Natural Resource Long Range Plan
Joliet NRCS Field Office, Carbon County, Montana
2020

Section I. Introduction

Purpose: To define the current resource concerns, to foster and leverage partnerships, and to focus conservation work for the next 5-10 years in Carbon County, Montana.

Mission: This plan will focus NRCS conservation work in Carbon County, Montana. Relying on the Carbon Conservation District to convene the local working group to gather input from farmers, ranchers, conservation partners and other members of the community to develop a vision for the county. To work with local, state, and federal partners to prioritize resource concerns and help leverage funds to address them.

Partners: There are many conservation partners in Carbon County, including the Carbon Conservation District (CCD), Farm Services Agency (FSA), US Forest Service (FS), Montana Fish, Wildlife, & Parks (FWP), MT Department on Natural Resources and Conservation (DNRC), Soil and Water Conservation Districts of Montana (SWCDM), Montana Association of Conservation Districts (MACD), Carbon County Weed District (CCWD), Montana State University Extension Service (MSU), Bureau of Land Management (BLM), Montana Watershed Coordination Council (MWCC) Montana Department of Environmental Quality (MT-DEQ), Montana Bureau of Mines and Geology (MBMG), Army Corps of Engineers (ACE), Carbon County (CC), Montana Rural Water (MRW) and Local Ditch Companies.

Resource Concerns targeted in this plan:
Soil erosion, wind and water
Surface & ground water quality and quantity
Plant productivity and health
Wildlife, food quality and quantity, cover and shelter

This plan will be reviewed annually, and adjustments will be made as necessary.

Section II. County Profile and Natural Resource Inventory

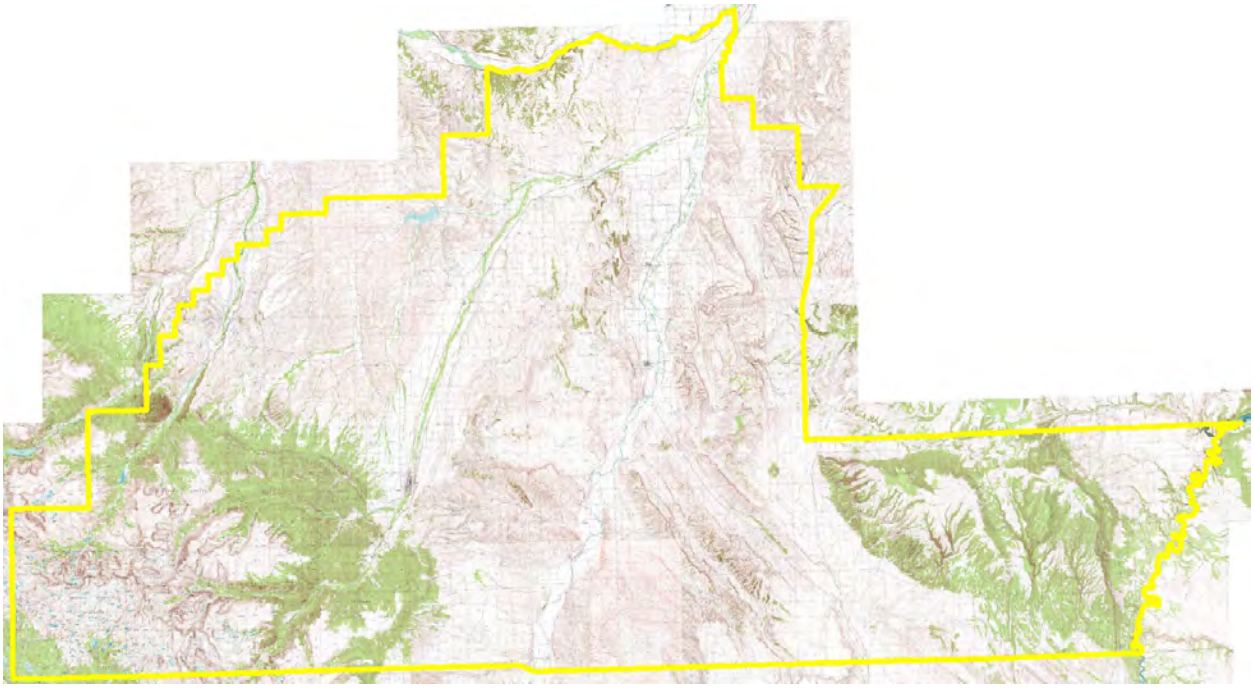
The territory comprised of present-day Carbon County was visited by members of the Lewis and Clark Expedition in 1806. In subsequent years, the area was explored by fur traders and trappers including John Colter. The area was once part of the Crow Indian Reservation until 1877 when a small section around Red Lodge was withdrawn to permit development of the extensive coal deposits there. In 1892 the entire area of Carbon County was opened to settlement and the Crow Reservation boundary was moved to its current location.

Today, Carbon County is 2,062 square miles in size with an estimated population of 10,696 people. Red Lodge is the county seat and the largest town with a population of 2,125. Bridger is the second largest town with a population of 708. There are several small towns along the Rock Creek and Clarks Fork of the Yellowstone River valleys with less population.

The south end of Carbon County is comprised of mainly federal land including 552,021 acres of US Forest Service and Bureau of Land Management. State land in the county includes 41,958 acres. Private land consists of approximately 84,800 acres of irrigated cropland, 92,000 acres of cropland, 543,274 acres of pasture and rangeland and 14,000 acres of private forest.

Physiographical, the area consists of the Rock Creek and Clarks Fork of the Yellowstone River valleys and steep and rolling uplands that merge with the high Beartooth Plateau to the southwest. Elevations range from 3,300 feet to more than 10,000 feet. About 6.2 percent of the county is irrigated, 7.1 percent dryland farmed, 0.8 percent private forest, and 40.2 percent private rangeland (MT Ag Statistics 2018).

There are 726 farms in Carbon County with an average size of 1,090 acres. Livestock production is the principal source of income. Hay, small grains, corn, and silage are grown to supplemental livestock feed. Other important crops include barley, spring wheat, alfalfa seed, dry edible beans, corn, and sugar beets.



Carbon County Topographic image showing the diverse landscape in the county

Carbon County Soils

Carbon County has an interesting and quite complicated geologic history, which has greatly influenced the soil structure of the area. The dominating geologic features of the County are the uplifted mountainous areas in the Beartooth and the Pryor Mountains. The drainage pattern for the entire county is north-northeast from these mountainous regions. As a result, the major stream valleys; e.g., the Clark's Fork Valley and the Rock Creek Valley, are filled with alluvial gravels whose origin can be traced directly to the upper regions. Also, many of the lower valley soils can be traced in part to the alluvium itself. Movement of glaciers from the Beartooth Plateau area resulted in the deposition of glacial till material over the south-central portion of Carbon County. Many of the soils of the upper benches on the north slopes of the mountains were derived from these glacial till deposits. The soils of the Beartooth Plateau itself are chiefly derived from the local rock formations and have been worked and reworked by the action of glaciation and frost heaving. These soils are almost entirely above timberline and are generally regarded as being comprised of very coarse materials.

