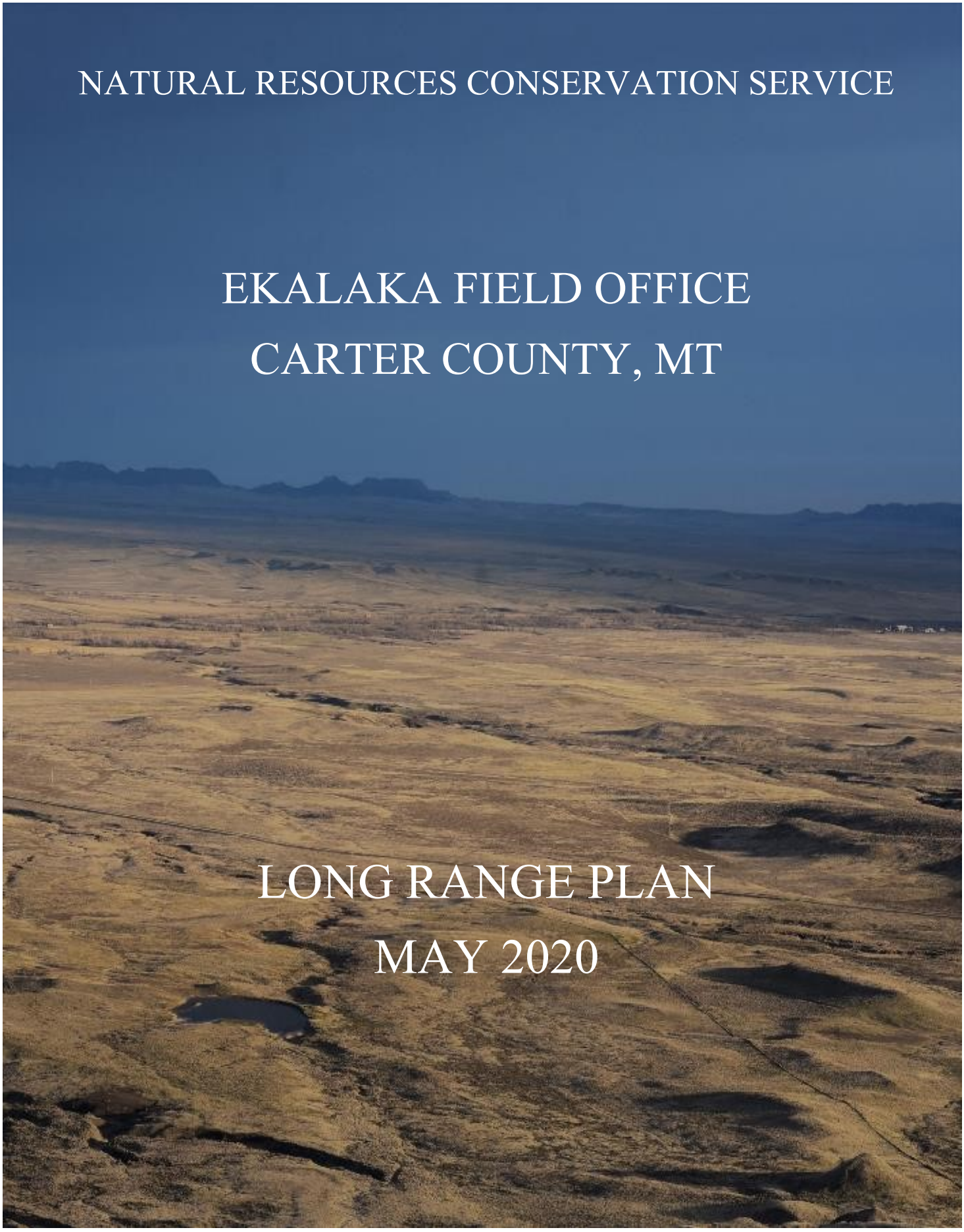
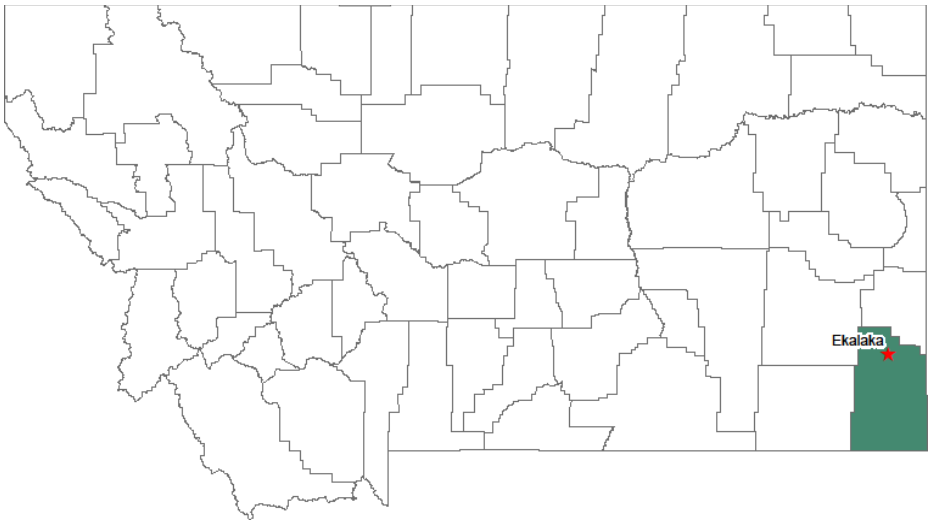
NATURAL RESOURCES CONSERVATION SERVICE

