Taking Soil Health to the Next Level: Miles City Area Soil Health TIP

FY2024 - FY2026

Increased snow catch on stripper header stubble on right, minimal snow catch on regular header stubble on left.

Daniels, Sheridan, Roosevelt, Richland, Wibaux, Fallon Counties,
& Fort Peck Tribal Reservation

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TIP Summary

This Targeted Implementation Plan (TIP) will promote the soil health principles of keeping the soil covered and minimizing disturbance by offering financial support to facilitate the adoption of Conservation Harvest Management (CHM) and converting to no-till. The TIP will focus on crop producers in Sheridan, Daniels, Roosevelt, Richland, Wibaux, and Fallon counties as well as the Fort Peck tribal reservation. There are approximately 2 million cropland (dryland and irrigated) acres in these counties. Due to poor soil cover the primary resource concern is aggregate instability and the secondary resource concern is naturally available soil moisture use.

Producers in the project area have made progress to increase diversity and keep a living root in the ground more days of the year by adding new crop types. Prior to the 1990s wheat/tilled fallow was the predominant cropping system, but over the past 30 years most producers have switched to continuous cropping by adding pulse (pea, lentil, & chickpea) and other broadleaf crops. They have also eliminated tillage and either switched to single pass hoe drills, a form of reduced tillage, or adopted no-till disc drills.

However, it is still a challenge to keep the soil covered as small grain harvest leaves stubble only 4 – 6 inches tall. This leaves more than 50% of the soil exposed, even in no-till systems. This exposure leads to soil aggregate instability, the primary resource concern of this TIP, and decreased naturally available soil moisture, the secondary resource concern. Even in long-term no-till systems wind and water erosion can continue to be a problem due to exposed soil leading to soil aggregates breaking down.

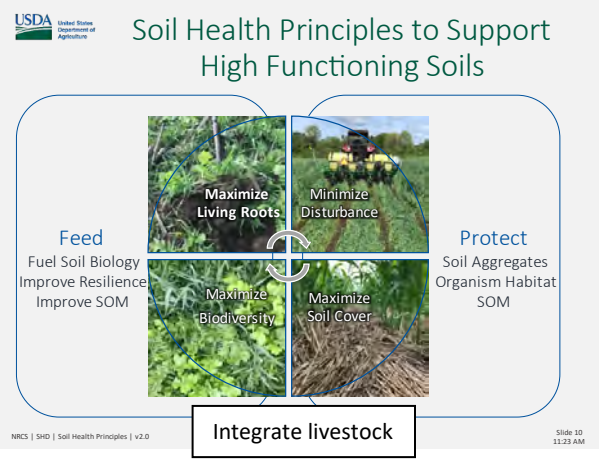


Figure 1. The 5 soil health principles. This TIP addresses protecting the soil.

Farmers can protect their soil from wind and water erosion by adopting CHM through the use of stripper headers, which leaves close to 100% of small grain stubble standing. For farmers who still use reduced till, the no-till option will allow them to use a stripper header, and minimize soil disturbance.[1] These changes will improve soil health by increasing soil aggregate stability and capture and storage of precipitation in the soil. This will stabilize yields and further increase soil armor. Other soil health benefits include increased organic matter (and thus more CO_2 sequestration); and improved nutrient cycling and water holding capacity. Stripper header stubble also provides excellent parasitoid habitat for biological control of wheat stem sawfly, a pest that costs farmers between $45-$80 million per year in harvest losses in Montana.[2]

The estimated project cost to NRCS, over three years (2024-2026), is $4,516,950.90. This TIP could cover more than 50,000 acres with conservation harvest management, and 15,000 acres of that converted to no-till. This TIP is timely in that many producers in the project area have well developed no-till systems with crop diversity, but sometimes struggle to maintain soil cover, especially in drought years. But they are innovators, having lead Montana in adopting diverse, continuous no-till systems, and are keen to use stripper headers to take soil health the next level on their farms.

[1] Hoe drills, used in reduced till systems, cannot seed into the large amounts of standing residue left by stripper header harvest as they act like rakes and make a mess of the drill and seeding operation.
[2] Wheat Stem Sawfly and Residue Management, Dr. Dave Weaver, MSU, webinar, January 25, 2023.

Geographic Focus

This TIP will cover approximately 2 million dryland and irrigated cropland acres in Sheridan, Daniels, Roosevelt, Richland, Wibaux and Fallon counties (see Table 1, Figure 3, & Figure 2). The entirety of the Fort Peck tribal reservation was also included in consultation with the NRCS Tribal Conservationist as there is some cropland in Valley county. These counties were chosen because producers expressed interest to NRCS field offices in adopting stripper headers (see Figure 4 for stripper header harvest operation). Farmers in these counties have been innovators and early adopters in implementing soil health practices such as no-till, continuous cropping with crop diversity and cover crops. This mindset is ideal for stripper header adoption, a logical next step in improving cropland soil health. If this TIP is successful it could be expanded to other counties in the future.

USDA-NASS data from 2021 (Table 1) shows very little fallow and a significant percentage of crop diversity in terms of broadleaves and the smaller subset of pulse (dry pea, lentil, chickpea) crops. Most of these acres are dryland, with the exception of irrigated acres in Richland and Roosevelt counties. Nearly three-quarters of all cropland in these counties is small grain. Since stripper headers are primarily used to harvest small grains, (although they can harvest flax and sometimes dry peas) the table demonstrates there is high potential for adoption in the TIP area.

Table 1. 2021 CropScape data of selected eastern MT counties.[3]

County	County Acres	Annual Crop Acres	Fallow Acres	Small Grain Acres	Pulse Acres	All Broadleaf Acres	% Small Grain	% Fallow	% Broadleaf	% Pulse
Sheridan	1,050,595	561,848	7,491	379,536	155,633	179,893	67.6%	1.3%	32.0%	27.7%
Daniels	899,673	427,870	8,938	317,143	80,736	108,804	74.1%	2.1%	25.4%	18.9%
Roosevelt	1,481,311	606,729	7,962	475,115	94,274	127,658	78.3%	1.3%	21.0%	15.5%
Richland	1,303,264	322,995	597	268,627	16,674	42,496	83.2%	0.2%	13.2%	5.2%
Wibaux	561,505	71,495	475	51,566	8,207	13,557	72.1%	0.7%	19.0%	11.5%
Fallon	1,027,827	54,478	3,281	36,543	4,220	9,325	67.1%	6.0%	17.1%	7.7%
Totals	**6,324,175**	**2,045,415**	**28,744**	**1,528,530**	**359,744**	**481,733**	**74.7%**	**1.4%**	**23.6%**	**17.6%**

[3] The geospatial data product called the Cropland Data Layer (CDL) is hosted on CropScape (https://nassgeodata.gmu.edu/CropScape/). The CDL is a raster, geo-referenced, crop-specific land cover data layer created annually for the continental United States using moderate resolution satellite imagery and extensive agricultural ground truth. https://www.nass.usda.gov/Research_and_Science/Cropland/sarsfaqs2.php#Section1_1.0)

