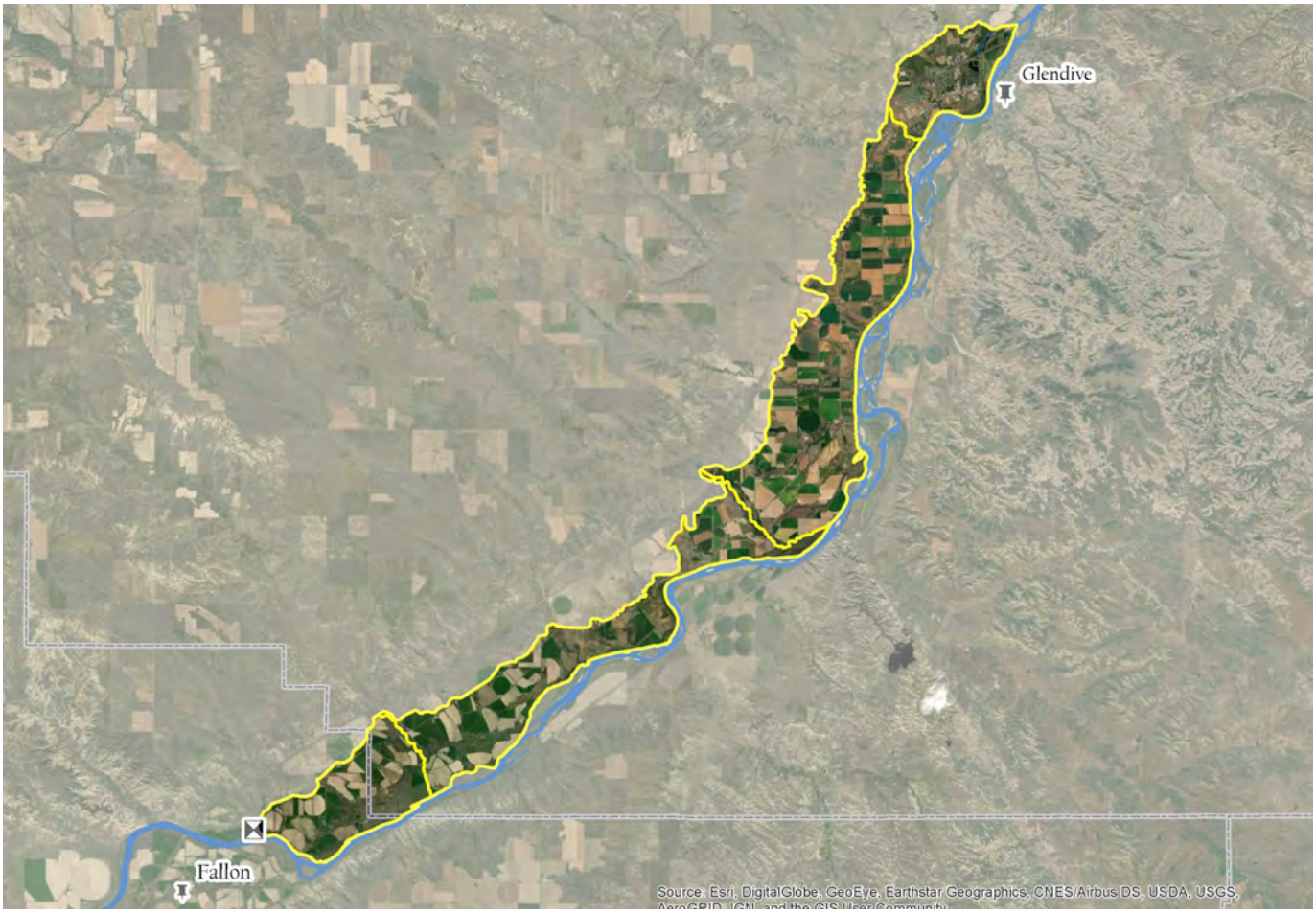
DAWSON COUNTY IRRIGATION WATER EFFICIENCY IMPROVEMENT TARGETED IMPLEMENTATION PLAN

MONTANA FOCUSED CONSERVATION STRATEGY

SUBMITTED BY: GLENDIVE FIELD OFFICE



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Irrigation Water Efficiency Improvement Project Proposal