The soils of Carbon County are categorized into nine great soil groups as outlined in the pedological system of soil classification. These groups include Alluvial, Lithosol, Brown, Chestnut, Chernozem, Sloldized-Solonetz, Grey Wooded, Brown Podzolic, and Soils of the Alpine.

Alluvial soils, as mentioned before, are young soils found along streams and valley floors. The material has undergone little or no modification except for a slight accumulation of organic matter on the surface. In Carbon County, these soils are important in the irrigated areas.

The Lithosols are thin surface soils usually closely underlain by soft or hard rock. They are young soils with relatively little development and are commonly found on mountain slopes and hilly areas. In Carbon County, these soils are used mainly for native range and for grain and hay production.

Brown soils occur in Carbon County where the rainfall is generally less than fourteen inches per year. The soil is characterized by a thin, light-grey surface layer underlain by eight or nine inches of clay and down lower by a grey calcareous layer of one to three feet. Principal uses of this soil in Carbon County are dryland grain production and range.

The Chestnut and Chernozem soils have dark friable surface characteristics with clay and lime layers beneath. The Chernozem soils are generally darker than the Chestnut soils because they have developed under tall and mixed grasses at 16 to 24 inches of annual precipitation. The Chestnut soils have developed under 12 to 16 inches of precipitation. These soils are used principally for dryland grain and hay production plus natural range.

A few small areas of the Chestnut and Brown soils in Carbon County contain solodized-solonetz soils. These soils have thin platy surface soils underlain by a dark layer of hard clay, which is usually alkaline. Spots of this soil within areas of Chestnut or Brown soils will usually produce stunted plant growth.

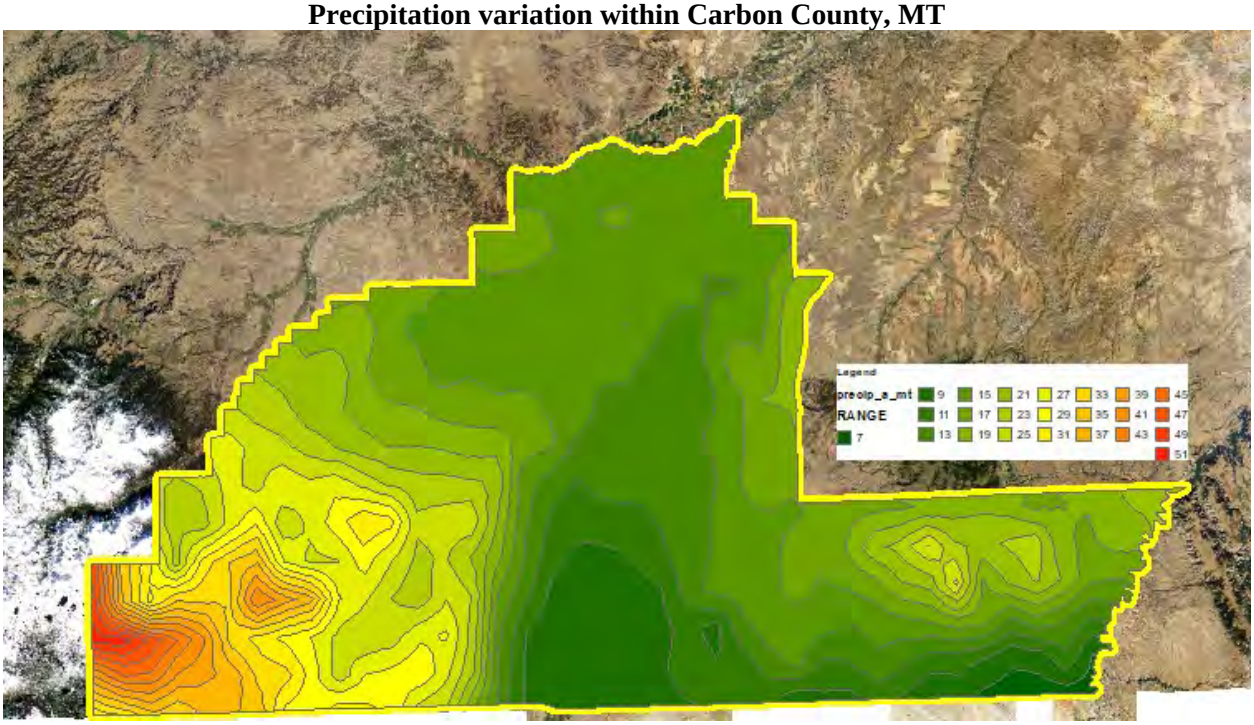
Grey Wooded soils and Brown Podzolic soils both occur primarily in mountainous areas. Whereas Grey Wooded soils are found where the mean annual precipitation is 12 to 25 inches, the Brown Podzolic soils occur in areas with 25 to 50 inches of precipitation per year. Both soils are used most commonly for timber production.

Most of the soils in the county are classified as Highly Erodible Land or HEL. There are NHEL, not highly erodible, soils on the irrigated valley bottoms. The prime agriculture soils are these NHEL river bottom soils.

Water

Precipitation varies, particularly across the mountainous parts of the county. Annual averages range from a maximum of 70 inches near the headwaters of the East Rosebud and Clarks Fork Rivers to less than 6 inches along the Clarks Fork south-southwest of Belfry. Approximately 30 miles separates these two areas. The Belfry area, in the "rain shadow" of the very high mountains, is one of the driest sections of Montana.

Precipitation variation within Carbon County, MT



Watersheds and Streams:

There are 5, 8-digit Hydrologic Unit Code (HUC) watersheds in Carbon County:
Clarks Fork Yellowstone River, Stillwater River, Upper Yellowstone River-Big Lake, Shoshone River, and Big Horn Lake, See Figure 1.