EKALAKA FIELD OFFICE
CARTER COUNTY, MT



LONG RANGE PLAN
MAY 2020



FOREWORD

The Ekalaka NRCS LONG RANGE PLAN (LRP) is a guide to direct Natural Resources Conservation Service (NRCS) conservation planning in Carter County. This plan was prepared by Rebecca Knapp, DC, with input from the Carter County Conservation District (CCCD); the CCCD Administrator, Stephanie Carroll; the Local Work Group (LWG); and fellow NRCS and Soil and Water Conservation Districts of Montana (SWCDM) staff members, including Lauren Manninen (NRCS Soil Conservationist), AJ Limberger (NRCS Range Management Specialist), and Jalyn Klauzer (SWCDM Range and Wildlife Conservationist).

This document considers and incorporates sections of the existing CCCD Long Range Plan document, which is currently under revision. Many thanks to Alissa Wolenetz, who gathered and updated county information prior to drafting the CCCD LRP, and to Johnna Cameron (Miles City Area Office NRCS Area Planner) for providing the County Resource Maps associated with this document.

CONTENTS

SECTION I | INTRODUCTION

Provides information regarding this plan's vision, mission, purpose, participating entities, and time frame.

SECTION II | INVENTORY

Includes an inventory of the known resources within the boundaries of Carter County, and presents a detailed analysis of the current resource situation.

SECTION III | ANALYSIS OF EXISTING CONSERVATION ACTIVITY

Includes current Integrated Data for Enterprise Analysis (IDEA), Performance Result System (PRS), and Program Contract System (ProTracts) data.

Details past knowledge of NRCS planning activity in Carter County.

Section IV | Natural Resource Problems and Desired Future Outcomes

Contains information on local issues and goals, as determined and prioritized by the LWG and/or Technical Advisory Committee.

Bibliography

Appendices

Appendix A: County Resource Maps and Charts

Appendix B: County MLRA Descriptions

Appendix C: Extracts from "Botanical and Vegetation Survey of Carter County, Montana: Bureau of Land Management-Administered Lands" (1998)

SECTION I | INTRODUCTION

GENERAL

The Ekalaka NRCS LONG RANGE PLAN is of local significance and is a plan of action to assist the Carter County Conservation District with soil and water conservation planning, which includes:

1. Resource conservation and development planning;
2. Comprehensive land use planning;
3. Environmental enhancement planning; and
4. Pollution abatement planning.

This plan . . .

1. Considers public input and established policy;
2. Considers natural resource inventory and analysis;
3. Considers CCCD and NRCS objectives and goals;
4. Establishes conservation planning priorities;
5. Recognizes problems and opportunities for the wise use and development of natural resources in Carter County;
6. Coordinates the efforts of local producers, NGO's and agencies;
7. Considers potential financial and technical resources; and
8. Is adaptive by nature, changing and updating to reflect current and/or future situations.

PURPOSE

The primary purpose of the CCCD and the NRCS (formerly SCS) is to provide for the conservation of soil and soil resources. Therefore, by necessity, the CCCD and NRCS are also involved in water conservation, grazing land management (including grazable forestlands) and the management and conservation of all related lands. The declaration of policy in Montana Statute pertinent to conservation districts is included below.