Goal Statement

As outlined in the Dawson County Long Range Plan, *Source Water Depletion—Ineffective Irrigation Water Use* is a priority resource concern that was identified by the Local Working Group in 2019. The goal of this project is to address that resource concern by improving on-farm irrigation water use efficiency and converting surface flood irrigation systems (graded furrows and borders) to sprinkler systems, largely center pivots, on existing irrigated cropland under the Buffalo Rapids Irrigation Project (BRIP) in Dawson County. Landowners/producers will additionally receive assistance with irrigation water management to ensure efficient water use by using soil moisture monitoring tools and checkbook methods to help them make irrigation decisions. Conversion to more efficient irrigation systems will also result in decreased soil and water erosion, decreased tillage requirements, and increased soil structure and organic matter. The geographic focus for this project is the Buffalo Rapids Irrigation Project District #1. The irrigated cropland area totals 14,870 acres, on the north side of the Yellowstone River Drainage.

Project Background and Background Information

The Buffalo Rapids irrigation project was constructed by the U.S. Bureau of Reclamation between 1937 and 1950. It was designed to divert water from the Yellowstone River for irrigation. The project was the result of a cooperative effort of several federal agencies that started during the Great Depression, and it played an important role in fostering permanent settlement and a stable economy for the local area. Irrigation water was first turned into the Glendive unit in 1940. All the water for this project is diverted from the Yellowstone River at two pump sites. The main pump site has three pumping plants and the second site, located approximately midway on BRIP system contains two pumping plants. The system consisted of one main earthen canal feeding several earthen lateral ditches that delivered water to each farm. From that point it was the landowner/producer responsibility to distribute the irrigation water to each field on the farm. For over 60 years, the BRIP and producers have suffered from inadequate water quantity and water quality problems as well as water delivery issues.

Over the last 20 years, there has been a persistent interest and much progress by producers and BRIP to improve the on-farm irrigation

efficiencies by converting surface flood irrigation systems to center pivot sprinkler irrigation systems and eliminating seeping, open earthen field and lateral ditches, replacing them with buried pipeline. The utilization of a more efficient irrigation system allows producers to increase crop yield through more efficient water use, decreased erosion of their land, and a more uniform and timely water application approach that can also provide landowners with labor savings that benefit their overall livelihood. The local irrigated producers and BRIP have historically utilized Environmental Quality Incentives Program (EQIP) financial assistance and NRCS technical assistance to help them in their efforts. An estimated 90% of landowners/producers within the proposed project area have expressed interest in such improvements on their land in previous years or moving forward.

In 1998, NRCS had a Priority Area Initiative to deal with erosion from the canal, open earthen laterals, and on-farm graded furrow irrigation. The local irrigation farmers and BRIP District #1 & District #2 participated in this initiative. District #1 (Glendive Unit) has 14,787 acres of irrigated cropland, beginning north of Fallon, on the north side of the Yellowstone River and running to just north of Glendive. District #2 (Terry & Shirley Units) has 10,593 acres of irrigated cropland and begins 17 miles east of Miles City and goes east to Fallon on the south side of the Yellowstone River.

Another benefit of converting surface flood irrigation systems to sprinkler systems is the decreased need for tillage, to such an extent that no-till may even be an option for some producers. Flood irrigation methods using graded furrows require residue be tilled down to allow irrigation water to flow from the head of the field to the bottom of the field without picking up excess residue that can force water to break over to the next furrow, negatively affecting crop production. Removal of residue for flood irrigation can also leave soil unprotected from wind and water erosion. With sprinkler irrigation, large amounts of residue do not create a hinderance to irrigation.

In 2007-2008, there was a Special Reduced Tillage project funded by NRCS with the Dawson County Conservation District as a partner to reduced intensive tillage operations and the equipment to manage the reduced tillage operations. The producers reduced tillage trips previously used in conventional tillage, from 13 trips down to at least 4 trips. The results of the special project demonstrated that the producers' fuel consumption was cut in half of what they used to need to grow their irrigated crops, a reduction amounts of fertilizer used, and fewer hours on their equipment. It also mostly eliminated the need for moldboard plowing and residue burning practices. The project was later offered in counties adjacent to Dawson County due to the success seen by local producers.