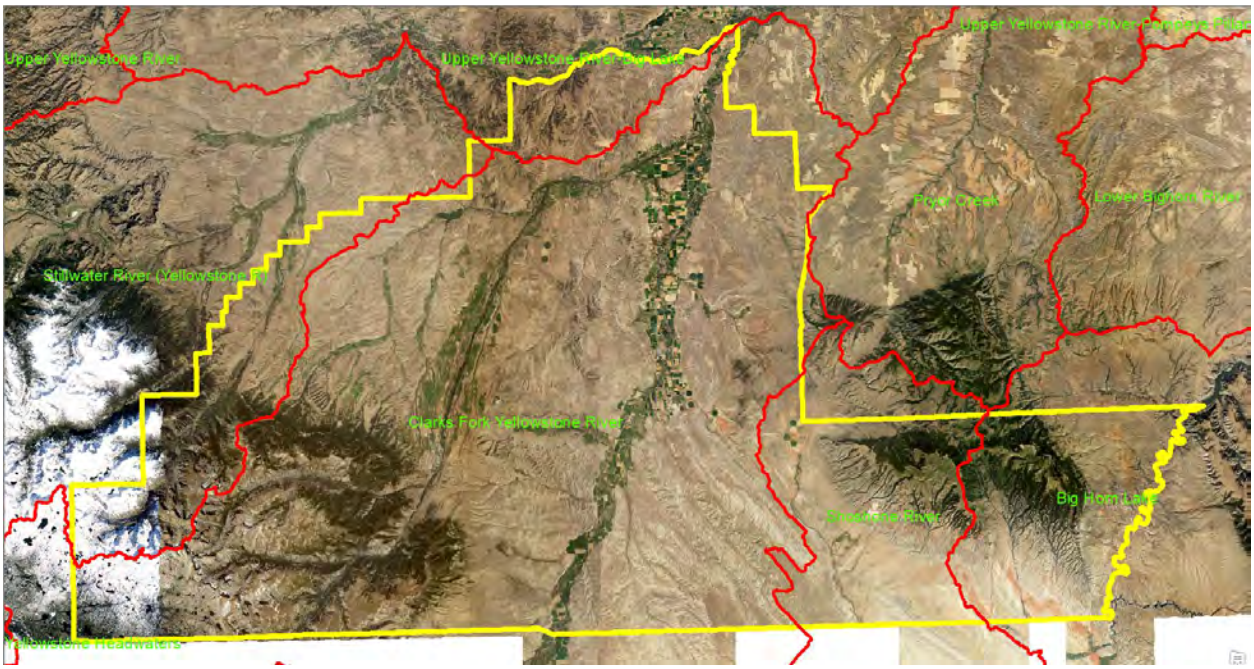
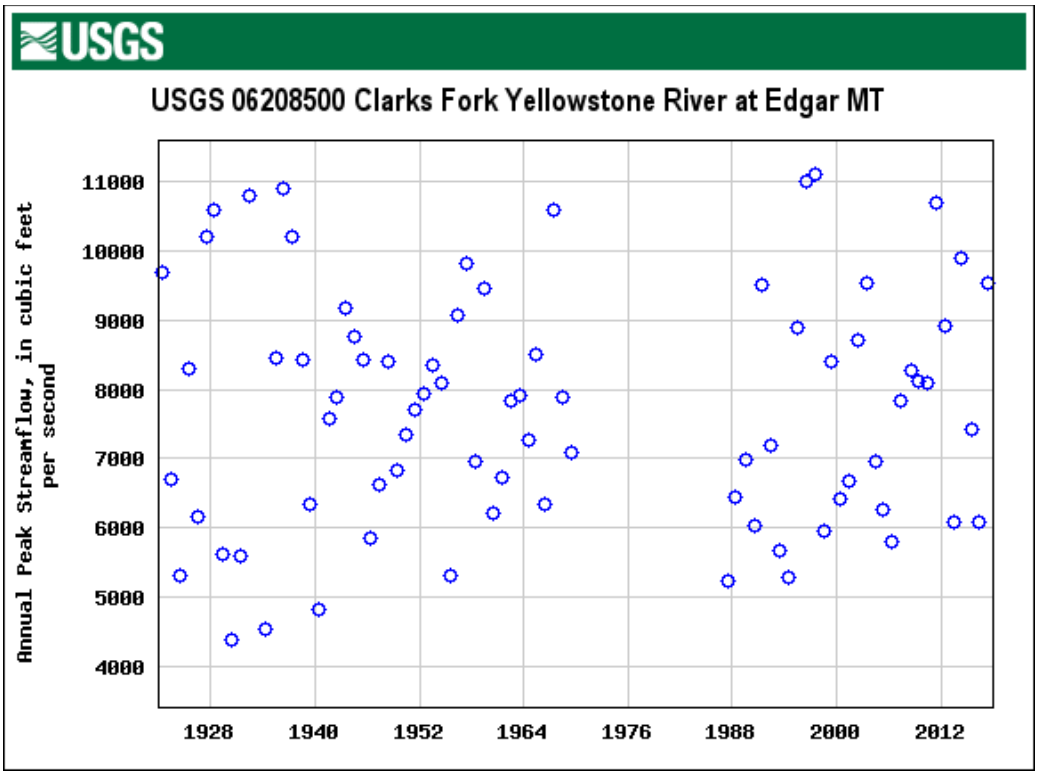


Figure 1, Hydrology
A limited amount of stream flow data is available for the lower Clarks Fork River. There is only one active United States Geological Survey (USGS) Gage Station in the county and it is located near Edgar and is designated *"Clarks Fork Yellowstone River at Edgar (06208500)."*

USGS Gage Station: Clarks Fork Yellowstone River at Edgar (06208500)
Period of Record: Flow measurements have been recorded from July 1921 to Present.

Peak Discharges: The highest peak flows over the last 97 years were:

June 08, 1932: 10,800 cubic feet per second (cfs)
June 02, 1936: 10,900 cfs
June 15, 1996: 11,000 cfs
June 12, 1997: 11,100 cfs
May 28, 2018: 10,500 cfs



Recorded peak flows over the last 97 years.

Mean Monthly Discharges: Over the recorded history of this station, June has the highest mean monthly discharge at 4,460 cfs and February has the lowest at 343 cfs. During the summer, flow is significantly affected by multiple irrigation diversions. The Clarks Fork River drainage area above this gauge station is 2,034 square miles which is approximately 73 percent of the total Clarks Fork River drainage basin.

Perennial streams in Carbon County, a non-comprehensive list:

Yellowstone river Drainage, Big Horn River Tributaries:

