & Economic Context

- Corn, soybeans, and other crops peaked in price in 2012 (Figure 6).
- The revenue assurance option in the federally subsidized crop insurance program also inflated land prices and incentivized the conversion of marginal land into row crops.
- From 2010 to 2013, estimated corn and soybean acres increased 4%.
- Technologies that broke down soil tilth included annual plowing, rolling before soybean planting, planting row crops year-after-year, use of heavy equipment on wet fields, and deep ripping to break up hard pans.
- In 2011, integrating cover crops into a row crop system was a "new" and untested idea.
- Managed rotational grazing for cow-calf operations was looked at with disdain. The C-10 engaged the Glacial Lakes Cattlemen's Association in introducing this more productive system to its members.

B. Natural Community Context

- The watershed is divided into six sub-basins that are monitored regularly, including near the mouth at Highway 40. We report water quality trends later.
- The Chippewa 8-digit Hydrological Unit Code (HUC) Watershed is located in the Northern Glaciated Plains and North Central Hardwood Forest Ecoregions of Minnesota. Soils are generally loamy clay and sands.
- The main resource concerns on the cropland are wind and water erosion, and flooding, resulting in cropland runoff. Associated with the cropland runoff are increased sediment and pollutant loadings to surface water.[1]
- Additional resource concerns include surface and groundwater quality (mercury, turbidity, and fecal coliform), ag waste and declining wildlife habitat.[1]
- Over 100 soil types are present in the Chippewa River basin; 41 most commonly are growing corn and soybeans. (LSP and USDA-ARS Morris Lab)
- Major bird guilds include: game birds such as pheasant, grassland passerines such as bobolink and western meadowlark, and waterfowl.

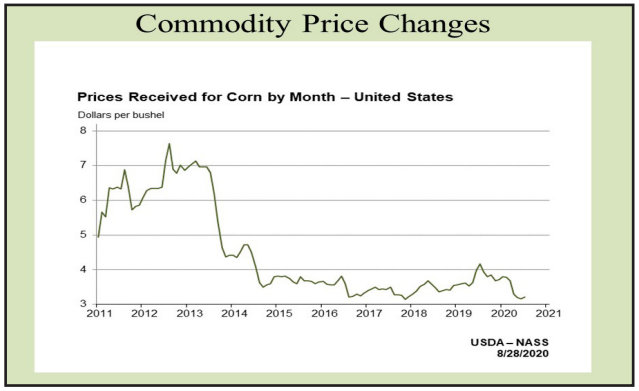


Figure 6: High commodity prices in 2010-2014 led to more acres of corn and resistance to more perennial living cover.

Pasque flower on pasture in Simon Lake area *(LSP Photo)*

Chippewa River meander *(Abdullah Jaradat)*

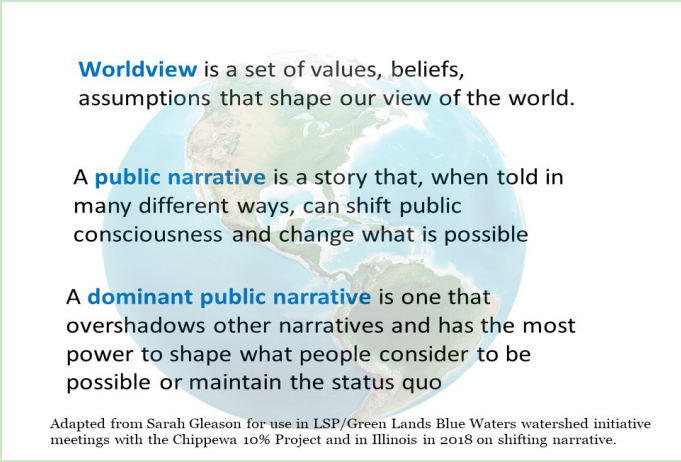
C. Human Community Context

- Excluding open water, nearly 90% of the acres within the basin are owned by private landholders.[2]
- There are about 2,300 farms. Approximately 50% of the operations are less than 180 acres in size, nearly 40% are 180 to 1,000 acres in size, and the remaining farms are larger than 1,000 acres. Sixty-four percent of the producers are full-time operators and do not rely on off-farm income.[1]
- The population totals roughly 42,500 in 32 towns and rural areas.[2]
- Prominent communities include: Brandon, Hoffman, Glenwood, Starbuck, Hancock, Benson, Kerkhoven, and Montevideo.

D. Dominant Public Narratives as Project Started

The dominant narrative in the watershed, as identified by C-10 farmers and community members, has been that:

- "Farmers should buy expensive corporate technology such as seeds, chemicals, and machines to achieve maximum yields and gross profit with the least amount of labor."
- "Farmers are good stewards of the land. Most land is owned by farmers. Great farmland is not going to change. We can replace lost fertility with technology. Water quality is fine."
- "Using the best science and the latest corporate technology is essential because it produces more food most efficiently. Technology is more important than biology. You can't stand in the way of progress."
- "Financial measurements should guide all decisions because this is the only way to measure value. Profit comes first. Land, workers, and communities are to be used in furtherance of that goal. Allowing large corporations to maximize their profits is good for all of us."
- "For years they told me, 'Someday you're going to feed the world.' And now that day is here — we have China, India, billions of mouths to feed, and they've got money." (C-10 Action Media interviews)



Footnotes: 1. Rapid Watershed Assessment Resource Profile Chippewa (MN) HUC: 7020005. 2006. NRCS
2. *Chippewa River Watershed Restoration and Protection Strategy (WRAPS) Report*. Minnesota Pollution Control Agency. Pages 25-35 wq-ws4-24a.
3. Wymar, Paul. *Chippewa River Watershed Monitoring Summary 2007*. Chippewa River Watershed Project.

III. Approaches: What Did We Do?

Partnership was essential for progress. The C-10 focused on how to build support for continuous living cover systems among farmers, community members, researchers and agency policy makers. Engaging farmers was critical and we relied on one-to-one conversations to elicit stewardship values in the context of profitable options for more living cover, connecting farmers with other farmers through events and local networks, and resource providers. Scenarios for profitable options were developed with farmer input and used in modeling. Scientific approaches included stream and field-edge monitoring, using geographic information system (GIS) techniques to identify environmentally sensitive corn and soybean fields, and models to predict the impacts if living cover scenarios were adopted on those fields.

A. Partnership/Teams

Co-conveners of the project were the Chippewa River Watershed Project (Kylene Olson) and the Land Stewardship Project (George Boody and Terry VanDerPol). Project coordinators included LSP's Robin Moore and her predecessor, Julia Ahlers Ness. A Project team met twice annually in the early years and was subdivided into "Farmer Landowner Engagement," "Science," and "Community Building" teams.