Problem Statement

The Glendive NRCS Field Office, local irrigation farmers and BRIP District #1 would like to continue to improve the delivery systems on the remaining open earthen ditch laterals to on-farm systems, which will reduce the inefficiencies caused from water erosion and seepage. Soil and water erosion caused by surface flood irrigation and intensive tillage will be reduced by converting to sprinkler irrigation systems. This project will take place on irrigated cropland in Dawson County. See attached project area map (Page 11).

The Dawson County Long Range Plan (2019) and Local Working Group compiled a suite of natural resource concerns in the county. This proposal seeks to address one major concern listed within the Long-Range Plan, water quantity and quality, and meet the desired outcomes of converting the highest eroding earthen laterals to irrigation pipeline, to convert flood irrigation systems to sprinklers, and to provide education about irrigation water management.

Farming production is limited by irrigation water availability to meet crop needs during the crop peak consumptive use period. This is during July to mid-August for most crops. Crop yields are reduced 10 to 20 percent depending on the existing on-farm irrigation system.

Farm Irrigation Rating Index (FIRI) calculations for land being converted from surface flood method to center pivot irrigation has shown a FIRI calculation averaging 20% estimated water savings or approximately one acre-foot per acre per year. Application efficiency for surface flood irrigation is approximately 55% and a center pivot sprinkler system has an average application efficiency of 77%.

Furrow erosion is induced through soil particle detachment during surface irrigation Furrow erosion is estimated to be 10 tons per acre per year on the row crop acres, well in excess of the soil loss tolerance (generally 5 tons).

Historically, intensive cropping systems and operations on small/grain/sugar beet rotations, as well as a lack of irrigation water management has degraded soil quality in terms of organic matter depletion and soil compaction. Soil Conditioning Indexes (SCI) in rotations containing row crops (sugar beets, dry beans, corn) using intensive tillage are often negative, indicating a loss of organic matter. Both wind and furrow soil erosion have been a resource concern on irrigated cropland. This issue has been caused partly from intensive tillage practices used on irrigated cropland, as well as a lack of irrigation water management. Average Soil Tillage Intensity Ratings (STIR) for row crop rotations are anywhere from

21-95 (the higher the number the more soil disturbance).

The continued loss of organic matter, primarily due to intensive tillage, results in more water use and higher input costs. A well-functioning soil (i.e. indicated by higher organic matter levels) will infiltrate and store water, reducing water use, and cycle nutrients such as nitrogen and phosphorus, reducing inorganic fertilizer costs. In addition, less tillage means lower fuel and labor costs. According to "Economics of Reduced Tillage in Sugar Beets[1]," the average savings was $81/acre and 1 hour/acre of labor when producers switched to a reduced till beet system. In addition, erosion was reduced from 3.1-11.3 tons/acre to 0-2.2 tons/acre.

Figure 1 shows recent, local examples of surface flood irrigation systems that were converted to sprinkler irrigation systems. These values were determined using the Wind Erosion Prediction System (WEPS).

Figure 1—Local WEPS Examples of Soil Loss and Soil Health Before & After Sprinkler Irrigation

Example 1 - Flood to Pivot; Soil Loss Tolerance = 5 tons/acre/year			
	Current	**Pivot**	**Pivot**
Crop Rotation	**Beets / Barley**	**Beets / Barley / Corn**	**Beets / Barley / Cover Crop / Corn**
Soil Erosion (tons/ac/year)	144	2.9	2.8
Average STIR	65.6	25.2	33
SCI	-10.9	0.5	0.6
OM subfactor	0.28	0.59	0.92
Example 2 - Flood to Pivot; Soil Loss Tolerance = 5 tons/acre/year			
	Current	**Pivot**	**Pivot**
Crop Rotation	**Alfalfa Seed / Spring Wheat / Soybean**	**Alfalfa Seed / Grain Corn / Soybean / Wheat**	**Alfalfa Seed / Grain Corn / Soybean / Wheat/ Cover Crop**
Soil Erosion (tons/ac/year)	0.7	0	0
Average STIR	38.2	10.3	7
SCI	0.3	0.5	0.5
OM subfactor	-0.3	-0.21	-0.06

[1] Ruffin, Lakeitha and Tallman, Susan. Economics of Reduced Tillage in Sugar Beets. January 2017. Montana USDA-NRCS

Goals and Objectives (Desired Future Conditions)

The primary goal of this proposal is to address inefficient use of irrigation water. Additionally, this proposal will help to reduce tillage operations on irrigated cropland and reduce the amount of soil erosion caused by wind and water. These items will be measured though various methods such as flow meters to measure the amount of irrigation water being delivered to the pivot, checking tailwater for sediment movements and the amount of residue left on the fields.