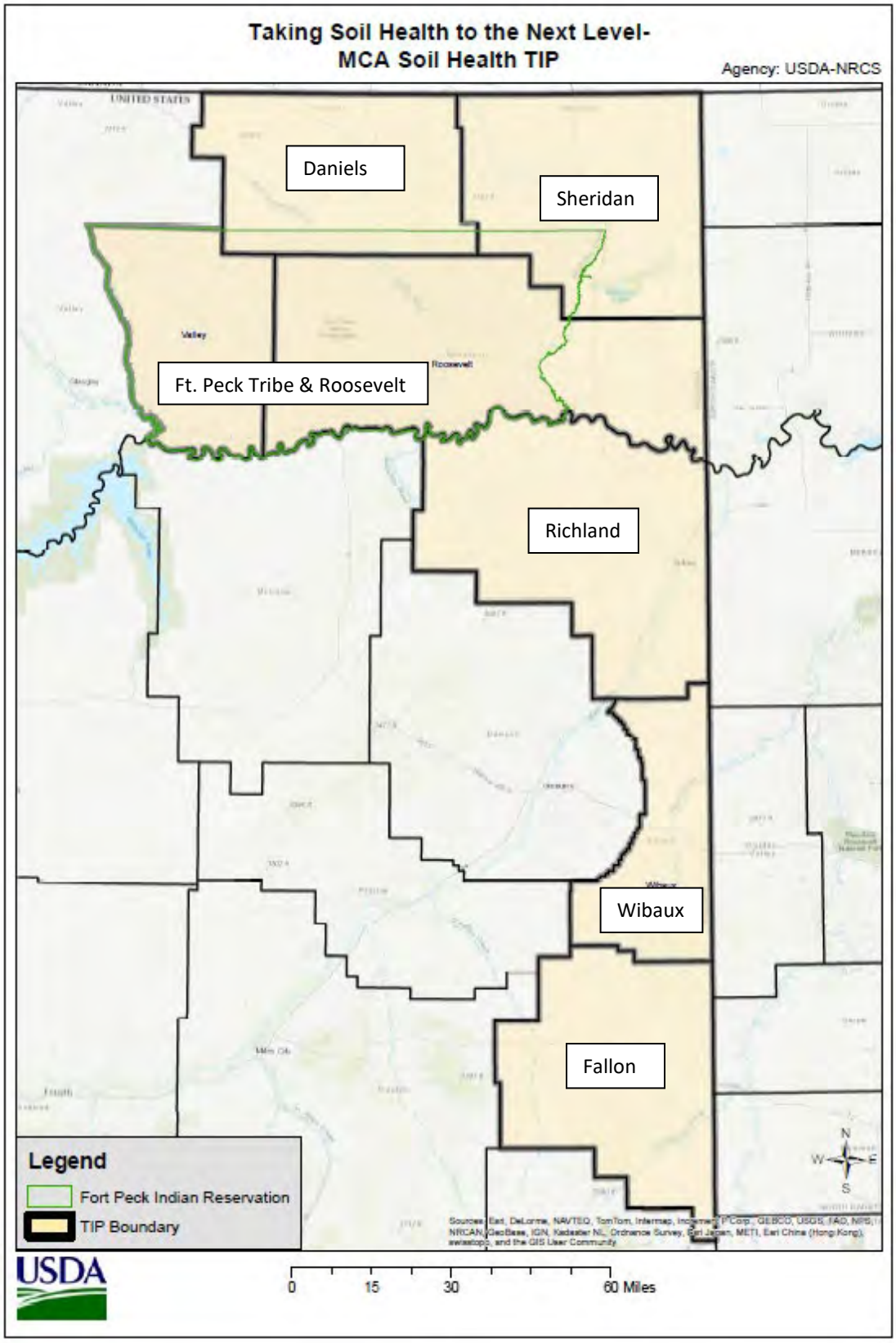


Figure 2. TIP area- tan shaded counties.

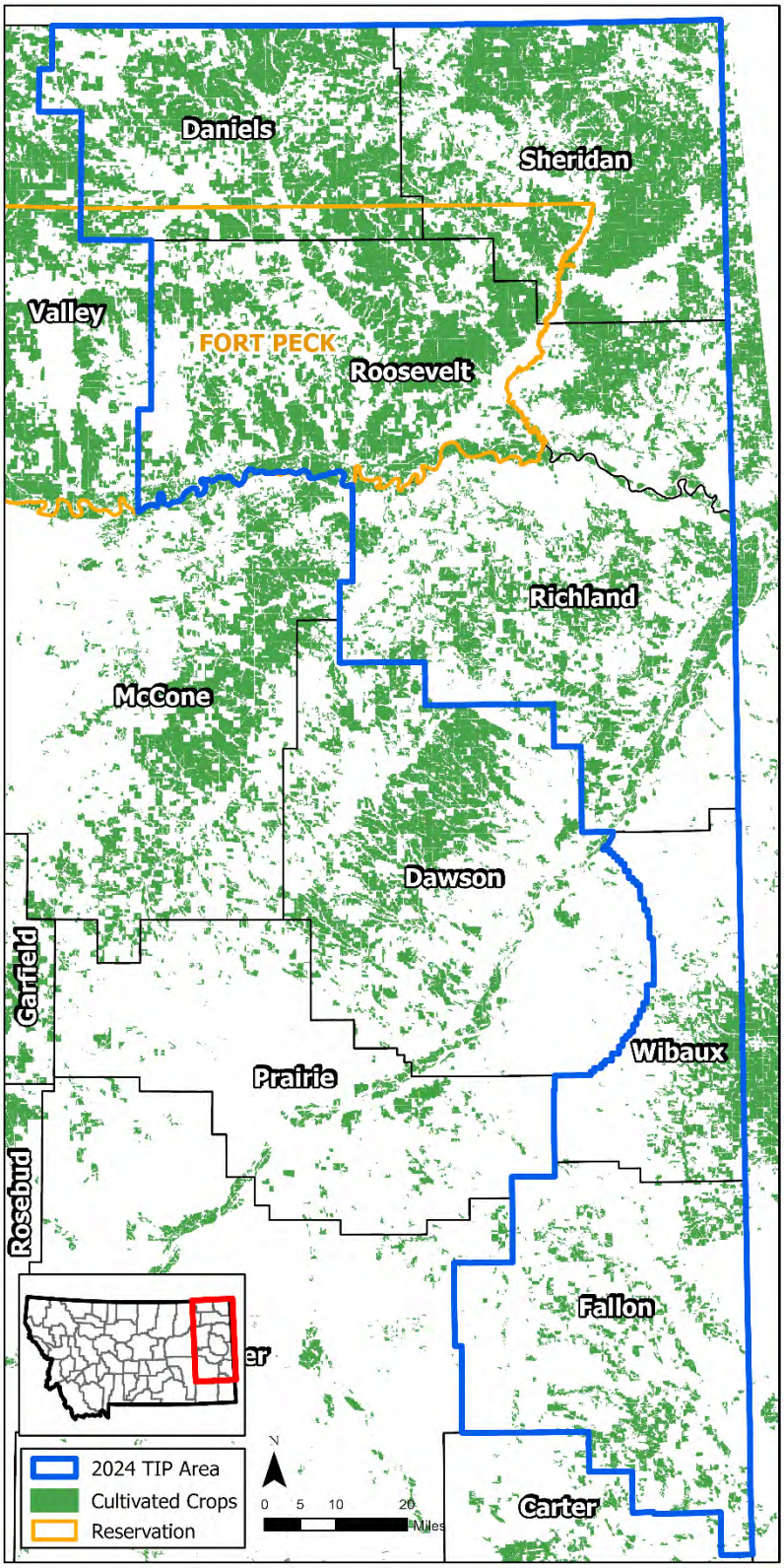


Figure 3. Cultivated crops in TIP project area.

Figure 4. Stripper header harvesting wheat in eastern Montana.

Resource Concerns

Long range plans (LRPs) in the six counties in this TIP all reference some aspect of soil health as a resource concern on cropland. The primary resource concern of soil aggregate instability, reflected in the LRPs references to soil health, will be addressed by this soil health TIP. Naturally available moisture use, which directly relates to soil health, will be the secondary resource concern addressed.