B. Farmer & Landowner Engagement

The Chippewa 10% engagement team was led by Terry VanDerPol and Robin Moore (the successor to Julia Ahlers Ness), and included Rebecca White, Andy Marcum, and Bryan Simon (LSP); Jennifer Hoffman (CRWP); Sharon Weyers (USDA-ARS); and Bruce Freske, J.B. Bright (USFWS), Jim Paulson (then with University of Minnesota Extension Service). Vital collaborators included Rich Olson (Minnesota DNR), NRCS (Jeff Duchene, Jeff Hallorman), and Pope County SWCD (Melissa Behrens). Note that similar work with landowners on cover crops, soil health, grazing, and women landowners occurred in southeastern Minnesota's Root River Watershed and was led by Caroline van Schaik and at times included David Rossman, with multiple partners.

The team:

- Engaged farmers and other landowners through 375 one-to-one individual conversations to help them speak about and exercise values of stewardship and community in the context of farm economics and to invite further participation.
- Identified participants through plat books, mapping that showed areas ripe for more perennials, conservation partners, and word-of-mouth.
- Cold-called farmers who were managing environmentally sensitive fields.
- Lifted up farmer-leaders willing to speak at or lead events, and to be quoted in blogs and articles.
- Held a few "kitchen table conversations with neighboring farmers" but found reluctance to host and invite neighbors at the beginning of the project. However, as indicated in ripple effect interviews, more farmers were eager to talk to neighbors about what they were learning by the end of the project.
- Held 52 field days or workshops with about 1,700 attending; these featured local farmers, as well as people from outside the area to introduce "new" ideas.
- Organized landowners and farmers to share ideas and visions, remove invasive shrubs and trees, and envision landscape-level grazing improvements in the Simon Lake area (a proposal to conduct planned grazing of a combined herd across private and public lands in one season did not come to fruition).
- Supported discovery and innovation through four farmer networks: 1) cover crops and soil health with the Haney Soil Test, 2) managed rotational grazing, 3) nitrogen management through corn stalk nitrate testing, and 4) women non-operating landowners.
- Partnered with NRCS and SWCD to use National Water Quality Initiative financial assistance for farmers in the Gilchrist Lake watershed to advance cover crops, managed rotational grazing, and improved filter strips in the East Branch.
- Partnered with the Pasture Project, Sustainable Farming Association of Minnesota, and Practical Farmers of Iowa to demonstrate the soil health and economic benefits of grazing cover crops.
- Engaged non-operating landowners around stewardship and how to create conservation-based leases with renting farmers.

Pasture Walk during a C-10 Field Day. *(LSP Photo)*

Farmer Jerry Morical showing his modified cover crop seeder at a C-10 cover crop field day; Robin Moore shown pointing to seed tube. *(LSP Photo)*

Grazier Greg Judy speaking at C-10 workshop. *(LSP Photo)*

Soil sampling at Jim Wulf farm field day. *(LSP Photo)*

Invasive species removal from grasslands — sumac on left before removal, cleared on right. *(LSP Photo)*

NRCS grazing specialist, Jeff Duchene, explaining results from a 2-inch rainfall simulation with and without well-manage cover and reduced tillage. *(LSP Photo)*

C-10 cover crops field day on Jim Wulf farm showing cover crops interseeded into corn. *(LSP Photo)*

C. Science to Predict Impacts, Track Change & Identify Sensitive Lands

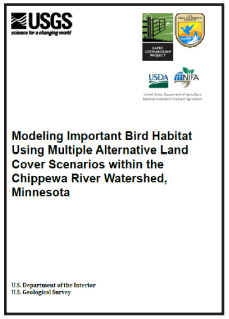
- Science Team: George Boody, Steve Ewest, Rebecca Wasserman-Olin (LSP); Paul Wymar (CRWP and later MPCA); John Westra (LSU Ag Center and later University of Nebraska); Abdullah Jaradat, Jon Starr and Sharon Weyers (ARS); Brad Heins and before him Dennis Johnson (WCROC). Jim Paulson (then with University of Minnesota Extension Service). Vital collaborator included Sara Vacek (USFWS).
- CRWP continued monitoring of six basins and the Chippewa River watershed as a whole. DNR and MPCA conducted monitoring.
- Tile monitoring at three sites on two farms (corn and manure, pattern tile with buried inlet in row crops, and surface tile inlet in row crops) for three years.
- Gilchrist Lake inlet follow-up monitoring for one year to compare to baseline.
- GIS used to identify 114,000 acres of corn and soybean opportunity fields for continuous living cover adoption that might help achieve ecological goals. We analyzed corn and soybeans parcels on Land Capability Classes (LCC) — 3>=6% slope and 4-8 — and fields in corn and soybeans within 50-feet of public waterways or 16 feet around drainage ditches as particularly vulnerable to erosion and runoff to shift to perennial systems such as managed rotational grazing, longer rotations or 10% shifts into prairie strips (Scenario C, 64,000 acres). Parcels on LCC 1, 2, and 3 <6% slope were considered well-suited for row crops and that is where we proposed cover crops (Scenario D, 50,000 acres) or reduced nitrogen use on corn (Scenario B).
- GIS-based LiDAR and Stream Power Index used to create “engagement maps” for use by organizers and farmers who requested them.
- Predicted water quality, bird habitat and economic impacts of adoption of four scenarios for continuous living cover adoption: (A) expiring Conservation Reserve Program land shifting to row crops; (B) applying 20% less nitrogen fertilizer on corn acres; (C) adoption of perennial systems, including managed rotational grazing. Several models were used. The Agricultural Production Systems Simulator (APSIM) was used by Abdullah Jaradat and Jon Starr to understand possible effects of climate change, greater continuous living cover, different cropping systems, and grazing systems on various soil types. C-10 living cover scenarios were incorporated in the Hydrologic Simulation Program FORTRAN, the MPCA’s major watershed model, to predict water quality impacts. John Westra developed an Integrated Water Quality Economic model with output from APSIM to understand economic impacts from widespread adoption of C-10 scenarios. The USGS LINK model was used to estimate impacts of scenarios for more CLC on passerine, waterfowl and game birds. InVest was used to estimate changes in habitat and soil carbon from adoption of Scenario C.
- Developed decision tools for organizers, farmers, and landowners to evaluate adoption of soil health-building continuous living cover systems, tied to soil erosion and nutrient loss impacts.

Figure 6: Paul Wymar adjusting sampler to monitor tile line drainage from a Shakopee Creek corn-soybean field. *(Paul Wymar photo)*


RESPEC

External Memorandum

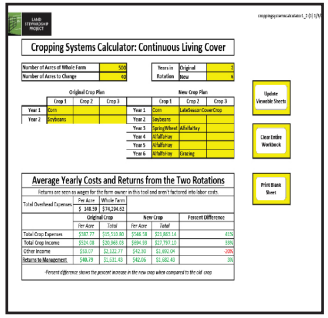
Figure 7: .Report from RESPEC integrating C-10 scenarios into the MPCA's HSPF model.