Objectives

1. Increase the irrigation water efficiency from 55% to 77% over the course of the contract.

   Producers will transition from flood irrigation systems to center pivot irrigation systems, thereby increasing water efficiency and applications to meet this objective. This will make adequate water quantity for producers and allow water to be available to crops during the peak consumptive period.

2. Decrease soil and water erosion by 50% over the course of the contract.

   By reducing irrigation-induced erosion down to sustainable levels (5 tons), this objective will decrease the sediment runoff into the Yellowstone River, improving overall water quality.

3. Increase soil structure and organic matter over the course of the contract.

   Reduction in tillage operations through the conversion of flood irrigation systems to center pivot systems will help to improve soil health and organic matter on irrigated cropland. Further, by planting perennial grasses along edges or corners of irrigation systems and/or planting cover crops, producers will also be able to improve soil health and organic matter.

4. Plant nutrient leaching will be greatly reduced with sprinkler irrigation over the course of the contract.

   Due to the control of the water application rate once surface flood irrigation is converted to sprinkler systems, plant nutrient leaching will be greatly reduced, improving water quality.

With the conversion of open earthen ditches to pipelines and the conversion of flood irrigated fields to center pivot irrigation, we expect to see a notable improvement in the efficiency of irrigation water application on cropland.

A few scenarios of expected water savings through this project are:

- Conversion of flood irrigation to center pivot = 2000 acres x 1 acre- foot/acre / 3 years = 400 acre-feet/year.
- Conversion of open earthen delivery ditch to buried pipeline = 9 acre-feet of water loss/ 1000 ft. of open delivery ditch.

All outcomes are achievable in 5 years or less.

Proposed Alternatives and Actions

The proposed alternative is to replace surface flood irrigation with a sprinkler system for more irrigation efficiency and additionally, reduced soil and water erosion. NRCS will financially assist, through EQIP funds, the purchase of a center pivot systems, irrigation pipelines with components to facilitate this Irrigation Efficiency strategy. NRCS would contract 449, scenarios #4 & #5 to help plan and implement this system over the course of 3 years.

The only alternative to the proposed alternative is no action. If no action is taken regarding the proposed system, current conditions and concerns will persist and worsen. Without irrigation system improvements, the soil and water erosion will continue at its current level, irrigation water application effectiveness will continue to be a problem and sediments and nutrients will eventually make their way to the Yellowstone River.

Implementing this system will cost an average of $76,250 per contract. This initial investment in several producers can set them to improve their irrigation system, soil health, and improve their crop yields.

To make this a functional system the following practices may be needed per individual's system.

Code	Practice Name
442	Sprinkler System (Center Pivot System)
533	Pumping Plant
587	Structure for Water Control
430	Irrigation Pipeline
449	Irrigation Water Management, Scenarios #4 & #5

Implementation and Outreach Efforts

There will be three (3) years of applications with contracts lasting five (5) years each. This will allow for practice implementation to be two (2) year and be ready for management the last three (3) years of the contract. Yearly contracting estimates are based on the FY2019 NRCS EQIP General Cost List payment rates.

Figure 2—Cost Share Estimate example of an *130 acre* center pivot with a swing arm and 1700' of irrigation pipeline