Deadman's Creek, Hough Creek, Crooked Creek, Lost Water Creek, and Sage Creek

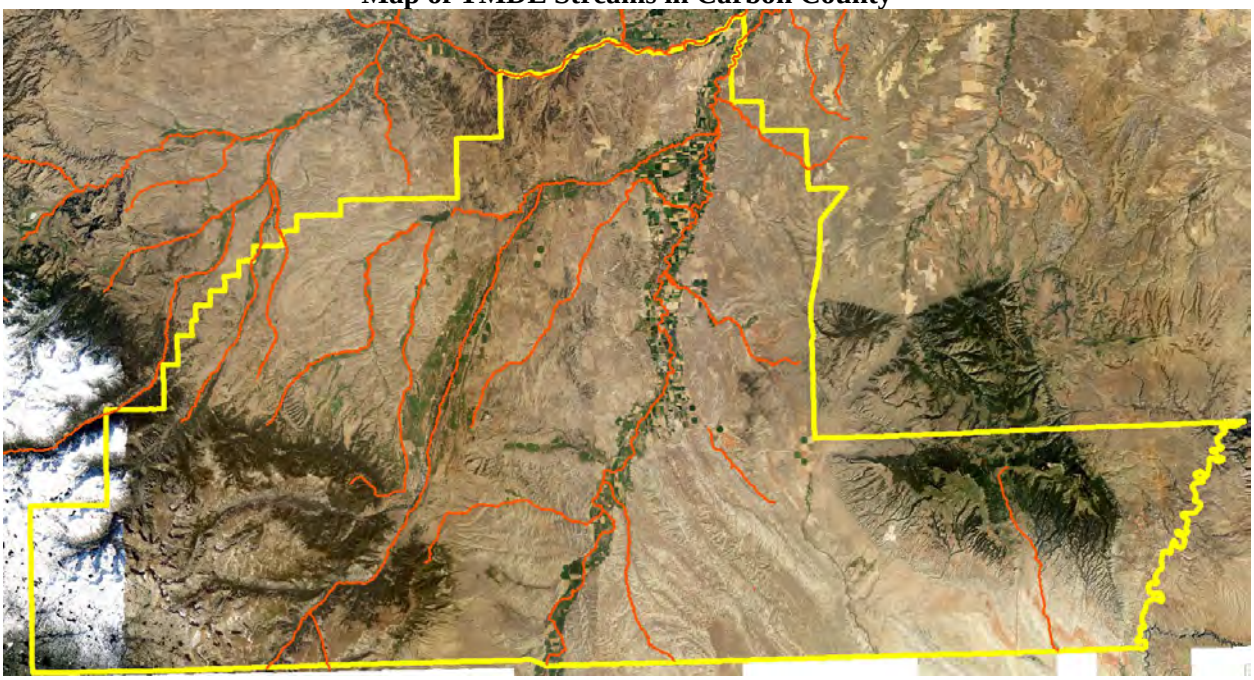
Clarks Fork of the Yellowstone River Tributaries:

Barlow Creek	*Maurice Creek*	*Bear Creek*	*Morris Creek*
Blue-Prewitt	*Piney Creek*	*Bluewater Creek*	*Powers Creek*
Bridger Creek	*Red Lodge Creek*	*Bull Creek*	*E. Fork of Red Lodge Cr*
Butcher Creek	*W. Fork of Red Lodge Cr*	*S. Fork of Butcher Cr*	*Rock Creek*
E. Fork of Butcher Cr	*W. Fork Rock Creek*	*W. Fork of Butcher Cr*	*Lake F.– Rock Creek*
Chaffin Creek	*East Rosebud Creek*	*Clear Creek*	*Rye Creek*
Cole Creek	*Sand Creek*	*Corral Creek*	*Schroeder Creek*
Cottonwood Creek	*Seeley Creek*	*Cow Creek*	*Shank's Draw*
Dry Creek	*Sheridan Creek*	*South Fork of Dry Cr.*	*Silver Tip Creek*
Elbow Creek	*Spring Creek*	*Five Mile Creek*	*Stanley Creek*
Harney Creek	*Tangelwood Creek*	*Hellroaring Creek*	*Thiel Creek*
Hogan Creek	*Volney Creek*	*Ingersol Creek*	*Willow Creek*

Water quality impaired and Total Maximum Daily Load (TMDL) streams determined by Montana Department of Environmental Quality (DEQ):
Butcher Cr, East Rosebud Cr, Bluewater Cr, Willow Cr, Clarks Fork River, Rock Cr, Red Lodge Cr, Bear Cr, West Rosebud Cr, Wyoming Cr, Silver Tip Cr, Cottonwood Cr, South Fork Bridger Cr, Crooked Cr.

Probable causes of impairment: nitrates, nitrogen, sediment, turbidity, temperature, phosphorous

Map of TMDL Streams in Carbon County



Irrigation Districts in Carbon County: total 84,800 acres:

Antelope Basin Ditch
Bailey Ditch Company
Bartlett Canal Company
Bridger Ditch Company
Clarks Fork and Silver Tip Ditch Company
Clear Creek Ditch Company
Consolidated Ditch Company
Danford Irrigation District
Dry Creek Canal and Ditch Company
Elbow Ditch Company
Finn Ditch Company
Glennwood Ditch Company
Golden Ditch Company
Grove Creek Canal Company
Haara Ditch Company
Highline Ditch Company
Holland Ditch Company
Joliet Irrigation Company
Mutual Ditch Company
New First Chance Ditch Company
Orchard Canal Company
Pleasant Valley Canal Company
Pryde Ditch Company
Red Lodge-Rock Creek Project
Riverview Ditch Company
Rock Creek-Clear Ditch Company
Rocky Point Ditch Company
Sand Creek Canal Company
Shoshone Project
Last Chance Ditch Company
Weast Irrigation Ditch
West Fork Irrigation Company
White Horse Canal Company
Wills Canal Company
Youst Ditch Company

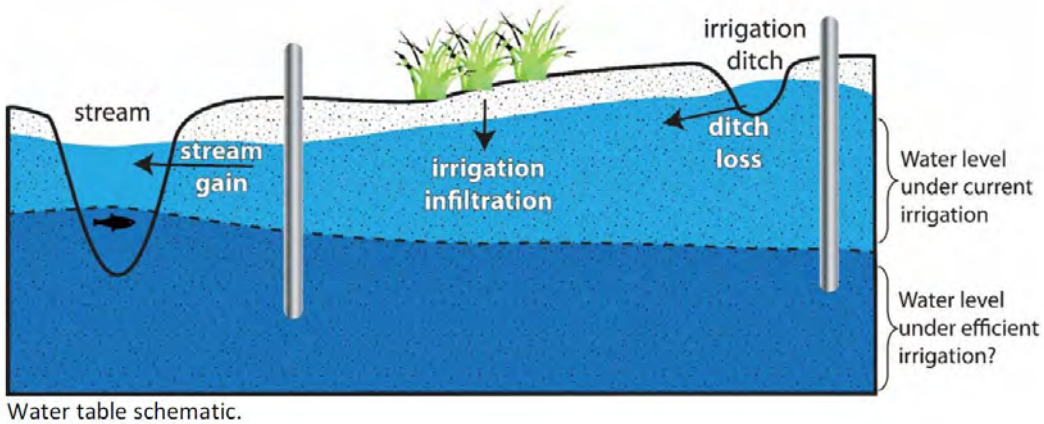
Groundwater:
Carbon County is divided into three general areas based on geology and physiography which include the Beartooth Plateau, Pryor Mountain, and the Basin area.

The hydrologic significance of the Plateau lies in its being a recharge and surface-water storage area, because of its high amount of precipitation and runoff to recharge streams and lakes. The Groundwater Information Center (GWIC) indicate wells drilled in the mountain reaches of Rock Creek and other streams have yields of 3-50 gallons per minute (gpm) with 13 to 24 feet of drawdown.