USGS

Modeling Important Bird Habitat Using Multiple Alternative Land Cover Scenarios within the Chippewa River Watershed, Minnesota

U.S. Department of the Interior
U.S. Geological Survey

Figure 8: .Report from USGS integrating C-10 scenarios into a habitat model.


Cropping Systems Calculator: Continuous Living Cover

Average Yearly Costs and Returns from the Two Rotations

Figure 9: C-10 Cropping Systems Calculator decision tool by Rebecca Wasserman-Olin, to evaluate rotations, covers and grazing.

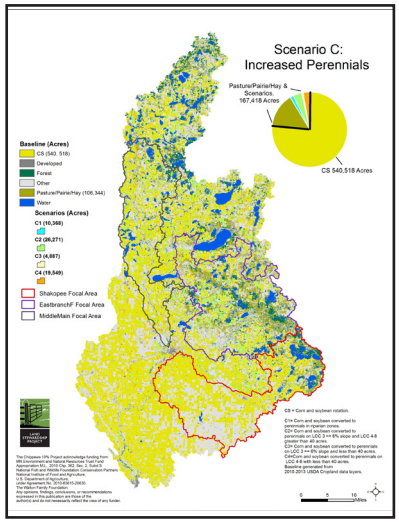


Figure 10: A map of the Chippewa River Basin showing C-10 Scenario C: increased perennial cover on high slopes and soils needing greater conservation, developed by Steve Ewest and George Boody.

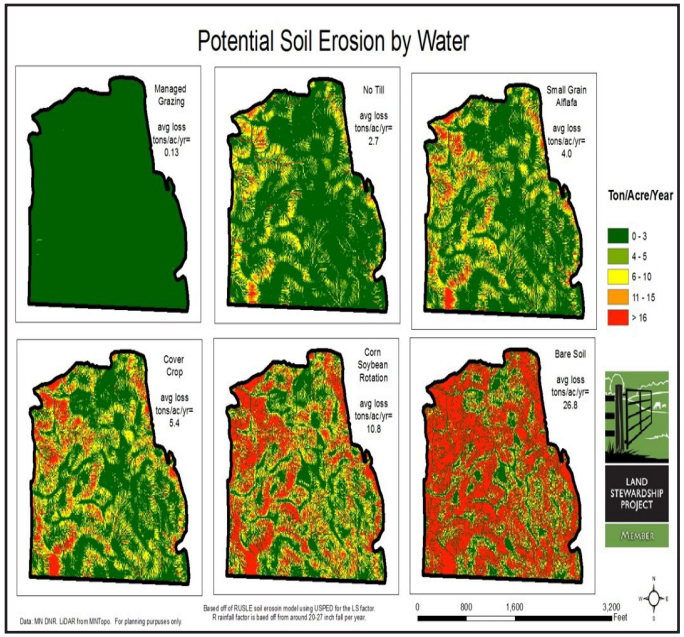


Figure 11: A map of water-caused erosion from different scenarios for cover using RUSLE in a GIS-based decision tool, developed by Steve Ewest. The average slope of this field was 6%, calculated with average rainfall of 21-25 inches per year.

D. Community-Building

Led by LSP (Robin Moore and earlier Julia Ahlers Ness), CRWP (Kylene Olson and Jennifer Hoffman); CURE (Peg Furshong and Duane Ninneman); USFWS (Bruce Freske and Sarah Vacek); University of Minnesota-Morris (Sandy Olson-Loy), the team:

- Held a community-based kick-off meeting in 2010 where they invited input on ideas and concerns.
- Listened to farmer advisers in 2010 to help develop scenarios and guide initial conversations.
- Talked about how healthy farmland and healthy habitat go hand-in-hand, and how well-managed grazing livestock can be a management tool for grasslands.
- Engaged Lake Associations and held community visioning sessions and bike rides to help people learn about farmers adopting managed rotational grazing and cover crops and how adoption of those systems protects water quality.
- Held three BioBlitz events to increase community awareness of the beneficial effects of managed rotational grazing on grassland ecology, learn about invasive fauna and flora, and monitor the health of the landscape.
- Developing initiatives related to local food at scale and use of perennials in the renewable energy burner at University of Minnesota-Morris proved elusive.
- Engaged non-operating landowners (women who live in the area, hunting landowners, The Nature Conservancy, DNR, and USFWS) to adopt soil health-building practices and/or work with cattle ranchers to manage land for more grass with well-managed grazing.
- In partnership with the MPCA, USDA, other groups, and policymakers, shared information on approach, results, and tools at Green Lands Blue Waters annual conferences, Soil and Water Conservation Society annual conference, Leadership for Midwestern Watersheds and others.
- In 2012, organized first statewide Soil Health conference (virtual and in-person); it featured North Dakota farmer Gabe Brown.

Women landowners in the Pope County NRCS/ FSA/SWCD office. *(LSP Photo)*

J.B. Bright of the USFWS and farmer Shane Blair present at a C-10 field day. The field day was held on a former soybean field Jessica and Shane Blair converted to prairie and grazing. *(LSP Photo)*

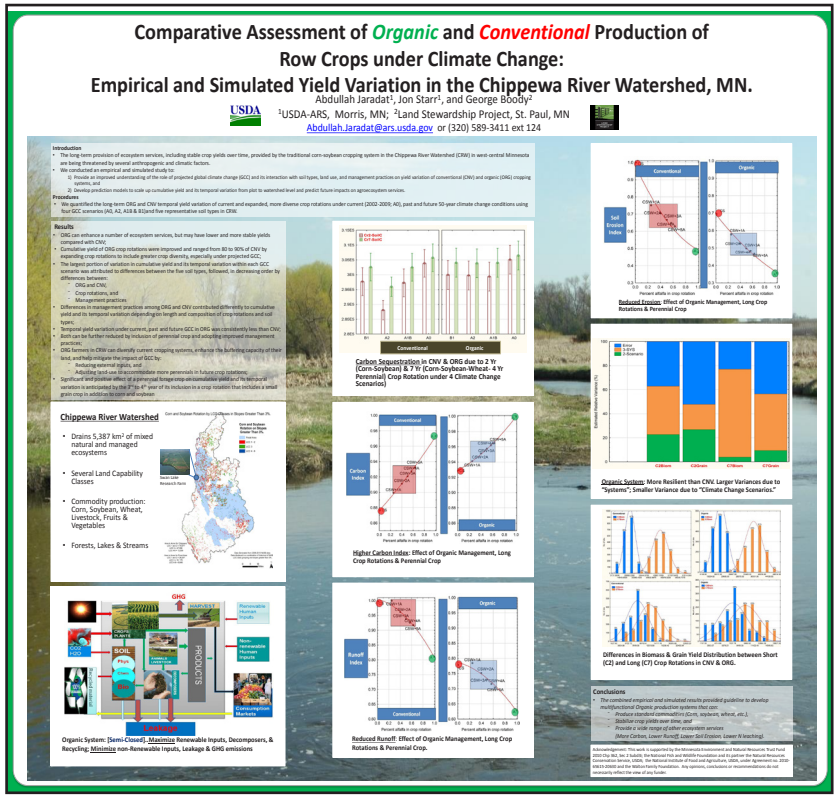


Figure 12: Poster on results from the Agricultural Production Systems Simulator model presented at the MOSES conference by Abdullah Jaradat, USDA-ARS.