Table 2. Long range plan references to soil health, Miles City Area.

County	Soil Health & Cropland Resource Concern(s)	Reference- page #s
Daniels	Soil health and plant health on croplands: residue management; soil erosion on croplands- large fields	p. 31, p. 33-34
Fallon	soil health on cropland- bare ground, poor infiltration, system based approaches; soil health on cropland #2 priority	p. 39, p. 43
Richland	soil erosion and soil health on cropland	p. 37, 39
Roosevelt	Cropland- continuous cover, residue management; soil health	p. 42, 44
Sheridan	Soil erosion – continuous cover; Soil quality limitations- #1 priority resource concern	p. 36-37, p. 40
Wibaux	soil health on cropland- erosion, increases runoff, inadequate moisture management, low organic matter	p. 37
Fort Peck Tribal Reservation	Soil health on croplands; development of soil health best management practices	p. 15-19

Cropping systems in the counties this TIP will focus on are primarily reduced/no-till with crop diversity that includes 2-3 crop types. Reduced till in this context consists of single pass hoe type drills that do not meet the NRCS 329 Conservation Practice Standard (No-Till). Producers often consider single pass hoe drills as no-till since there is no other tillage in the system (e.g. a pre-plant tillage pass) but the level of disturbance of a hoe drill is excessive when compared to no-till (see Figure 5, Figure 6, and Figure 7). Research from USDA-ARS in Minnesota showed that there is more water and CO_2 loss from a hoe drill than a single disc drill (Figure 8). Use of a single disc drill can save 0.30 inches of water over a 24-hour period after planting compared with a hoe drill. That is water not lost to evaporation that can be used for plant growth. The reduced loss of CO_2 under no-till translates into more carbon available to maintain and build soil aggregates, which increases overall aggregate stability.

Figure 5. Typical hoe drill and resulting 100% soil surface disturbance after single-pass seeding operation on dryland cropland in eastern Montana.

Figure 6. No-till disc drill and resulting low disturbance environment that results in excellent soil cover. Spring wheat has been seeded into cover crop residue in the right photo.

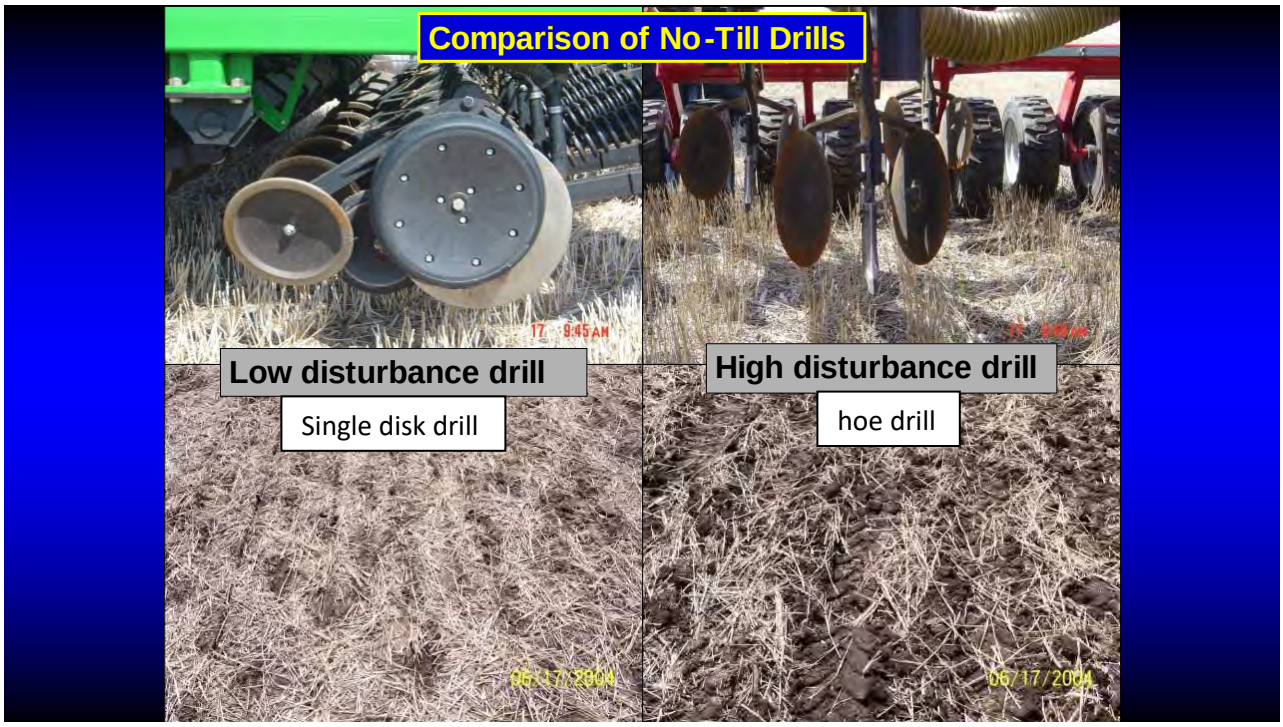


Figure 7. Comparison of "No-till" drills, Dr. Don Reicosky, USDA ARS retired. Left- single disc drill; right- hoe drill.