The Pryor Mountains consist mostly of sedimentary limestone of the Madison Group. The limestone is fractured and has dissolution features which include karst and caves. Precipitation can soak into cracks and holes and offer significant recharge to the limestone aquifer. Discharge areas hosts large-yielding springs and wells. Bluewater Springs reportedly sustains Bluewater Creek with an annual flow rate of 27.4 cfs. Large-yielding artesian wells have been developed in the Madison limestone aquifer.

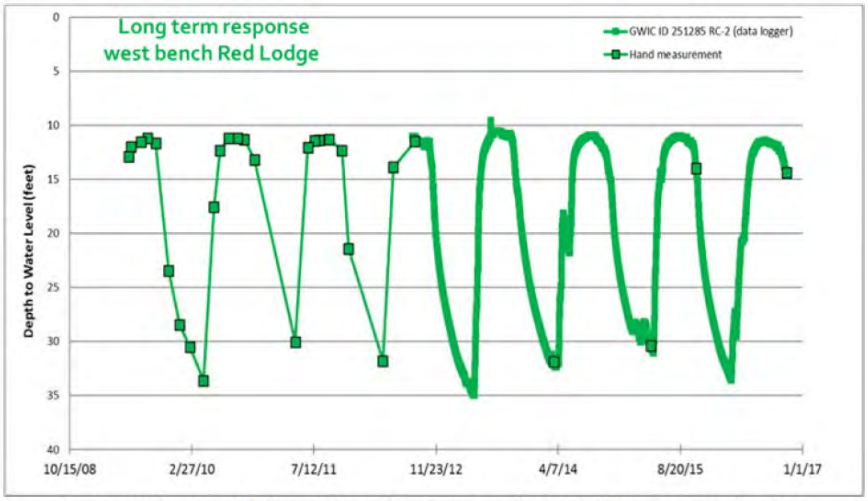
The Basin area includes all of Carbon County between the Beartooth Plateau and the flank of the Pryor Mountains. Most of the population is located in the valleys and they depend entirely upon groundwater for potable water through either public water supply wells or individual domestic wells. The average depth of the alluvium in the major valleys is about 30 feet, much of the material is sand and gravel and well yields range from 5 to 50 gpm. Irrigation effects dominate the hydrology in the alluvial valley. Irrigation canals convey water out of the rivers by way of rock-constructed weirs. The water is then transported across fields through unlined canals. Flood irrigation is the main form of irrigation; however, center pivots and sprinkler systems in the valley are also supplied by canal water. Land use changes from agricultural to domestic and changes in irrigation practices from flood irrigation to sprinkler irrigation may reduce shallow groundwater storage that could have adverse effects on well supplies and the Clarks Fork River flow rates, and temperate especially in periods of low flow.

See below schematics from MBMG. (Montana Bureau of Mines and Geology 2019)



Water table schematic.

Irrigation practices influence the shallow groundwater and streams through applied irrigation and ditch leakage. Depending upon the specific stream, the additional water from irrigation can change a stream from losing water (dark blue in above schematic) to gaining water (light blue).



Seasonal groundwater level response from irrigation recharge.

Plants

Native rangeland makes up approximately 75 percent of the county. For the most part, the rangeland in the county is still comprised of the native plant community, which includes: bluebunch wheatgrass, green needlegrass, western/thickspicke wheatgrass, sandberg bluegrass, blue grama, praire junegrass, sedges, purple prairieclover, dotted gayfeather, winterfat and wyoming big sagebrush. However, today these plant communities are shifting in species composition to less productive and less desirable species. Also, winter annual grasses, noxious weeds, and conifer trees (juniper and ponderosa pine) are invading these rangelands and contributing to their decrease in condition and overall rangeland health and function.

Much of the private forestlands consist of ponderosa pine and douglas fir communities with higher elevation forests having douglas fir, lodgepole pine, engelmann spruce, and sub-alpine fir. Most of the private forestland is utilized throughout the summer for cattle grazing. The private forests have been logged for timber in the past. A standard practice was to harvest all the prime timber and leave the less desirable trees (trees with forks, crooks and sweeps) for a seed source. Today many timber stands have been high graded to a lesser quality, they are also overstocked as a lack of markets has reduced harvest over the last decade. Many of these stands are experiencing an increase in disease and insect pressure due to a lack of management.

The riparian area along the Clarks Fork of the Yellowstone River and some of the tributaries have become invaded with Russian olive and saltcedar. Russian Olive can be found along the whole reach of river, whereas saltcedar has been found from south of Edgar to the confluence of the Yellowstone River.

Fish and Wildlife

Streams in Carbon County vary in their ability to produce trout. Rock Creek is known to be the best, however there are reaches of the creek that produce better than others. The Clarks Fork of the Yellowstone River is an important spawning river for trout. In 2017 and 2018, Montana Fish, Wildlife & Parks (FWP) biologists conducted present/absent surveys on the Clarks Fork of the Yellowstone River and found the following species present in the following reaches:

Near Bridger: burbot, Flathead chub, longnose sucker, mountain sucker, rainbow trout, white sucker;
Bridger to Fromberg: brown trout, common carp, goldeye, longnose sucker, mountain whitefish, rainbow trout, shorthead redhorse, white sucker, Yellowstone cutthroat trout;
Fromberg to Edgar: brown trout, burbot, channel catfish, flathead chub, longnose sucker, mountain sucker, shorthead redhorse, stonecat, white sucker;
Edgar to Silesia: burbot, channel catfish, longnose sucker, shorthead redhorse, stonecat, white sucker;
Silesia to the Yellowstone River: brown trout, burbot, flathead chub, longnose sucker, shorthead redhorse, stonecat, white sucker.

There is a fish hatchery at the head of Bluewater Creek. The Beartooth Plateau contains many lakes, and most are stocked with trout and provide an excellent source of recreation.

Mule deer are the most abundant big game species found throughout the county. The Pryor Mountains offer some of the state's finest deer hunting. Whitetail deer and elk are becoming more abundant. In 2017 chronic wasting disease was discovered in deer in the county. More and more antelope (pronghorn) are found in the county. Mountain goats are found at the upper west fork of the Rock creek drainage, along with bighorn sheep up the plateau.

Predators such as grizzly bears and wolves are increasing. Grizzly bears made their return to the Beartooth front in 2010. Today there are numerous bears along the whole front. Livestock have been killed by wolves shortly after wolf reintroduction to Yellowstone National Park.

Lynx are a priority species for the county. Critical lynx habitat in the Beartooth Mountains consists of montane spruce/fir forest above 4000 feet elevation.

Upland birds include ring-neck pheasant and Hungarian partridge and are mostly found in suitable cover along the stream bottoms and cultivated fields. Sharp tailed grouse are in the uplands. Blue and Ruffed Grouse are found in timbered areas. Chukars may be found in the rough rocky country of eastern Carbon County. Sage grouse are found in the sagebrush prairie in the central part of the county. There is a sage grouse core area that stretches along the state border with Wyoming from the Pryor Mountains to the Beartooth Mountains north to Bridger MT. This area is where most of the breeding leks are located where over 75 percent of the sage grouse activity takes place.