BioBlitz in Simon Lake area pasture, with LSP's Amy Bacigalupo leading plant identification and Brian DeVore chronicling. *(LSP Photo)*

Farmer Andy Marcum explaining contract grazing to reclaim a recreational landowner's overgrown savanna pasture. *(LSP Photo)*

E. Challenges

- Managed rotational grazing was linked to grass-fed beef, and in producers' minds was viewed as serving an elite market. But engagement with the local cattle association helped shift understanding that rotational grazing could help improve pasture production in all types of operations.
- Funding patterns shifted for CRWP to focus more on specific BMPs or areas, versus engaging farmers more broadly.
- LSP's funders shifted focus to "I-States" losing the most nitrogen from the Corn Belt, and projects that supplement NRCS project funding.
- We were not able to reach as many farmers as desired, especially when it came to grazing along stream corridors. Proportionately, more resources for farmer engagement could have made a difference.
- Corn, soybean, and sugar beet farmers in the Shakopee Creek sub-watershed were reluctant to engage, although several leaders did.

IV. Impacts: Stories of the Difference Made

From when it was launched in 2010, until it wrapped up in 2018, the Chippewa 10% Project produced numerous positive results in the watershed. Qualitative and quantitative results are described for farmer and landowner engagement, tracking progress through monitoring and prediction, and community building. While it is not possible to isolate landscape level impacts exclusively from this project, water quality trends are shown. Predictions from modeling are provided alongside monitoring.

A. Individual Farms & Farmers

- Farmers adopted continuous living cover on 23,945 acres (Figure 13), but there was not much change in the Shakopee Creek sub-basin that is heavily corn and soybeans below a dam and lake. There was little improvement in water quality at the mouth of Shakopee Creek.
- Cover crops were adopted on 11,185 acres in the Chippewa River watershed that we tracked (Figure13).
- Managed rotational grazing was adopted on 10,509 acres (Figure 13); this practice gained acceptance with farmers and wildlife officials, helping normalize it as a livestock production and land management practice.
- Farmers adopted conservation practices such as conservation tillage or nitrogen testing on 3,199 acres (Figure13).
- Farmer-leaders reported that they increasingly talked to neighbors about cover crops and soil health; see quotes from a "ripple mapping" gathering.
- Farmers adopting innovative practices were predicted to increase net returns by $4.5 million per year using average 10-year prices and costs.

Ripple Mapping Responses

* "Cover crops and managed rotational grazing seemed odd, and now it has become more mainstream. First hurdle was hardest one."
* "I would not have been able to talk my landlord/uncle [into letting] me try grazing on his land without LSP and the C-10."
* "It took awhile to get there, but I have learned to brag about how healthy my soil is!"
* "I use the information I get from C-10 workshops and meetings — like seeds to be planted."
* "I use a lot of information I have gotten through C-10 workshops in working with other farmers."

Farmer Byron Braaten with a cover crop of tillage radish, which naturally breaks up soil compaction while providing forage. *(LSP Photo)*

Acreage Changes Through C10 Engagement	
More Living Cover	
Managed Rotational Grazing (Scen C)	10,509
CRP, WRP (Scen C)	2,251
Cover Crops (Scen D)	11,185
Sub-total	*23,945*
Best Management Practices	
Nutrient Management (Scen B)	2,124
No-Till, WASCOBs	1,075
Sub-total	*3,199*
Total	**27,144**

Figure 13: Chart of acreage changes tracked by C-10's Robin Moore and Andy Marcum resulting from C-10 farmer engagement, 2011-2017.

C-10's Robin Moore in conversation. *(LSP Photo)*

Cattle grazing being used to manage grasslands managed by the Minnesota Department of Natural Resources *(DNR Photo)*

B. Watershed & Landscape Level Impacts

The results of water quality monitoring or acreage tracking and predicted impacts from modeling are listed for each category.

- **Total suspended solids**
  - » *Monitoring:* 25% reduction in average flow-weighted mean concentration (FWMC) from 2011 to 2017 (compared to 25% reduction goal) — 52.7 ppm vs. previous 10-year average of 69.9 mg/L.[1,2] **Trend suggests goal reached.** (See Figure 14)
  - » *Modeling:* Predicted a 3.7% change in acreage (49,368 acres) from corn-soybeans to perennial production would lead to a 16.7 % reduction across the watershed.[3]
- **Total phosphorous**
  - » *Monitoring:* 30% reduction in FWMC from 2013 to 2017 (compared to 35% goal) — 0.15 mg/L vs. previous 5 years.[1,2] **Trending toward meeting goal.**
  - » *Modeling:* Predicted a 3.7% change in acreage (49,368 acres) from corn-soybeans to perennial production would lead to a 16.5% reduction across the watershed.[3]
- **Nitrate Nitrogen**
  - » *Monitoring:* Increasing FWMC from 2.1 to 2.49 gm/L in watershed as whole, driven by large contributions from Shakopee Creek (6.1 ppm) and Dry Weather Creek (7 ppm). A proposed stream eutrophication standard is 4.9 ppm, requiring reductions of 20% in Shakopee Creek.[1,2] **Trending away from goal in high corn-soybean system sub-basins.**
  - » *Modeling:* Predicted a 3.8% change in acreage (7,721 acres) from corn-soybeans to perennial production would lead to a 27% reduction of total nitrogen in Shakopee Creek.[3]
- **Perennial terrestrial habitat:**
  - » *Acreage tracking:* 12,760 acres of improved pasture, new grasslands, and wetland easements (Figure 13).
  - » *Modeling prediction:* Grassland bird guild occurrence (selected passerine species native to Chippewa River watershed) could increase by 18.47% with a shift from cultivated to grassland habitat by 54,637 acres in focal areas.[4]

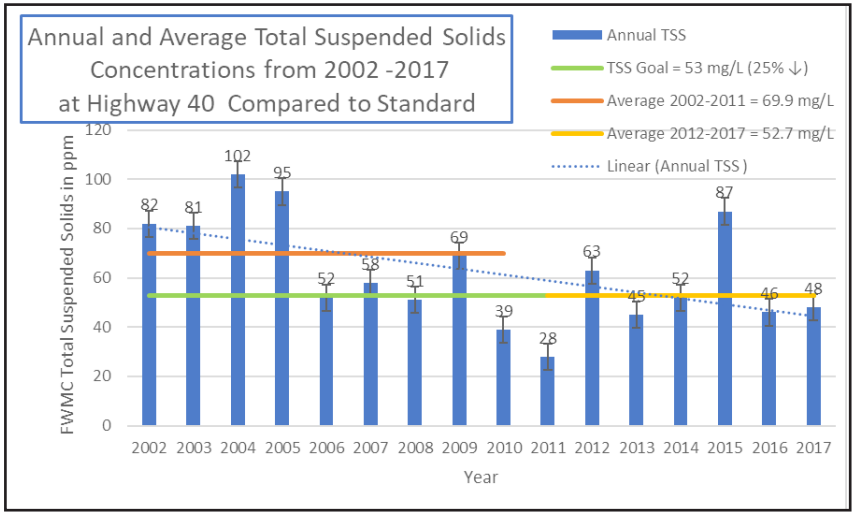


Figure 14: Water quality monitoring trends for the Chippewa River watershed for total suspended sediments, assembled from MPCA data.