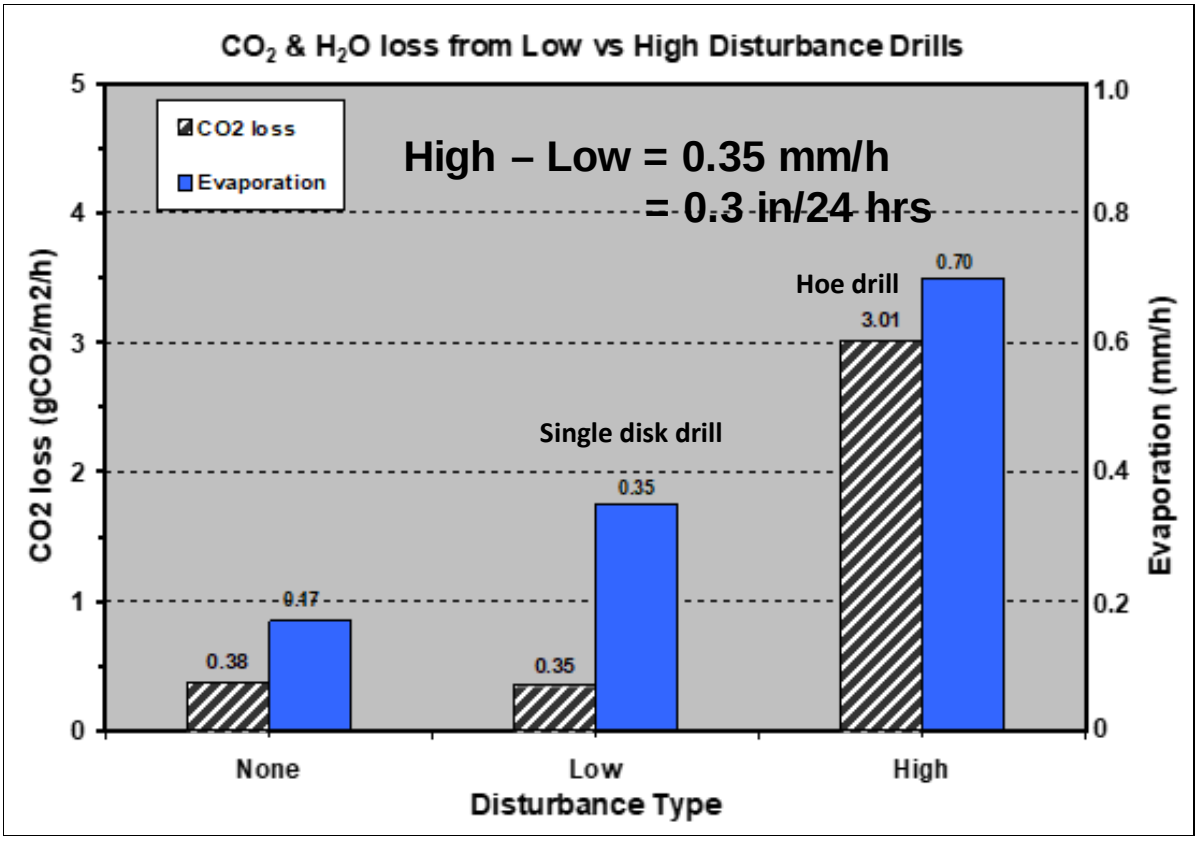


Figure 8. Water and CO_2 loss from low disturbance disc drill versus high disturbance hoe drill, Dr. Don Reicosky, USDA-ARS retired.

Crop types in these systems are cool season grasses (small grains), cool season broadleaves (pulses, oilseeds) and sometimes warm season broadleaves or grasses. The degree of warm season crops varies within the TIP area due to climatic differences. Warm season types tend to be more prevalent in Fallon, Wibaux, and Richland counties as there are enough frost-free days to grow crops such as sunflowers and corn.

While these no-till diverse cropping systems are a significant improvement from the days of tilled fallow/wheat, there are often still resource concerns to address. Standard combines harvesting at 4-6 inches from the ground leave little standing stubble behind to protect the soil. This is exacerbated in drought years when yields are low. Two years of low yields, which happened in Daniels county in 2021 and 2022, can lead to very little cover (Figure 9 and Figure 10), even in no-till systems.

This lack of cover exposes soil to degradation from wind and water and increases soil temperatures. This leads to the aggregate soil structure weakening as soil life declines in a hostile environment. With lower soil microbial populations and activity, soil structure is not built or maintained since biology is what builds soil aggregates and drives soil function. As aggregate stability declines the capacity of the soil to infiltrate water declines. This dysfunctionality can result in ephemeral gully erosion when there are significant rain or snowmelt events. Wind erosion can also be a result. It's important to note that erosion is a *symptom* of poor soil health. Erosion is simply a result of dysfunctional soil. While it may be surprising that erosion occurs on no-till fields, there are examples in the Miles City area (see Figure 11 and Figure 12).

The lack of cover and resulting higher soil temperatures also allows for more soil moisture loss. Water is lost to evaporation and not used by plants for growth. Lack of cover also leads to less snow being trapped in crop fields, which means less soil moisture in the spring when most crops are seeded or coming out of dormancy. All of this exacerbates low yields in drought years and results in not reaching the yield potential in wetter years. This process is pictured in the "Downward Spiral of Soil Degradation" slide from NRCS's Soil Health and Sustainability for Field Staff Course (Figure 13).

Figure 9. Wheat stubble in Daniels county following two years of drought, fall 2022.

Figure 10. Close up of lack of soil cover in a no-till field following two years of drought, Daniels county, fall 2022.

Figure 11. Wind erosion in a no-till system in eastern Montana.

Figure 12. Ephemeral gully erosion in a no-till system in eastern Montana.

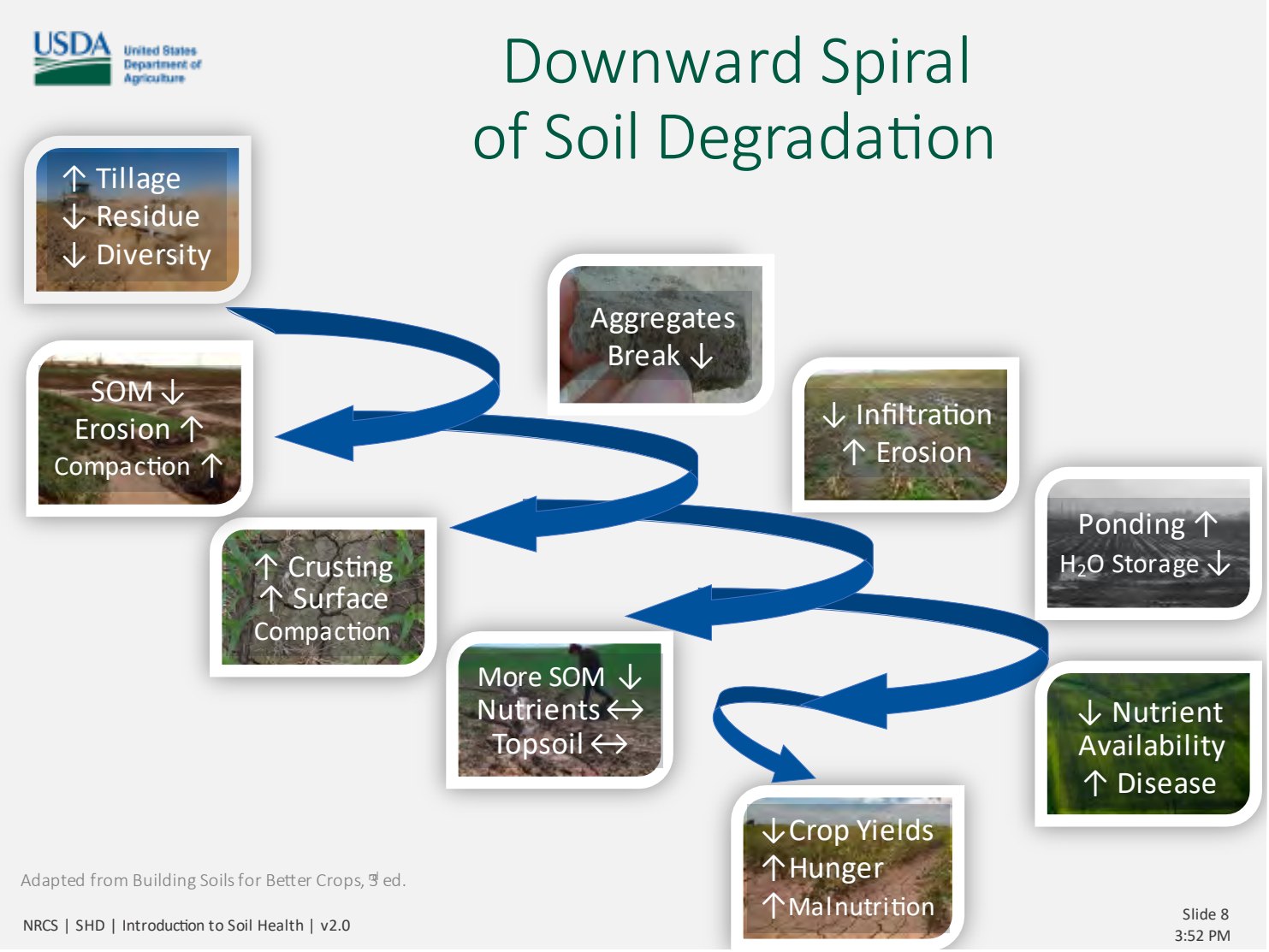


Figure 13. NRCS diagram summarizing the process of a downward trend in soil health.