Animal Species of Concern
The MTNHP Animal Species of Concern Report last updated on October 31, 2019 lists 53 animal species of concern for Carbon County. Species of Concern are defined as native taxa that are at-risk due to declining population trends, threats to their habitats, restricted distribution, and/or other factors.
For additional information on Species of Concern, check out the State Website.
http://mtnhp.org/SpeciesOfConcern/

Threatened and Endangered Species
The U.S. Fish and Wildlife Service (USFWS) has listed two animal species as threatened and two as proposed to be listed under the Endangered Species Act for Carbon County.

USFWS Endangered, Threatened, Proposed and Candidate Species	
Canada lynx	Threatened with Designated Critical Habitat
Grizzly bear	Threatened
Wolverine	Proposed
Western glacier stonefly	Proposed
Whitebark pine	Candidate

Section III Conservation Activity Analysis

In the last 10 years the Carbon Conservation District and the local NRCS office have achieved work in Russian olive removal (170 acres), cropland seeding to perennial pasture (2,834 acres), moving animal feeding operations off perennial streams (5 operations), livestock water development (9 systems), prescribed grazing systems in sage grouse habitat (12,717 acres), and reducing soil erosion by converting cropland from flood irrigation to sprinkler irrigation (17 pivots on 1,179 acres) .

In the last 5 years substantial progress has been made with reducing soil erosion in irrigated beet systems. This can be attributed to the Carbon Conservation District hosting field tours in 2015, 2016, and 2017, as well as NRCS outreach through soil health events, publications and presentations at the biennial Malt Barley and Sugar Beet Symposium. These outreach efforts have focused on the benefits of reduced tillage. One publication is "Economics of Reduced Tillage in Sugar Beets" by Susan Tallman 2017, Area Agronomist Bozeman, MT NRCS. This report highlights six sugar beet producers across Montana (two of which are in Carbon County), showing a partial budget for each one, and comparing their previous conventional tillage operations to their current reduced tillage operations. Farming inputs such as operating expenses, capital expenses, labor, and time are evaluated. Additionally, conservation factors such as average soil loss from wind erosion, Soil Tillage Intensity Rating (STIR), and Soil Condition Index (SCI) are evaluated. On average, these six producers estimated savings of 21 to 57 percent in ownership and operating costs when they converted to a reduced tillage system in their sugar beet rotations. The operators significantly reduced their machinery usage, which translates into tremendous fuel, maintenance, and labor savings. Their soils benefitted with significant decreases in wind erosion and with improvements to soil condition from changing their farming methods.

Shawn Kuzara, hydrologist with the Montana Bureau of Mines and Geology (MBMG), has partnered with the Carbon CD for two groundwater investigation projects. The first was a 3-year study evaluating groundwater levels in domestic wells in the Rock Creek Valley from Red Lodge to Rockvale. This study emphasized the importance of irrigation to the shallow alluvial valley and found that leaky irrigation ditches and deep percolation from flood irrigation water replenishes ground water. This study also promoted ground water monitoring work with a participant near Edgar who was converting from flood irrigation to pivot irrigation with an NRCS Environmental Quality Incentives Program (EQIP) contract. It also led to MBMG being asked to be a partner in the Regional Conservation Partnership Program's Yellowstone Regional Agriculture Sustainability Project (RCPP-YRASP). MBMG is establishing monitoring for RCPP contracts to capture the groundwater differences displayed from irrigation efficiency conversion.

Shallow monitoring wells are installed to characterize groundwater conditions in and around irrigated fields. The total number of wells is dependent upon location and depth of the aquifer. The monitoring wells are equipped with water-level data loggers that record information on an hourly basis. Monitoring will take place for a minimum of two irrigation seasons, pre and post pivot installation. Water level results and interpretations from RCPP fields will be integrated with other irrigated fields monitored by the Montana Bureau of Mines and Geology to provide a broad understanding of the influence irrigation practices have in the watershed. This information will be shared with RCPP participants, partners, and conservation districts and made publicly available through the Montana Bureau of Mines and Geology.

In 2018 the Carbon CD received a 223 grant from Montana Department of Natural Resources and Conservation (DNRC) to have a river assessment completed for the Clarks Fork of the Yellowstone from South of Bridger to the confluence of the Yellowstone. The assessment was completed in late summer of 2018 and the final report was generated in June 2019. This report is available on the Carbon

Conservation Districts website, https://www.carbonconservationdistrict.com/. Many priority projects addressing resource concerns are listed in this assessment.

In 2019 the Carbon CD received a DEQ Voluntary Monitoring grant. The purpose of this grant is to establish a base line for water quality throughout the irrigation season. The Clarks Fork Irrigators have been blamed for adding significant nutrients and turbidity to the river. The sampling strategy is to sample the first of each month (May through October) at eight bridges (Laurel, Theil, Silesia, Edgar, Fromberg, Bridger, Belfry, and Chance) 2 miles from the WY state line. The sampling included Total Suspended Solids (TSS), Total Persulfate Nitrogen (TNP), Total Phosphorus (TP), and nitrate & nitrite (NO2+3). The goal of this sampling is to establish a base line of these nutrients prior to, during, and following the irrigation season.

Section IV. Resource Concern Overview

Soil Erosion from Wind

Soil erosion has been the priority resource concern for the county for over 100 years and continues to be a concern. Today, erosion is the highest in sugar beet rotations. Sugar beets are an important cash crop for local farmers and the agriculture industry in Montana. Sugar beets have been produced in the area since 1906. However, conventional sugar beets are produced with intensive tillage and little crop residue is left after harvest. This creates the potential for large amounts of erosion from both wind and water via furrow irrigation.

All beets grown are purchased by the Western Sugar Cooperative and processed at the factory in Billings. Western Sugar requires growers to grow beets no more than every third year. Typical crop rotations include beets-malt barley-malt barley and beets-malt barley-silage corn. Therefore, it is reasonable to triple the amount of beet acreage in any given year to find the total acreage in any phase of the beet rotation. We estimate 9,300 total acres in beet production in Carbon County.

Beets are a high value crop, usually grown on irrigated river valley land on the most productive soils. Producers received $36.60 per ton of beets in 2016, with an average yield of 35 tons per acre, resulting in a gross profit of $1,281 per acre. This is down from the decadal high price of $71.90 per ton reported in 2011 on an average yield of 26 tons per acre, resulting in a gross profit of $1,869 per acre.
In contrast, winter wheat is a low value crop per acre and is usually grown under dryland conditions on a wide variety of soil types. Producers received $3.88 per bushel of winter wheat in 2016, with an average yield of 49 bushels per acre, resulting in a gross profit of $190 per acre.

Because beets are a high value crop, producers rely heavily on this crop in their rotation for income and have less tolerance for costly mistakes. Likewise, with beet prices at historic ten-year lows, farmers have little room for error and must re-coup all costs of production on every acre. Any solutions we propose must recognize and respect this fact.