Typical Pivot Irrigation System				
Item	*Unit*	*Amount*	*PR Unit Cost*	*Total Cost*
Sprinkler System				
442 - Center Pivot System	ft	1250	$ 40.89	$ 51,112.50
442 - Swing Arm add on	ft	250	$ 156.35	$ 39,087.50
	ft			
Irrigation Pipeline (not gated)				
430 - PVC pipe>/= 10"---- 12" PIP 80 PSI PVC (1700 ft @ 6.1 lb/ft)	lb	10370	$ 1.19	$ 12,340.30
Pumping Plant				
533 - Electric Powered Pump, >30-74 HP	hp	50	$ 136.31	$ 6,815.50
533 - Variable Frequency Drive, less than 75 HP	hp	50	$ 116.52	$ 5,826.00
587 - Miscellaneous Structure, Extra Small (filter)	ea	1	$ 2,038.77	$ 2,038.77
587 - Flow Meter w/ Electronic Index	in	10	$ 285.17	$ 2,851.70
449 - Irrigation Water Management (Intermediate) Year 1	ea	1	$ 913.97	$ 913.97
449 - Irrigation Water Management (Intermediate) Year 2 & 3	ea	2	$ 476.72	$ 953.44
Total				**$ 121,939.68**

Figure 2 is an example of a cost share estimate break-down similar to what we've planned with EQIP. The total amount in this example is generally higher than what is expected as an average cost per contract going forward with the TIP. Based off recent average estimates, we anticipate the cost share to be approximately $938/ac. Some scenarios may be more or less depending on certain specifics including amount of pipeline needed, pump specifics, and a swing arm option.

After a general inventory of the Targeted Area, we determined the individual pivot acreage will be less due to the majority of the large farms already under established sprinkler systems. We anticipate more applicants with smaller acres converting to pivot. According to the inventory, approximately 2600 acres of current flood irrigated cropland have the potential to be put under sprinkler irrigation (if the landowner/producer is willing and able within the application period). This would address the Ineffective Irrigation Water Use resource concern for the selected area. Our goal with this TIP is to be able to treat at least 75% of the available acres within the 3-year signup period.

Refer to **Figure 3** for a year-to-year breakdown of funds.

The Glendive Field Office is requesting the following for the Dawson County Irrigation Water Efficiency Improvement Project:

Figure 3—Annual breakdown of TIP fund requests by acre and potential contract

TIP Funds					
Fiscal Year	Number of Contracts	Acres Treated	Average Expected Cost per Acre	Average Expected Cost per Contract	Total
2020	8	650	$938	$76,250	$610,000
2021	8	650	$938	$76,250	$610,000
2022	8	650	$938	$76,250	$610,000
TOTALS	**24**	**1950**			**$1,830,000**

Technical assistance and staff time from NRCS will include:

- Cultural Resources Search
- System engineering design and plan development
- Construction checks and “as-built quantities” documentation
- Operation and maintenance plans
- Assistance with soil moisture monitoring and IWM
- Contract development & management

The Glendive FO will handle approximately 95% of the Sprinkler System projects that go through the Glendive office. There may be larger systems that may need to have their designs reviewed and signed off by the Area Engineering staff due to Job Approval Authority (JAA) levels.

Demonstrations and field tours will be held to continue the education on irrigation water management, soil health, cover crops, and pollinator plantings implemented in TIP contracts.

Partners will provide planning, education and outreach, and financial assistance for cover crops and pollinator plantings. See partner list for more information.

Operation and maintenance of the implemented systems will meet NRCS standards and specifications. It is the intent that this will be demonstrated on how to be efficient with irrigation water-profitable for growing more crops, increase soil health and reducing soil and water erosion.

Progress, Evaluation and Assessment

Progress will be measured by:

- Measuring irrigation water through the (587) Structure for Water control -Flow meter.
- Measuring irrigation water infiltration with soil moisture sensors after each irrigation.
- Running individual WEPS scenarios at the beginning of each application to determine potential soil losses from erosion, shifts in organic matter, and average Soil Tillage Intensity Ratings (STIR) before and after the proposed system.

Progress will be documented and reported to NRCS Area Office staff and to the community through outreach and newsletters to continue the educational aspect. Measurements will be taken and reported by Glendive Field Office staff and partners.

Ranking/Prioritization

Screening questions:

Has the applicant had an NRCS program contract terminated since January 1, 2017; OR does the applicant have an existing contract that has been determined to be in noncompliance and currently under an active NRCS-CPA-153 (only answer as Yes if the non-compliance was for something within the participant's control)? If yes, identify the following: Date of Termination or date participant signed the NRCS-CPA-153 with an existing deadline to bring the contract back into compliance.	Yes - Application is a **LOW** Priority No - Continue to question 2
Is the proposed conservation treatment within the geographic boundaries of this Targeted Implementation Plan (TIP)?	No - Application is a **LOW** priority and will not be ranked Yes - Continue to question 3
Does the application meet the intent of the Targeted Implementation Plan, (TIP) and is for practices currently offered in the TIP that will treat the identified priority resource concern?	Yes - Application is a **HIGH** Priority and will be ranked No - Application is a **LOW** priority and will not be ranked

Ranking Questions:
See page 12

Partnerships and other Funding Sources

This project's success can only be assured through the cooperation and contributions of a number of agencies listed below.