Goals and Objectives

The goal of this TIP is to improve soil health on cropland by maximizing soil cover and minimizing soil disturbance. This will be achieved by using Conservation Harvest Management (CHM), coupled with no-till where needed, to address the soil aggregate instability and naturally available moisture resource concerns that have been created through low soil cover and disturbance. The implementation of this TIP, primarily through the use of CHM by using stripper headers, will improve soil aggregate stability by increasing soil cover. As a result moisture use will be more efficient as more water is stored and captured and not lost to evaporation since the soil will be more protected by residue. CHM requires 90% of residue to be left standing for small grain crops and 80% for other crops (e.g. flax). A stripper header on a combine is capable of leaving this much residue.

With improved soil aggregate stability soil can take in and store more water and is less susceptible to erosion. Ephemeral gullies and wind erosion events will be less common. In some cases, Residue and Tillage Management, No-Till, will also be needed to get systems out of reduced tillage (hoe drills) and to make use of CHM. Hoe drills cannot seed into the large amounts of standing residue left behind by stripper header harvest as they act like rakes and make a mess of the drill and seeding operation. Farmers have consistently said that no-till single disc/low disturbance drills pair very well with a stripper header.

These practices can result in ground cover increasing from less than 50% to 80 – 100%, depending on the crop, yield, and weather conditions. Figure 14 and Figure 15 show what ground cover looks like after using Conservation Harvest Management. This mulch layer reduces soil moisture loss to evaporation. Early no-till research showed that a thick mulch layer reduces moisture loss substantially compared to bare soil (see Figure 16). Bare soil will lose about 100% of moisture, but a mulch layer 1.5 – 2 inches thick almost eliminates moisture loss.

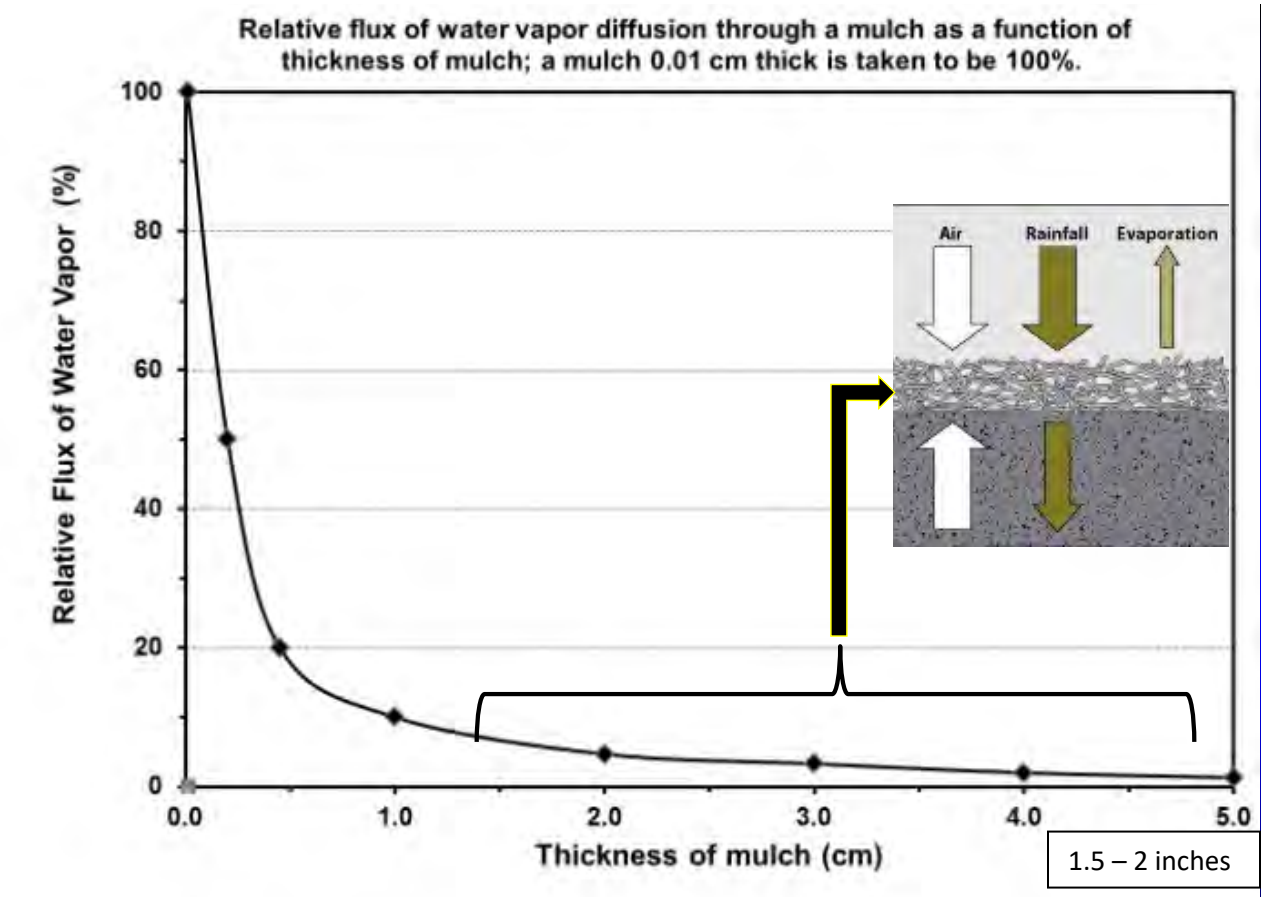
Other benefits of using CHM (stripper headers) include:

- Soil is cooler in the spring, which means more moisture for the crop when temperatures increase.
- More uniform heating across fields, which leads to more uniform germination and better stand establishment.
- Combines can run at a higher speed, reducing harvest time, and there is less wear and tear on the combine as very little material is moving through the combine, which reduces maintenance costs.
- Excellent cover and food for upland birds and other wildlife as there is about a 1 bu/ac loss during harvest. This loss is acceptable to farmers due to the efficiency gains from a stripper header.
- Less hairpinning occurs as residue is vertical, making it easier for a disc drill to move through the residue and get good seed to soil contact. This results in more uniform crop stands and better yields. Hairpinning occurs when crop residue lying flat on the soil surface is not cut or removed by the drill, preventing the seed from being contact with the soil and the seed trench from being covered with soil. This often results in a poor and uneven stand of plants. See Appendix B for photos of this.

- Pulse crops establish and grow well in tall grain stubble, and are protected from spring wind events that can damage them.
- After harvest cover crops can be more successful in stripper header stubble due to the extensive cover that creates a better seed germination environment (higher humidity, more shade).

Figure 14. Stripper header stubble after harvest in eastern Montana. Only the grain has been removed.

Figure 15. Close-up of ground level view of stripper header stubble/residue. Note 100% soil cover.



Phillips, R. E., G. W. Thomas and R. L. Blevins, Editors. 1979?. No -Tillage Research: Research Reports and Reviews. University of Kentucky, College of Agriculture and Agricultural Experiment Station, Lexington. pp 151.

Figure 16. Slide from Dr. Don Reicosky, USDA-ARS retired, showing reduction in water loss as mulch layer thickness increases.

Alternatives

To address soil aggregate instability and naturally available moisture use several alternatives were considered and debated by NRCS staff in participating counties.

Alternative 1 (Not Selected) – Conservation Harvest Management (809), Residue and Tillage Management – No-Till (329), Conservation Crop Rotation (328), Cover Crops (340), and Soil Health Testing (216 Conservation Evaluation and Monitoring Activity- CEMA).