Wind Erosion: Beet production in Carbon County is mostly limited to a narrow border on either side of the Clarks Fork of the Yellowstone River. The river runs north from Wyoming and flows into the Yellowstone River at Laurel, MT (see Figure 1).

Fig. 1. Beet production area of Carbon County, MT indicated by green band along the Clarks Fork River.

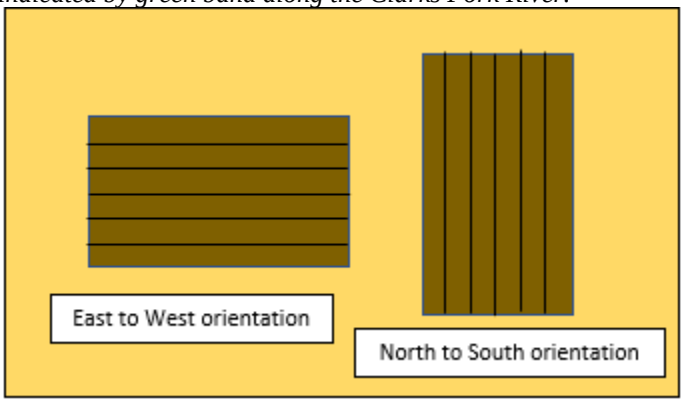


Fig. 2. Orientation comparison

Most beet fields in Carbon County are oriented east to west to accommodate drainage towards the river (see Figure 2). Both the furrow irrigation and tillage operations are conducted in this east to west direction. In contrast, almost all dryland fields in Montana are oriented north to south to decrease the unsheltered distance perpendicular to the prevailing westerly winds. In general, fields-oriented east to west in Montana will be more vulnerable to wind erosion compared to fields oriented north to south. We interviewed three Carbon County farmers to understand wind erosion in conventional beet operations. We then ran erosion modeling software called the Wind Erosion Prediction System (WEPS) to calculate the average annual erosion across a three-year rotation. Results are listed in Table 2. (Beet Systems in Carbon County 2019)

Table 2. Wind erosion in conventional beet production, Carbon County, MT.

Farmer	**Rotation**	**Average Annual Wind Erosion (ton/acre)**
A	Beet-barley-silage corn	3.4
B	Beet-barley-barley	7.1
C	Beet-barley-silage corn	29.5
AVERAGE		**13**

We estimate 80% of beet acres in the county are still farmed conventionally, resulting in approximately 97,720 tons of wind erosion in Carbon County.

(9300 acres x 0.8 x 13 ton/acre/year wind erosion = 96,720 tons erosion /year)

Soil Erosion from Water

Irrigation-induced Erosion: Another main erosion pathway in these beet systems is via irrigation induced erosion. Large amounts of sediment are flushed out of the fields every June when the furrow irrigation is turned on. This process results in sediment transport to surface water and negatively impacts water quality by increasing turbidity as well as nitrogen and phosphorus levels. NRCS interviewed two Carbon County farmers with furrow irrigation and used the graphs from the MT Irrigation Manual to calculate erosion levels. Results are listed in Table 3. (Beet Systems in Carbon County 2019)

Table 3. Irrigation-induced erosion in conventional beet production, Carbon County, MT.

Farmer	**Rotation**	**Average Annual Irrigation-induced Erosion (ton/acre)**
B	Beet-barley-barley	3.8
C	Beet-barley-silage corn	9.7
AVERAGE		**6.75**

Irrigation-induced erosion (IIE) is highly dependent on the crop type grown. Calculations show that small grains, such as barley, have little to no IIE. Beets have a moderate amount of IIE, and corn has the most. It was estimate that 75% of beet acres in the county use furrow irrigation, resulting in approximately 47,081 tons of erosion every year. This erosion drains directly to the Clarks Fork River as sediment. NRCSs plans to work with DEQ to get water samples measuring sediment load in the future.

(9300 acres x 0.75 x 6.75 ton/acre/year irrigation erosion = 47,081 tons/erosion/year)

Total Erosion: **With both wind and irrigation-induced erosion, it is estimated that approximately 143,801 tons of soil are lost every year from irrigated beets systems in Carbon County.**
(Beet Systems in Carbon County 2019)

Water Quality and Quantity- Surface and Groundwater:

Surface Water
Irrigated cropland is the highest priority for water quality. As mentioned in the *soil erosion from water* section above, water leaving traditionally irrigated fields contributes to surface water quality degradation. Focused conservation efforts to work with producers to reduce tillage and irrigation induced erosion will improve water quality. The Clarks Fork of the Yellowstone River Assessment documents irrigated water return flows returning to the river. The assessment states that there are multiple return flows and waste ways that produce a sediment plume into the Clarks Fork river that can be seen for nearly a mile. These return flows are adding large concentrations of sediment and crop nutrients adhered to the sediment to the river.

Ground Water
Ground water quantity is directly linked to surface water. As we work with producers on irrigation sprinkler/drip tape projects, we want the ability to evaluate pre and post groundwater levels. The unintentional, and sometimes negative, consequences of efficient irrigation are controlled by local conditions, such as the geology or location within the watershed. Irrigators can use this understanding to select fields for center pivots or drip tape installation that will protect domestic water supplies. However, not enough is known about the interrelated factors that influence groundwater recharge, e.g. the importance of ditch leakage versus applied irrigation, to help irrigators make these important decisions.

It is important for future irrigation projects to continue the ground water investigation work of Montana Bureau of Mines and Geology. Over time, this will provide a better understanding of how irrigation systems influence ground water, and how changes in irrigation efficiency can inadvertently impact the groundwater resource. The better educated we become on surface/groundwater interaction; more informed decisions can be made to provide the benefits of irrigation efficiency while protecting the groundwater resource.

Headquarters
Carbon County has at least 100 small livestock operations with cattle, horses, and other animals. Many of these are located near waterways and deliver nutrients, organic material, and potential pathogens downstream. These livestock operations are usually not monitored by MT DEQ and don't require CAFO permits. A high percentage of such operations could be considered low management. The headquarters and barn areas are typically muddy, ponded and have surface run-off with substandard housing and wintering areas. In some cases, livestock are not excluded from waterways or wetland access. Many of these small AFO's would benefit from being moved away from the nearby water sources, as well as having off-site water sources installed in order to prevent livestock access from rivers and creeks.