NRCS is the leading partner for this TIP. The local field office staff along with the Area Office engineering staff will be coordinating to make sure the project practices meet our requirements and will function to meet the applicant's needs.

The Dawson County Conservation District will assist by applying to the Montana Department of Natural Resources and Conservation (DNRC) HB 223 grant program to assist landowners and USDA-NRCS in providing outreach and education to local landowners, as well as fund the soil moisture sensors.

Buffalo Rapids Irrigation District #1 will assist by purchasing irrigation pipe at a discounted rate and make available to the irrigation producers for purchase. Additionally, Buffalo Rapids will carry out installation of the lateral pipeline.

Private Landowners will be responsible for the remaining expenses not covered by cost share.

Montana Fish Wildlife & Parks will fund pollinator plantings and cover crops that follow their state-regulated program requirements.

Bird Conservancy of the Rockies will assist with education and outreach on wildlife.

Montana State University Extension Service in Dawson County will assist with tours and outreach.

References

Dawson County Long Range Plan (LRP), 2019.

Ruffin, Lakeitha and Tallman, Susan. Economics of Reduced Tillage in Sugar Beets. January 2017. Montana USDA-NRCS

Application Ranking Summary

2020 Targeted Implementation Plan

Dawson County Irrigation Water Efficiency Improvement

Ranking Date:	Applicant:
Final Ranking Score:	Application Number:
Planner:	Phone:
Farm Location:	

Ranking Questions

Select one of the following:			Points
1a	Does the application include an irrigation project that will increase irrigation efficiency by at least 15% as calculated in FIRI according to an NRCS-approved design?	Yes No	
1b	Does the application include an irrigation project that will increase irrigation efficiency by at least 20% as calculated in FIRI according to an NRCS-approved design?	Yes No	
1c	Does the application include an irrigation project that will increase irrigation efficiency by at least 25% as calculated in FIRI according to an NRCS-approved design?	Yes No	
Select one of the following:			
Does the application include a sprinkler irrigation system where…			
2a	…all the corners will be flood irrigated?	Yes No	
2b	…none of the corners will be flood irrigated, but all will be sprinkler irrigated?	Yes No	
2c	…none of the corners will be flood irrigated, but some will be sprinkler irrigated (the remaining corners will be converted to dryland)?	Yes No	
2d	…none of the corners will be flood irrigated, but some will be sprinkler irrigated and the remainder will be converted to dryland AND planted to pollinator habitat?**	Yes No	
2e	…all the corners will be converted to dryland?	Yes No	

2f	…all the corners will be converted to dryland AND planted to pollinator habitat?**	Yes 0 No 0	50
Select one of the following: (Crop types = cool season grass, cool season broadleaf, warm season grass, warm season broadleaf)			
3a	Planned rotation includes 3 crop types, or 2 crop types with 1 cover crop**.	Yes 0 No 0	10
3b	Planned rotation includes 3 crop types with at least 1 cover crop**.	Yes 0 No 0	20
3c	Planned rotation includes 4 crop types with at least 1 cover crop**, or 3 crop types with at least 2 cover crops**.	Yes 0 No 0	30
4	Will the proposed project reduce soil erosion to tolerable limits (From > "T" to < or equal to "T")?	Yes 0 No 0	20
5	Will the proposed project increase soil organic matter and carbon content, and improve soil tilth and structure?	Yes 0 No 0	15
6	Does the application address at least one or more inadequate wildlife habitat requirements (pollinator plantings on field corners)?**	Yes 0 No 0	5
7	Does the application include a multi-species cover crop?**	Yes 0 No 0	5

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**Planned pollinator habitat & cover crop plantings will need to be planned and implemented under a partner agreement.

FY-2020

Irrigation TIP Project Area

Dawson County, Montana

USDA-NRCS
Glendive FO