All of these practices are part of a soil health management system and together can contribute substantially to improving cropland soil health. However, this alternative was not chosen because of the types of farmers and farming systems in the project area. Many farmers in the target area are already implementing 328 at some level- often having 2-3 crop types in their rotation with 50% high residue crops (e.g. small grains). This is supported by the USDA-NASS CropScape data comparison in Table 3, which shows the increase in crop diversity from the addition of pulse crops. Farmers made great strides

in adding diversity, mainly through broadleaf crops, to their systems since 2007, although the changes started in the late 1990s with the adoption of pulse crops, but NASIS CropScape data is not available for this time period. Adding a fourth crop type requires using a warm season grass or broadleaf, which is not feasible in all counties in the project area. Northern counties for the most part do not have a long enough growing season to use warm season crops such as sunflowers, soybeans, or corn.

Table 3. Change in acres of fallow, pulse, and broadleaf crops from 2007 to 2021 (USDA NASIS CropScape). Data prior to 2007 is unavailable.

	Change in Acres, 2007 to 2021		
County	**Fallow**	**Pulse Crops**	**Broadleaf Crops**
Sheridan	-15,022	91,799	139,809
Daniels	-28,218	33,560	58,990
Roosevelt	-75,231	66,353	92,962
Richland	-46,611	9,275	16,345
Wibaux	-3,441	6,192	9,918
Fallon	-4,118	3,770	8,204

In addition, NRCS staff in the targeted area confirmed that most farmers, especially those who have interest in this TIP, already have 50% high residue crops in their rotation. Further NASIS data to support this is in Appendix A.

Cover crops have been used in the target area to varying degrees, mainly full season plantings where there are livestock to graze the cover crops. However, the northern counties use cover crops less as there are less livestock and the post-harvest seeding window is tight or in some seasons non-existent. Some farmers have successfully flown in cover crops into a standing crop, but this depends on the availability of a plane and pilot, which is not always assured.

NRCS offers the Conservation Evaluation and Monitoring Activity (CEMA) 216 Soil Health Testing. A soil health (Haney test), Phospholipid Fatty Acid (PLFA)[4] and wet aggregate stability tests[5] would be used each year over three years. Results would be used from participating producers for monitoring and tracking changes in soil health.

Alternative 2 (Selected)- Conservation Harvest Management (809), Residue and Tillage Management – No-Till (329), Soil Health Testing (216 Conservation Evaluation and Monitoring Activity- CEMA)

This combination of practices makes the most sense for the counties that wish to participate. A farmer who wants to use Conservation Harvest Management (809) will in general already have a good rotation with 2-3 crop types and 50% high residue crops. Adding 809 is the logical next step for these farmers. No-till (329) is available for farmers who want to change from hoe drills/reduced tillage, which will enable them to adopt 809. Without no-till, Conservation Harvest Management (through using stripper

[4] PLFA measures the types and numbers of microbes present in the soil and can be used to track changes in soil health.

[5] Wet aggregate stability is a necessary physical soil property that can indicate a soil's ability to resist disturbances from physical and chemical forces, store water, allow the movement of air and water, and influence the growth and form of roots.

headers) is not possible. Under NRCS standards, crop residue cannot be baled/removed/burned under Conservation Harvest Management or no-till.

NRCS will offer the Conservation Evaluation and Monitoring Activity (CEMA) 216 Soil Health Testing. A soil health (Haney test), PLFA, and wet aggregate stability tests will be done each year over three years with interested producers. We expect many will be interested in these tests. The data will be used for monitoring and tracking changes in soil health.

Alternative 3 – No Action.

The downward spiral of soil health may continue, and cropland will not reach its potential for building and storing soil carbon, which builds soil aggregate stability.

Implementation

This TIP will be funded for three years— FY2024 - FY2026. The average estimated contract cost is $129,055.74. Table 4 shows the estimated acres that could be covered under this practice based on acres reported by producers to NRCS. Table 5 breaks down the cost by practice. Conservation Harvest Management can be capped at 500 acres/year since it is an interim practice standard. No-till (329) is included for producers who need a low disturbance drill to be able to plant into high crop stubble.

Table 4. Summary of producer interest and estimated acres of Conservation Harvest Management (809).

County	**Estimated Conservation Harvest Management (809) Acres & Producers**			
	Producers	Acres/yr	Total Acres- 1 yr	Total Acres- 3 yrs
Daniels	2	1,000	2,000	6,000
Sheridan	4	2,000	8,000	24,000
Roosevelt	10	2,000	20,000	60,000
Richland	5	2,500	12,500	37,500
Wibaux	10	1,000	10,000	30,000
Fallon	10	500	5,000	15,000
Totals	**41**	**9,000**	**57,500**	**172,500**

NRCS will evaluate the impact of Conservation Harvest Management (809) on soil health by comparing regularly harvested fields (before and after implementation) with stripper header stubble on 3-5 sites using:

1) Soil moisture analysis to 10 inches using a 3 inch soil core.
2) Montana soil health cropland assessment- a quick field assessment of soil health, includes % soil covered.
3) Visual comparisons of snow catch, wind, and water erosion.
4) Water infiltration (measures rate soil can take in water in inches/hour)- an indicator of aggregate stability.

This work will be done by the regional soil scientist and/or the area agronomist in conjunction with field office staff. The MLRA office in Miles City has a lab capable of measuring soil moisture. This data, in

addition to the lab tests under 216 Soil Health Testing, will help report on outcomes. All data will be tracked in a spreadsheet and shared with the MT State Soil Health Specialist (with producer personal information removed). NRCS can assist producers in gathering soil samples for soil health testing.

If no-till (329) is contracted, then field transects to measure residue will be done in the fall or spring (dependent on weather, access, and field office workload). No-till requires 60% flat surface residue to be maintained throughout the year. Adequate cover improves plant available moisture. CHS residue requirements are detailed in Appendix D.

The total estimated amount requested, based on 35 contracts, is $4,516,950.90 over a three year period (see Table 6). This estimate is based on FY23 Environmental Quality Initiatives Program (EQIP) rates.

Table 5. Conservation practices, payment rates and estimated contract cost for 3 years. FY23 EQIP rates.

Practice Code	Practice	Payment Rate	Extent	Unit	Payment – 3 yr. contract
809	Conservation Harvest Management	$59.67	500	Acres	$89,505.00
329	Residue and Tillage Management, No-Till	$19.88[6]	640	Acres	$38,169.60
216	Soil Health Testing	$153.46	3	Number	$460.38
Total cost for one 3 yr. contract					**$129,055.74**

Table 6. Financial assistance by fiscal year, based on a total of 35 contracts. FY23 EQIP rates.

Practice Code	Practice	FY24	FY25	FY26	Total
809	Conservation Harvest Management	$1,044,255.00	$1,044,255.00	$1,044,255.00	$3,132,675.00
329	Residue & Tillage Management, No-Till	$445,312.00	$445,312.00	$445,312.00	$1,335,936.00
216	Soil Health Testing	$16,113.30	$16,113.30	$16,113.30	$48,339.90
Total request		**$1,505,650.30**	**$1,505,650.30**	**$1,505,650.30**	**$4,516,950.90**

NRCS field offices will work with conservation districts through mailings and newsletter articles to publicize the TIP. Through preliminary outreach efforts there are approximately 35 interested producers who could cover an estimated 57,500 acres with Conservation Harvest Management in one year (see Table 4). Projects will be prioritized through the ranking process, with emphasis given to projects that are implemented on soils more susceptible to wind erosion (see Table 7 for ranking questions).

A potential challenge to this TIP is the financial burden of purchasing both a no-till drill and a stripper header at the same time. This could be a stretch for many producers as a 50-60 foot wide air drill setup can run $200,000+ (new). However, under NRCS financial assistance programs such as the Conservation Stewardship Program (CSP) and Environmental Quality Incentives Program (EQIP), producers in the Miles City area are converting to no-till drills from hoe drills, so it is not unheard of. The payment for

[6] MT EQIP High Priority Practice.