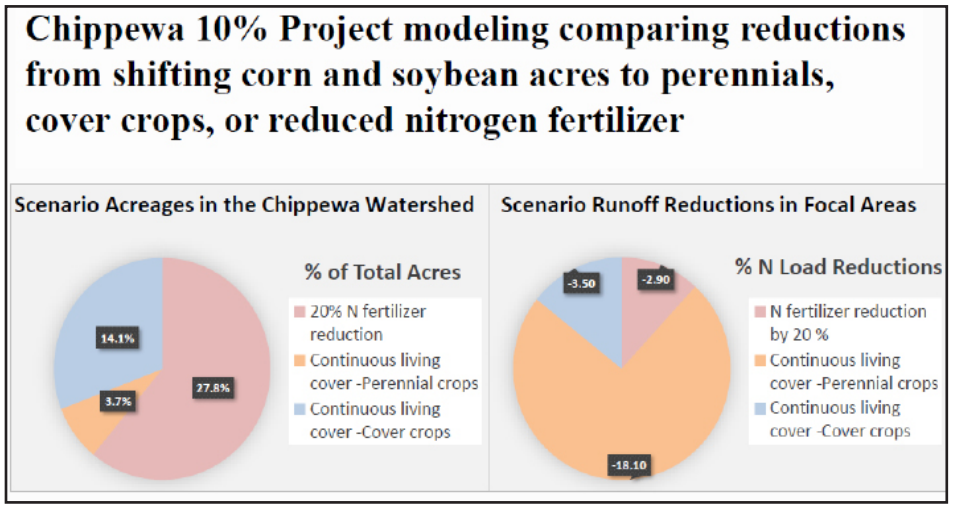


Figure 15: Predictions for nitrogen load reductions from Scenarios B-D using LSP's GIS analysis and data from RESPEC.

C. Community Building & Systemic Change

Through this project, we also influenced the public's view of innovative, soil-building agricultural practices and water quality. There is a lot more community acceptance and support for these kinds of practices as a result of the C10 Project. The engagement and community-building approaches gave permission to talk about stewardship values, along with economics. It's not either-or, but can be both. It is more socially acceptable to voice and pursue values along with profit-ability, and to have a sense of agency to find ways to turn values into action that benefits the farm, the land, and community.

Grounded narrative themes resulted from meetings centered around shifting narratives:

- » Good farming builds healthy soil. Healthy soil is connected to good nutrition and is intrinsic to the value of the land as an asset and a legacy. Good farming means leaving our land and resources in better condition than we found them for future generations.
- » Agriculture works best when it works with natural cycles and systems. This means livestock in association with humans and crops, diversity in crops and species, living cover, etc. Work with nature, rather than against it.
- » The true costs of farming, from food-production through consumption, should be transparent and accounted for. This includes fair pay to farmers and workers throughout the system, transparency of agricultural processes and their effects on the environment, and honesty with native people about historical trauma and the land.

Reflections at Final Team Meeting

* "Our hope was cattle would be used extensively as a water quality tool along streams. This did not happen on a widespread basis. But, it did in Gilchrist watershed, which helped the local Lake Association understand the beneficial role well-managed cattle can play in advancing healthy grass along and upland of streams and lakes."
* "How do you introduce community to the linkages of water quality, farming, and how systems work? One way is through the BioBlitz. It also creates access for larger community."
* "We impacted MPCA models used for analysis of all Minnesota watersheds at the 8-digit level."

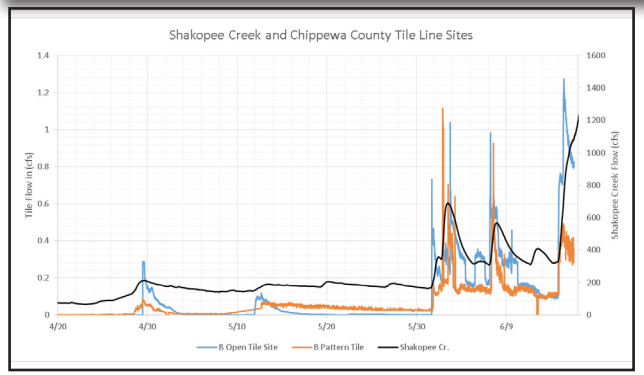


Figure 16: Monitoring showed tile line flows in a corn and soybean field coincide with Shakopee Creek stream levels (MPCA WRAPS report).

* "At MPCA, one team member gets regular calls/questions about the project. C-10 impacted the WRAPS process and other plans focusing on landscape impacts."
* "Learning how to really engage with farmers through [C-10] net-works and not just the Extension linear model has made me a better scientist."

Invasive species removal from grasslands to make management with rotational grazing possible again. *(LSP Photo)*

WCROC dairy scientist Brad Heins talking at a Chippewa 10% workshop. *(LSP Photo)*

Footnotes: 1. *Chippewa River Watershed Restoration and Protection Strategy (WRAPS) Report.* Minnesota Pollution Control Agency. Pages 25-35 wq-ws4-24a.
2. MPCA WPLMN water quality data and data from private conversation with Paul Wymar of MPCA.
3. Report from RESPEC integrating C-10 scenarios, GIS analysis and USDA-ARS ecosystem services output coefficients from APSIM; into the MPCA's HSPF model.
4. Report from USGS integrating C-10 scenarios into a habitat model.

V. What Endures

The Chippewa 10% Project has concluded, but farmer, landowner, researcher, and agency leaders who participated are talking with others about the possibilities for improving soil health through more living cover and reduced disturbance from tillage and chemicals. The project influenced how they think about and use living cover on their farms or in their work, and how they relate to others. Here are few kernels about what endures.