Plant Productivity and Health
Much of Carbon County is overgrazed resulting in decreased plant productivity and health. There are many factors that contribute to this, one being the size of land ownership. Although there are large ranches along the Beartooth front, most operations in the county tend to be small, as land in the county is highly subdivided. Most livestock producers also have a town job, taking time away from managing their operation. Operations rely on leased land to increase their grazeable acres to make raising livestock worthwhile. Most of the time the leased land is separate from the home place, complicating logistics. Because of this, herds are split and trailered to the different properties for the grazing season. This often leads to continuous grazing as pastures typically receive the same season of use from year to year for most of the summer. A lack of investment in infrastructure, such as livestock water and cross fence, also contributes to grazing the same pasture for too long. The home place typically has animals from November through May for winter feeding and calving. Pastures here also receive the same use, with feeding, calving, and spring grazing typically happening in the same locations. A lack of management

with continued spring use by livestock is hardest on cool season grasses. Generally, there is a lack of caring and education for the rangeland resource. Producers and owners seem to be focused on the dollars generated in the short term.

According to the Carbon County Weed District, there are many noxious weeds throughout the county that can spread at a rate of 27% per year. Leafy spurge alone accounts for 27,450 acres of the county (2018 Weed Management Plan). Other noxious weeds include spotted knapweed, Russian knapweed, dalmatian toadflax, whitetop, sulphur cinquefoil, purple loosestrife, saltcedar, absinith wormwood, scotch thistle, milk thistle, musk thistle, common mullein. Other invasive species that reduce productivity in the county include russian olive, cheatgrass, Japanese brome, and ventenata.

Wildlife habitat, food quality and quantity, cover and shelter
Fish habitat decreases with a lack of streambank vegetation, impacted by overgrazing, and poorly executed rip rap along the streambank accounts for accelerated erosion. Accelerated erosion can exacerbate channel movement that influences the physical characteristics needed by trout to flourish such as a meandering channel, shallow riffle areas, deep pools are important. Proper vegetation along the streambank provides overhead cover. It also binds soil, preventing accelerated erosion, and yet permitting water to undercut the bank, forming a pocket or hole, which is needed habitat for fish that allow them to flourish. Other important native fish to the county include sauger and ling. Fish Wildlife & Parks are currently looking into fish passage issues due to full width irrigation diversions. Their study will be ongoing for the next few years.

Several tributaries have historically been used as irrigation waste ways that have severely down cut the lower end of these creeks. Tributaries most affected by this include, Bluewater, Sand, Elbow and Bridger Creeks. These streams would need to have a comprehensive assessment completed to determine options for bank stability, water quality improvements, irrigation influences, riparian restoration, and fish habitat.

As the trend of rangeland health decreases and desirable native plants are replaced by less desirable plants (increasers, invaders, and noxious weeds) the quality of wildlife habitat will continue to decrease.

Section V. Resource Concern Prioritization for Future Work

Resource Concern Development*:* Prioritization of resource concerns in Carbon County is a collaborative effort with Carbon Conservation District, state and federal agencies, Non-Governmental Organizations (NGO), and local producers. Regular interactions help facilitate knowledge sharing of resource concerns as well as strengthen partnerships. Once a year we actively pursue input in a formal setting with our Local Working Group (LWG) meeting. We bring together partners from across the county including County Commissioners, Montana Fish Wildlife & Parks (FWP), Conservation District, Bureau of Land Management (BLM) and United States Forest service (USFS). These meetings identify and determine the priority resource concerns, how to address it, the area or areas affected by a resource concern, and potential strategies for addressing the concern. In accordance with Montana Focused Conservation (MFC) we will develop a Targeted Implementation Plans (TIP), commonly referred to as TIP's. Funding will be committed to the TIP using the Environmental Quality Incentives Program (EQIP) as allocated from the Farm Bill.

1) **Soil Erosion**

Tillage Reduction*:* NRCS believes that most farmers can reduce tillage to some extent, regardless of equipment, soil type, and irrigation system. One farmer in the county is a leader in reduced-tillage beet production. This farmer has reduced his tillage so that beet harvest is his only full-width tillage during the

rotation. Wind erosion levels are close to zero by using no-till methods. Several resources exist to help farmers reduce tillage. The 2016 "Economics of Reduced Tillage" publication outlines the rotation operations of six reduced-tillage beet farmers and shows the economic savings. Likewise, the 2018 "No-Till Sugar Beets in Montana: Producer Perspectives" video gives detailed information on planter set-up from four reduced-tillage farmers. https://www.youtube.com/watch?v=PMXz_MKzRC4

One piece of information that may be lacking is field trials on managing crop residue. Farmers continue to ask how to manage crop residue from barley or grain corn in reduced tillage systems, and most reduced tillage farmers still burn their ear-corn stover. On-farm field trials would help to bridge this information gap.

Irrigation improvements: Reducing tillage does not significantly alter irrigation-induced erosion. However, switching to sprinkler or sub-surface drip irrigation eliminates irrigation- induced erosion completely.

2) Ground Water Monitoring

Continue working with the Carbon Conservation District and Montana Bureau of Mines and Geology and include ground water monitoring in future irrigation efficiency projects. MBMG has secured grant funding for 2 additional projects. More funding will be needed to continue this work. Work with partners in this effort, over time we hope to better understand of how changes in irrigation efficiency affects the alluvial groundwater aquifer.

3) Saltcedar Removal

As identified in the 2019 Clarks Fork Yellowstone River Assessment Site 3.25 (south of Edgar), "This site is the uppermost sighting of saltcedar. Infestations of saltcedar are generally light all the way to the confluence. A window of opportunity now exists for an aggressive salt cedar elimination program that needs to be initiated soon before infestations are out of control." Partner with the Carbon CD, Carbon Weed District and others, to make progress on saltcedar control. Outreach and educational workshops are needed to make landowners aware of saltcedar and the benefits of its control and help generate interest.

4) Conifer Tree Encroachment

Prioritize an area that would directly benefit current greater sage grouse use of USFWS "core or general" habitat, where invading trees are limiting habitat. Possibly partner with State and/or BLM land that is to be treated as well to increase the area of treatment. Work with Biologists and other partners to refine areas of treatment. Outreach and educational workshops maybe needed to generate interest. It is estimated that there are 20,000 acres of conifer tree encroachment in the county.

5) Range Management

Work with the Carbon CD and the LWG (and other partners) to generate interest with landowners in a watershed to address plant productivity and health. Develop individual conservation plans with landowners/operators to improve rangeland management that can impact the whole watershed. Develop a TIP to provide the funding for individual to implement the facilitating practices (such as livestock water and cross fences) to make grazing management and positive rangeland health trend possible.

6) Perpetual Easements

Work with Non-Government Organizations (NGOs) that hold perpetual easements, as well as interested landowners who want to keep their land in production agriculture. Areas of priority would be groups of

connecting landowners in areas of special significance, such as river valley bottoms and sage grouse habitat.

7) Ventenata Control

Partner with the Carbon County Weed District and Carbon Conservation district to provide education and to promote ventenata control. Provide landowner workshops to help get the word out on current infestations and alternatives for control. Develop a TIP to provide cost share assistance in the expense of controlling this new priority noxious weed in the county.

8) AFO / CAFO RELOCATION

Work with landowners to relocate confined feeding facilities so they do not impact state waters.

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