CHM will come fairly close to covering a stripper header, and the no-till payment will help with switching to no-till.

A second challenge is stripper header availability. Interest and demand for stripper headers has grown in the last several years, so the market may not be able to keep up in the short-term. However, a quick web search in the used market turned up 187 stripper headers, some in the Montana/Dakotas/Canada region. The stripper header patent expired in 2022, and a Canadian company is working on a model that will be sold starting in 2023. This has potential to help with equipment availability.

Partnerships

Montana Fish, Wildlife and Parks (FWP), under their Upland Game Enhancement Program (UFBEP), provides cost share for leaving at least 14 inches of grain stubble. Producers receive $6 per acre per crop year under the following guidelines:

- Maximum of 320 cropland acres per payment year; minimum of 30 acres.
- Habitat site must be 'idled' until the following spring (i.e. no grazing).
- Cropland must be adjacent to nesting cover (as defined for HMLs) at least 20% of the size of the taller stubble; or winter cover at least 2% the size of the taller stubble under contract; or an existing habitat project site.
- Use of a stripper header is the best way to accomplish taller grain stubble heights, but is not required if height can be met with traditional equipment.
- Verification taken before Sept. 1 or after harvest.
- Minimum 50 days of hunter access for upland game bird hunting (not part of the block management program).

FWP regions 6 and 7 are interested in this project, which encompasses the TIP area (see Appendix C). FWP could also informally help with wildlife monitoring as they make field visits to verify practice implementation before payment, and make anecdotal notes on wildlife sign.

Ducks Unlimited – Ducks Unlimited supports soil health initiatives to help achieve their mission to conserve, restore, and manage wetlands and associated habitats for North America's waterfowl. Daniels and Sheridan counties are high priority areas in Montana's prairie pothole region. The grassland and wetland-dense habitat in northeastern Montana plays a crucial role in supporting a significant number of breeding and migrating waterfowl. According to the most recent waterfowl breeding pair density data, parts of northeastern Montana can support over 100+ breeding pairs per square mile (see map). This is some of the best breeding habitat in Montana. The benefits of implementing the listed soil health practices while utilizing stripper headers will positively impact overall wetland health, hydrology and wildlife habitat throughout a landscape that has been altered through farming. Ducks Unlimited can provide technical and outreach assistance along with assisting with site monitoring for practice implementation and document wildlife habitat improvements.

There is potential to partner with Dickinson State University (DSU) professors and undergraduate students who would conduct standard soil health testing measures and possibly nutrient density testing of the grain. Soil health measurement would include: PLFA, Haney Soil testing, and infiltration measurements. Nutrient profiling of the plants would include tissue sample analysis and nutrient

testing of the grain. NRCS would coordinate with DSU to cover multiple site/years to avoid duplication of effort.

NRCS field offices will work with conservation districts to organize field days on stripper header fields. Many of the participating counties are active in soil health, e.g. several have no-till disc drills they rent to producers.

Outcomes

The desired outcome is 15,000 acres seeded with a disc drill compared to that of a hoe drill (1000 acres/contract x 15 contracts) and 17,500 acres harvested with a stripper header each year (500 acres/contract x 35 contracts). This is 52,500 stripper header acres over three years. Converting from minimum till to no-till and switching from a conventional header to a stripper header also has many other advantageous outcomes:

- **Increased Organic Matter.** More carbon will be built and kept in the soil. By minimizing soil disturbance at the time of seeding and leaving tall stubble, organic matter stays intact providing numerous benefits to crops such as increased water holding capacity and nutrient supply The soil health test can measure water soluble carbon, which changes more rapidly than organic matter, and is closely tied to soil health.
- **Improved Moisture Retention.** With the increase in organic matter in and on the soil, water is infiltrated at the point of contact. Stripper header stubble catches more snow, doesn't blow, creating more evenly spread snow melt. Increased moisture will improve seed germination and crop yields. Water holding capacity and soil moisture analysis, measured in labs, can quantify this.
- **Reduced Soil Erosion.** By minimizing soil disturbance at the time of planting with a no-till drill and the increased organic matter, the potential for water erosion is greatly reduced. No-till drills leave the soil more intact at the time of planting and standing stripper header stubble decreases the potential for wind and water erosion. This can be documented through visual observation in the Montana soil health cropland assessment.
- **Increased Wildlife Habitat.** Stripper header stubble creates excellent cover for deer and nesting habitat for upland gamebirds (Rodgers 2002). The 1 bu/acre harvest loss in small grains is also a food source for waterfowl and other wildlife.
- **Fuel Savings.** The use of a conventional header uses about 1.25 gallons/ac of fuel compared to that of a stripper header only using 0.75 gallons/ac, a decrease of 40%. Fuel consumption also decreases with implementation of a disc drill, producers reporting another 40% decrease from 1.25 gallons/ac to 0.75 gallons/ac. (NRCS MT 2023). On 2000 acres at $4.00 per gallon of farm diesel that is a savings of $8,000 in fuel costs.
- **Reduction in Economic Losses from Wheat Stem Sawfly.** The increased stubble height from a stripper header results in better wheat stem sawfly parasitoid conservation than lower stubble heights.[7] This reduces the damage and economic losses from sawfly in wheat.
- **Reduced Weed Pressure.** Minimized soil disturbance at the time of planting and increased shade from taller stubble created by harvesting with a stripper header reduces weed pressure.

[7] Wheat Stem Sawfly and Residue Management, Dr. Dave Weaver, MSU, webinar, January 25, 2023.

This reduces herbicide costs. Elimination of one herbicide application can save $10/acre, which is $20,000 on 2000 acres.

- **Energy Savings in No-till Conversion.** Transitioning 15,000 acres of cropland from reduced-till to no-till will reduce fuel use, which will reduce greenhouse gas emissions by 3,000 tons CO_2 per year. This is equivalent to 342 homes' energy use for one year.[8]
- **Energy Savings in Stripper Header Use.** Harvesting 17,500 acres per year will reduce fuel use, and thus greenhouse gas emissions (CO_2), by 98 tons per year, which is equivalent to 220,042 less miles being driven by an average passenger vehicle.[9]

[8] http://comet-planner.com/. Comet-planner does not have a way to measure stripper header CO_2 reduction.
[9] https://epact.energy.gov/fuel-conversion-factors.

Ranking Questions

1. Does the application include Conservation Harvest Management (809) on enrolled cropland acres?
    a. Yes.
    b. No.
2. Through using 329 in this application, STIR will:
    a. Go from ≥ 80 to ≤ 10.
    b. Go from > 20 to ≤ 10.
    c. No change in STIR value.
3. Pick one of the following:
    a. Based off the soils on the cropland acres in the application, do at least 51% of the cropland acres consist of soils with an I Factor Rating of greater than or equal to 86?
    b. Based off the soils on the cropland acres in the application, do at least 51% of the cropland acres consist of soils with an I Factor Rating of less than 86?
4. Pick one of the following:
    a. Based off the soils on the cropland acres in the application, do at least 51% of the cropland acres consist of soils with a T Value of 3 or less?
    b. Based off the soils on the cropland acres in the application, do at least 51% of the cropland acres consist of soils with a T Values greater than 3?

Appendix A – CropScape Data

Table 7. Breakdown of crop types and acres in participating counties – 2007 NASS CropScape data.