A. Farmer-leaders Talking to Neighbors, the Media & Others

- A SARE grant led to farmers investing in cover cropping equipment and continuing to plant those cover crops.
- The ripple effect: farmers talking to neighbors to encourage improved soil health through cover cropping and other practices. Examples:
  - "Water Quality & Farming: Looking for the Long View," by Robin Moore, provides a firsthand account of how farmer Dan Jenniges influenced a neighbor on the spot.
  - Jim Wulf asked neighbors to grow cover crops so he would have additional grazing for his cattle.
  - Jess Berge bought cover crop seeding equipment and does custom work.
  - Byron Braaten talked with neighbors about his experiences with the C-10 and, after using the Cropping Systems Calculator to evaluate economics using his own numbers, increased pasture acres from 20% to 30% of his land base.

"Pope County, at the request of a C10 farmer-leader, included in their new comprehensive plan a goal to work toward 'an increase in soil organic matter,' and discussed ways to potentially link it to regulation." — *from Ripple report and final team meeting*

Farmer John Lederman showing women landowners how cover crops improve soil health. *(LSP Photo)*

LSP's Brian DeVore talking with farmer Dan Jenniges and the USFWS's J.B. Bright for a podcast called Cattle, Cover, and Conservation. *(Rebecca Wasserman-Olin Photo)*

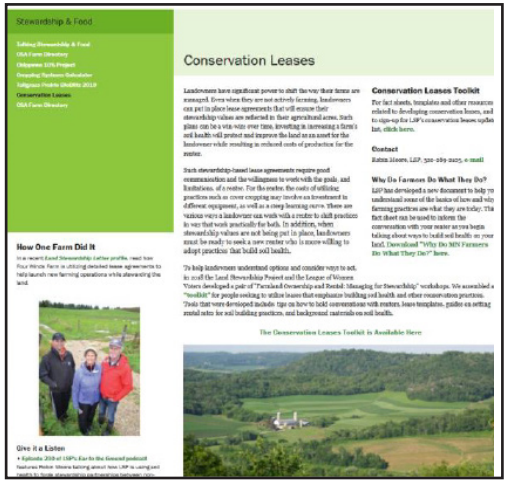
Conservation grazing on left and no grazing on right in prairie country in Pope County. *(LSP Photo)*

B. Events & Outreach Continue

- The BioBlitz, after being coordinated in previous years three times by the C-10, continued in 2019 under the sponsorship of other community groups.
- The annual soil health tour in Pope County continues.
- Observation suggests there is more cross-fencing and managed rotational grazing is becoming the norm in the watershed.
- Agency partners expanded outreach in new ways in conjunction with the C-10. LSP continues to be asked to partner to expand impact and reach.
- Soil scientist Sharon Weyers is working with other partners on soil monitoring, and continues to work with LSP on "Renting It Out Right" workshops.
- Soil health is being more widely embraced with each passing year. In 2012, the C-10-convened the first statewide combined in-person and virtual soil health conference, which featured farmer Gabe Brown, NRCS, and other agencies. That conference, combined with the local on-the-ground work, kick-started soil health activity across Minnesota. The Sustainable Farming Association of Minnesota holds an annual Midwest Soil Health Summit and has an active soil health program, and numerous other soil health initiatives are active in NRCS, the University of Minnesota and more.
- "Renting It Out Right" got started during the life of the C10 and Root River work and has evolved into a more robust effort that includes workshops, individual assistance, and the Conservation Leases Toolkit. This is in conjunction with LSP's Soil Health Program.
- Decision-tools generated or upgraded through the C-10 continue to be downloaded. The Cropping Systems Calculator has been downloaded over 300 times, along with the Monitoring Tool Box (139) and the Conservation Leases Toolkit (83 before tracking stopped).

Robin Moore leading a Renting It Out Right workshop in 2019. *(LSP Photo)*

Sharon Weyers, USDA-ARS, soil sampling with farmer Mark Halls. *(LSP Photo)*



LSP Conservation Leases Toolkit web page.

"I learned as much from farmers as they learned from me. It takes effort to get out of the analytical mindset and talk to them at their level. With Robin's help and with farmers' help I learned how to do this. Some of my colleagues have yet to learn some of these things." — *Sharon Weyers, USDA-ARS*

C. Organizational Efforts Carrying Forward

- Agencies embraced greatly expanded living cover as a conservation strategy. The C-10 effort to set quantitative change goals while integrating science, soil health, and living cover on working farmland through cover crops, longer rotations, and shifts to managed rotational grazing had a significant impact. Targeted farmer outreach informed by modeling and tracking changes were also effective. Examples of agency/institutional impacts:
  - » The Minnesota Pollution Control Agency's 2014 Minnesota Nutrient Reduction Strategy.
  - » The Minnesota Environmental Quality Board's Minnesota Climate Strategies and Economic Opportunities 2016 report.
  - » Beyond the Status Quo: EQB Water Policy Report in 2015.
  - » Green Lands Blue Waters developed a watershed initiative.
  - » NRCS-Minnesota formed a watershed subcommittee of the State Technical Committee and developed Watershed Selection Criteria for programs, co-chaired by George Boody.
- The C-10 underscored the need to build on University of Minnesota resources for managed rotational grazing such as the Organic Pasture Dairy Research program at WCROC, including grazing of Kernza.
- LSP's Soil Health Program is extending LSP's soil health efforts significantly. The C-10 and Root River work helped create a foundation for cover cropping and other soil health practices in southeastern and western Minnesota.
- The C-10 helped make the case for the USDA Agricultural Research Service to include the Chippewa River basin and the work of the Morris USDA-ARS laboratory in its Upper Mississippi River Basin Long Term Agricultural Research.

"One thing I appreciated is that we did something unique and innovative and many of my peers in the academic setting are now trying to replicate that approach in their own work. It's difficult at times and frustrating. Partnerships that developed as a result of this introduced me to some people I didn't know or vice-versa, and it led to the robustness and importance of our work together." — *John Westra, University of Nebraska*

"I joined the project as an assistant professor. The C-10 project helped frame research done in the last few years such as grazing cover crops here at the station, on farms, and in Iowa and Pennsylvania based on some ideas from this project. Integrating crops and grazing livestock drives a lot of things." — *Brad Heins, WCROC*

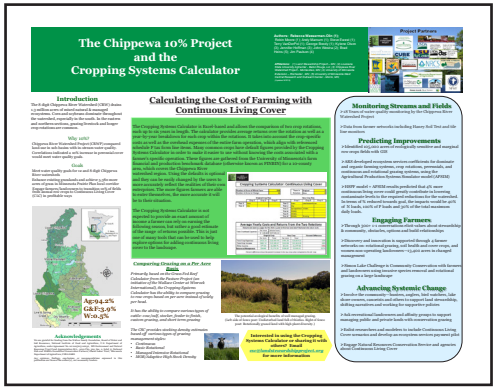
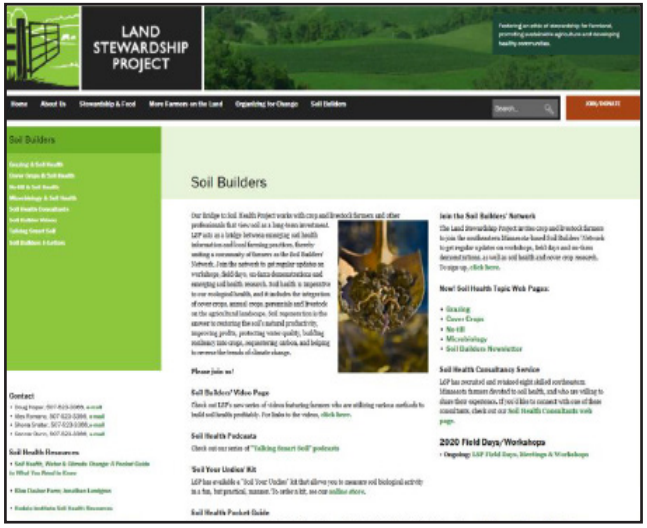


Figure 17: C-10 poster at the Minnesota Buffer Symposium meeting in 2018.

"That door [using managed rotational grazing as a tool for managing grasslands] is getting cracked open wider. We went through the same battles early in my career about burning. It took a long time. Grazing is the same — it is getting better. We are making progress." — *Bruce Freske, USFWS*

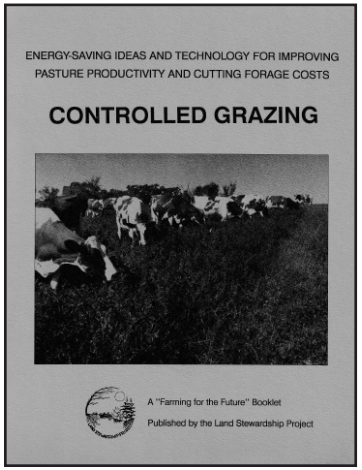


LSP Soil Builders web page.

VI. C-10 Building Blocks

A strong foundation of specific programs and relationships dating back to the 1980s led up to the Chippewa 10% Project. For example:

- LSP's organizing of farmers and particular projects from the 1980s up to 2009. LSP helped organize the precursor to the Chippewa River Watershed Project.
- CRWP's stream monitoring since 1999, geographic information systems analysis, enrollment of farmers in best management practices, and involvement of partners in the watershed such as SWCDs, NRCS, and others. CRWP assisted with the Minnesota Pollution Control Agency's efforts to calibrate the Hydrologic Simulation Program FORTRAN watershed model for flow and stream concentrations.
- The Minnesota Institute for Sustainable Agriculture co-sponsored the Monitoring Project and the Sustainable Farming Systems Project that included field-edge monitoring and modeling in the Chippewa River basin.
- The USDA-ARS Morris lab researched comparisons between corn and soybeans, diverse rotations with perennials and grasses. This plot data were used to calibrate the Agricultural Production Systems Simulator model used to evaluate climate impacts and generate ecosystem service coefficients for other models. The soils work included soil carbon tracking.
- John Westra, with George Boody, conducted modeling on LSP's Multiple Benefits of Agriculture project, including a study area in the Chippewa Basin.
- The late dairy scientist Dennis Johnson, followed by Brad Heins, researched rotational grazing at WCROC and knew farmers in the watershed. Terry VanDerPol worked with Johnson on the Sustainable Livestock Project, which monitored farms in the Chippewa.
- These streams of data and expertise, plus GIS land cover analysis by Steve Ewest and George Boody, farmer cost and return data for grazing and diverse farms collected by John Westra, and scenarios generated with farmers by Julia Ahlers Ness, were used by John Westra to develop an Integrated Economic Water Quality Model to analyze costs alongside ecological impacts.
- Relationships with agency leaders, researchers, and funders around the country were leveraged to aid the project and in turn were influenced by the approaches used in the project. Richard Warner of Green Lands Blue Waters amplified C-10 as part of its watershed focus. The NRCS's National Water Quality Initiative and Mississippi River Basin Initiatives were avenues to amplify the project.



A 1992 LSP publication on managed rotational grazing.


PAGE 12—LEWISTON JOURNAL, Lewiston, Minn. - Tuesday, January 25, 1994

Intensive grazing workshop to be held

A "how to get started" workshop on management intensive grazing will be held at the United Methodist Church in St. Charles on Jan. 27 and Jan. 28.

The two-afternoon practical, how-to workshop will give livestock producers the opportunity to explore and discuss this innovative, rapidly-growing technology that is being adopted by profit-oriented dairy beef and sheep producers. The workshop runs from 1 p.m. to 4 p.m.

Management intensive grazing can increase profitability, reduce workload and improve pasture productivity. Workshop topics will include: paddock layout and design, new fencing products, animal nutrition on pasture and low cost pasture renovation options.

According to workshop instructor Richard Ness, "The goal of this workshop is for farmers to be able to develop a management intensive grazing plant that fits their farm. They'll have the knowledge to make sound investments in fencing materials and watering systems and have the ability and confidence to get started with management intensive grazing this coming spring."

Ness, Education Project Director of the Land Stewardship Project, has conducted on farm research and helped farmers get started with management intensive grazing for ten years. He will be joined by Art Thicke, a dairy farmer from LaCresent with seven years successful management intensive grazing experience.

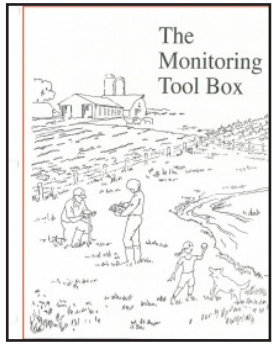
The workshop is being conducted by the Land Stewardship project. To register for for more information, call the LSP office in Lewiston at 523-3366.

A 1994 article on an LSP managed rotational grazing workshop.

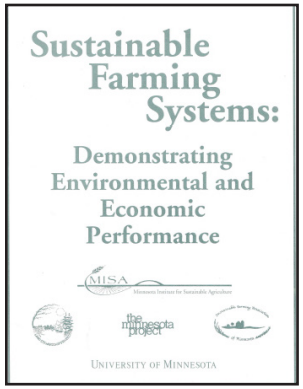

Resource management is high-light of seminar

St. Charles Press
February 15, 1994

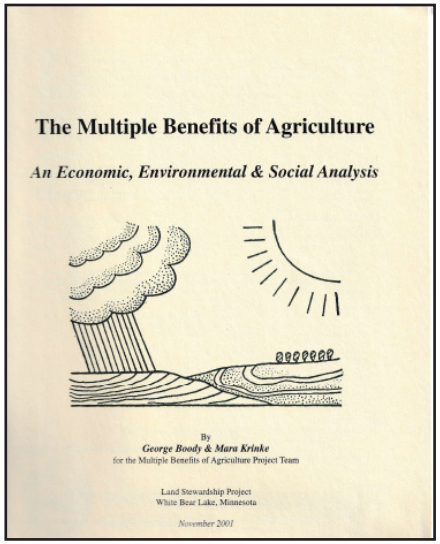
A 1994 article on an LSP Holistic Management course.