2007										
County	**County Acres**	**Annual Crop Acres**	**Fallow Acres**	**Small Grain Acres**	**Pulse Acres**	**All Broadleaf Acres**	**% Small Grain**	**% Fallow**	**% Broadleaf**	**% Pulse**
Sheridan	1,015,581	326,174	22,513	252,397	63,834	40,084	77.4%	6.9%	12.3%	19.6%
Daniels	871,278	282,888	37,156	231,462	47,176	49,814	81.8%	13.1%	17.6%	16.7%
Roosevelt	1,426,757	353,353	83,193	316,274	27,921	34,696	89.5%	23.5%	9.8%	7.9%
Richland	1,287,850	199,113	47,208	165,763	7,399	26,151	83.3%	23.7%	13.1%	3.7%
Wibaux	557,902	38,104	3,916	31,212	2,015	3,639	81.9%	10.3%	9.6%	5.3%
Fallon	1,033,010	23,131	7,398	21,404	450	1,121	92.5%	32.0%	4.8%	1.9%

Table 8. Breakdown of crop types and acres in participating counties – 2021 NASS CropScape data.

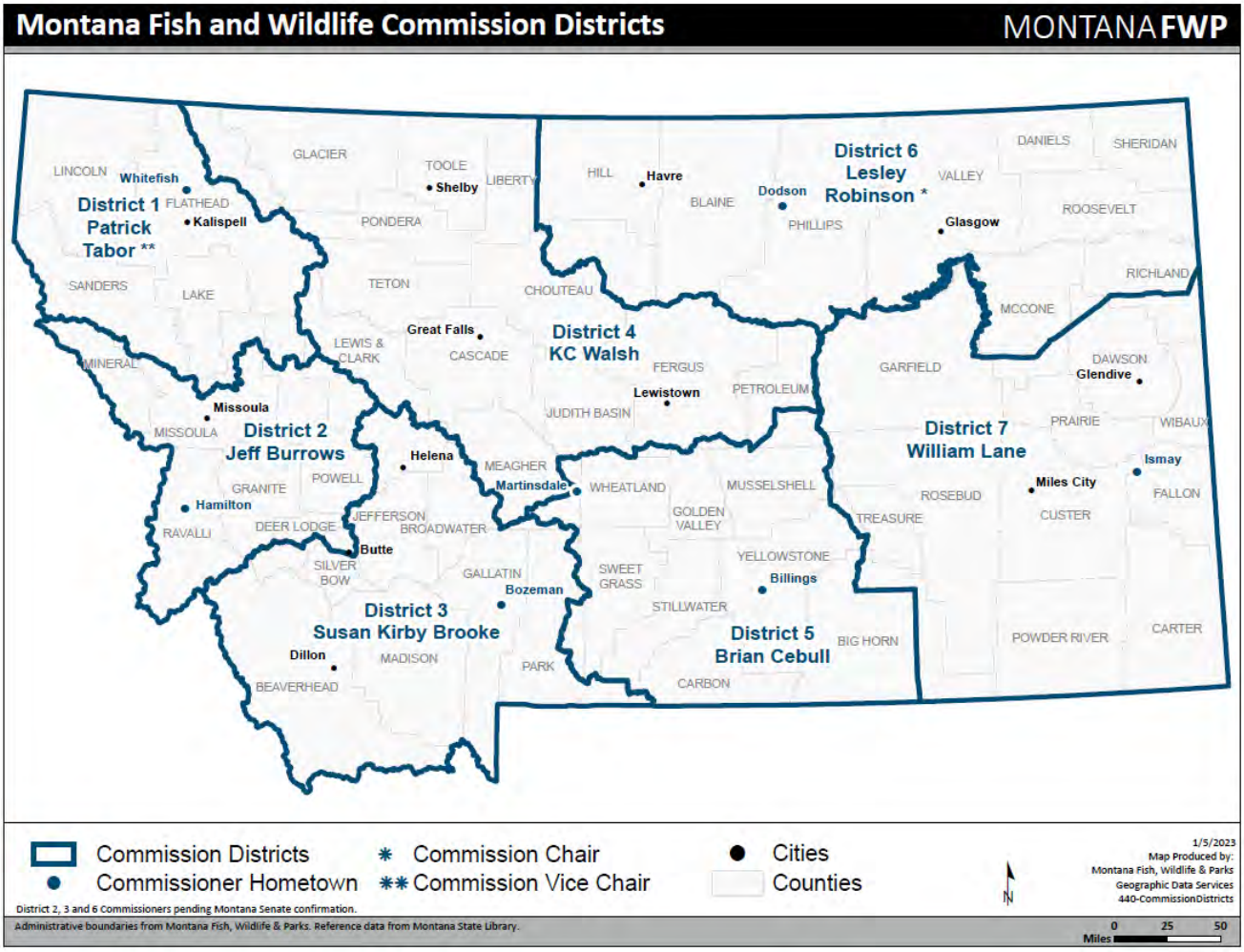
2021										
County	**County Acres**	**Annual Crop Acres**	**Fallow Acres**	**Small Grain Acres**	**Pulse Acres**	**All Broadleaf Acres**	**% Small Grain**	**% Fallow**	**% Broadleaf**	**% Pulse**
Sheridan	1,050,595	561,848	7,491	379,536	155,633	179,893	67.6%	1.3%	32.0%	27.7%
Daniels	899,673	427,870	8,938	317,143	80,736	108,804	74.1%	2.1%	25.4%	18.9%
Roosevelt	1,481,311	606,729	7,962	475,115	94,274	127,658	78.3%	1.3%	21.0%	15.5%
Richland	1,303,264	322,995	597	268,627	16,674	42,496	83.2%	0.2%	13.2%	5.2%
Wibaux	561,505	71,495	475	51,566	8,207	13,557	72.1%	0.7%	19.0%	11.5%
Fallon	1,027,827	54,478	3,281	36,543	4,220	9,325	67.1%	6.0%	17.1%	7.7%

Appendix B – Hairpinning Photos

Figure 17. No/poor seed to soil contact due to hairpinning. Note the wheat seed on top of the flat residue. Seeding was done with a single disc drill into heavy, flat residue, which facilitates hairpinning. Large amounts of flat residue can be difficult for a single disc drill to cut through as it flexes downward instead of being sliced. This prevents seed from being placed in the soil.

Figure 18. Skips in a wheat row due to hairpinning.

Appendix C – MT FWP Districts



Appendix D – NRCS Criteria for Conservation Harvest Management (809) -Naturally Available Moisture Use

Additional Criteria to Improve Naturally Available Moisture Use and Maximize Precipitation Retention

On cropland, leave residue standing through periods of precipitation and snowfall.

- ***Leave residue until after planting (fall or spring) to maximize capture of snow.***

Minimum crop stubble standing height during winter months shall be:

• 10 inches or 80% of the plant stalk height for crops with a row spacing of less than 15 inches;

- ***For Montana, 90% of current year's growth for small grains should be standing, and 80% of current year's growth should be standing for all other crops.***

• 15 inches or 80% of the plant stalk height for crops with a row spacing of 15 inches or greater.

- ***For Montana, 90% of current year's growth for small grains should be standing, and 80% of current year's growth should be standing for all other crops.***

These heights shall be present over at least 80% of the field.

Leaving standing stubble taller than the 15-inch minimum will increase the amount of snow trapped.

- ***For Montana, 90% of current year's growth for small grains should be standing, and 80% of current year's growth should be standing for all other crops.***

References

Economics of Stripper Header and Disc Drill, NRCS draft, 2023.

Rodgers, R.D. 2002. Effects of wheat-stubble height and weed control on winter pheasant abundance. Wildlife Society Bulletin 30: 1099-1112.