A 1998 LSP publication from the Monitoring Project, which focused on on-farm observation of grazing operations practicing Holistic Management.

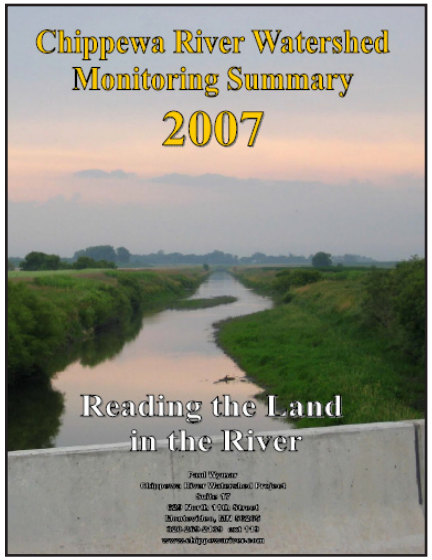


Minnesota Institute for Sustainable Agriculture monitoring and modeling report, 2002.



LSP Multiple Benefits of Agriculture report on the modeling of living cover in areas like the Chippewa River basin, 2001.

BioScience paper describing the results of modeling of increased living cover in areas like the Chippewa River Basin, 2005.



CRWP stream monitoring report from 2007 correlating pollutant concentrations with percent of perennial cover, 2007.

Paper on grazing in the 2009 Soil and Water Conservation Society publication, *Farming With Grass*.

Terry VanDerPol utilizing concepts from the *Monitoring Tool Box* to lead an LSP Farm Beginnings class on monitoring, 2010.

Abdullah Jaradat, USDA-ARS, speaking in 2009 at the Jim and LeeAnn VanDerPol farm about agriculture and climate change. He is showing data from long-term research plots.

WCROC web page with report on grazing cover crops, 2015.

VII. Appendix

A. Acknowledgments

We thank the project partners listed on pages 7-11 for participating in the project utilizing their expertise, connections, and insights. Thank you to Brian DeVore for editing. The opinions expressed in this report are those of the authors and are not necessarily those of team members, partners, or funders. Those include and included people from the following institutions:

- Chippewa River Watershed Project
- Louisiana State University Agricultural Center/University of Nebraska
- Morris Wetland Management District, U.S. Fish and Wildlife Service
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- North Central Soil Conservation Research Lab at the USDA's Agricultural Research Service in Morris
- University of Minnesota-Morris
- University of Minnesota Extension Service
- West Central Research and Outreach Center at the University of Minnesota-Morris

Project partners who collaborated and helped in specific ways:

- Clean Up the River Environment
- Green Lands Blue Waters
- Pope County Soil and Water Conservation District and later, Swift County and other Soil and Water Conservation Districts
- USDA Natural Resources Conservation Service in Pope County

Funding Partners

- Environment and Natural Resources Trust Fund through the Legislative-Citizen Commission on Minnesota Resources, State of Minnesota and Minnesota Legislature
- Minnesota Board of Water and Soil Resources (Clean Water Land and Legacy funding) through the Chippewa River Watershed Project
- Minnesota Department of Agriculture
- Mortenson Family Foundation
- National Fish and Wildlife Foundation
- National Institute of Food and Agriculture, United States Department of Agriculture
- Sustainable Agriculture Research and Education Program of USDA
- Walton Family Foundation
- Working Lands Initiative in Pope County

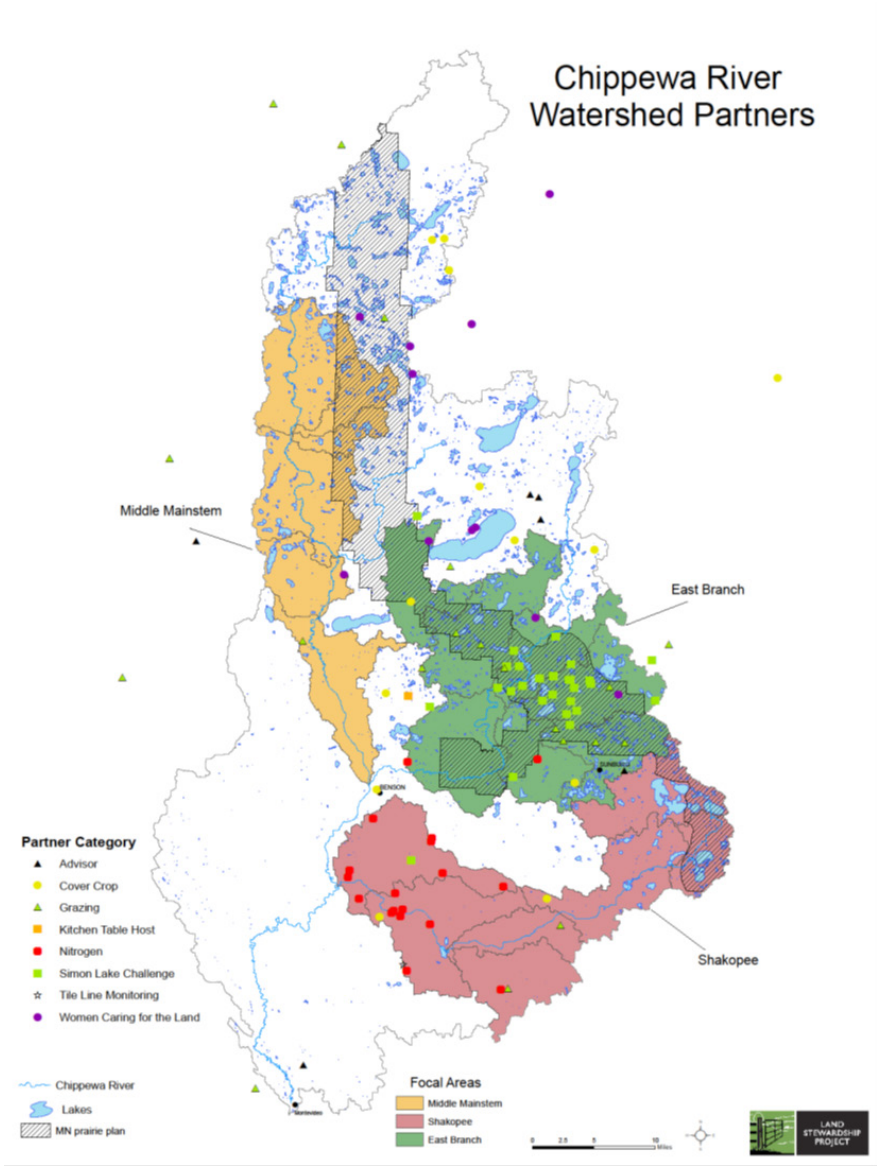


Figure 17. Map of C-10 focal areas and farm partners in 2016.