> *76-15-102. Declaration of policy. It is hereby declared to be the policy of the legislature to provide for the conservation of soil and soil resources of this state, for the control and prevention of soil erosion, for the prevention of floodwater and sediment damages, and for furthering the conservation, development, utilization, and disposal of water and thereby to preserve natural resources, control floods, prevent impairment of dams and*

reservoirs, preserve wildlife, protect the tax base, protect public lands, and protect and promote the health, safety, and general welfare of the people of this state.[1]

In the past, technical and financial assistance has primarily been an agency role. Moving forward, funding from NGO's and grants will be coupled with agency funding to provide financial assistance for focused conservation efforts.

Conservation work in Carter County has traditionally been oriented toward agriculture, for this is the use to which most land and water resources have been allocated. There is now public pressure for diverse land use as well as quality environment. We recognize that soil conservation leads to the enhancement of water quality, natural beauty, and wildlife; the preservation of scenic places, historic sites, and unique natural areas; and the improvement of environmental health, job opportunities, and public education.

POLICY AND OBJECTIVES

This LRP defines the jurisdiction, policies, goals and objectives, and working procedures of the CCCD and NRCS. This document considers both private and public lands.

INVENTORY AND ANALYSIS

The LRP explains and evaluates past and present natural resource conditions, conservation work and conservation achievements in Carter County.

IDENTIFICATION OF PROBLEMS AND OPPORTUNITIES (PLANNING ALTERNATIVES)

The Ekalaka NRCS Long Range Plan identifies and documents conservation problems (resource concerns) and opportunities recognized by CCCD supervisors, cooperating agencies (USFS, BLM, DNRC, DEQ), advisory groups (i.e. the LWG) and local organizations. The plan will outline measures to address local resource concerns and develop best management practices for the sustainable use of Carter County's natural resources.

ANNUAL WORK PLAN AND PRIORITIZATION

The LRP establishes broad priorities for conservation work in Carter County and will be utilized to formulate the Ekalaka NRCS Field Office Annual Plan of Operations and Targeted Implementation Plans (TIP's) for focused conservation.

REFERENCE, INFORMATION AND OUTREACH

The collection of information in this planning document may be used as reference material and for outreach purposes by NRCS staff, the CCCD, other conservation agencies, Carter County commissioners, land use planners, researchers, educators, USDA program participants, land owners-managers-occupiers-developers, etc.

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[1] Montana Code Annotated § 76-15-102 (2019). Specified code can be accessed at https://leg.mt.gov/bills/mca/title_0760/chapter_0150/part_0010/section_0020/0760-0150-0010-0020.html.

WORKING RELATIONS

Informal working relations have been established, or are desired, with the following entities:

Federal

US Environmental Protection Agency

US Army Corps of Engineers

USDA - USFS – Camp Crook, SD

USDA – Fort Keogh

USDI – BLM

USFWS

State

Montana Department of Environmental Quality

Montana Department of Natural Resources and Conservation

Montana Fish Wildlife and Parks

Public Lands Commission

Montana State University

University of Montana

Local/Regional

Carter County Commissioners

MSU Extension Services

Town of Ekalaka

Carter County Planning Board

Carter County Museum

Carter County High School

Ekalaka Elementary School

Carter County Superintendent of Schools and rural schools

Carter County Rural Fire Department

Eastern Plains Economic Development Corporation (EPEDC)

Non-Governmental

Associations of resource interests such as conservation organizations, economic development groups, banks, youth groups, civic groups, etc.

Ekalaka Chamber of Commerce

Carter County Stockgrowers

Carter County Woolgrowers

C&B Grazing District

Little Missouri Grazing District

Carter County FFA

Carter County 4-H

American Bird Conservancy

Ducks Unlimited

National Wild Turkey Federation

Mule Deer Foundation

Rocky Mountain Bird Conservancy

Pheasants Forever

Plank Stewardship Initiative

Rocky Mountain Elk Foundation

JURISDICTION

By invitation of the Carter County Conservation District, NRCS is authorized to conduct business within the district boundaries. The CCCD is authorized by Montana statute 76-15-101.

PRIVATE LANDS

At the invitation of the Carter County Conservation District, the NRCS provides planning assistance on privately owned acres and deals with water, soil and related resources.

NRCS strives to treat each acre according to its land use, capability class and conservation needs with consideration to landowner objectives.

PUBLIC LANDS

Mutual problems and opportunities for the conservation, development and use of public lands exist and are typically resolved through the cooperation of public land administrators, managers, and users. The CCCD and the Ekalaka NRCS desire closer working relations with federal land administrators on all problems concerning public land in the hope that we can effectively partner to address similar resource concerns on adjacent/adjoining public and private lands.

METHOD

The Ekalaka NRCS LONG RANGE PLAN (LRP) can be modified at any time but should be re-evaluated at least once every five years.

As in the past, land occupiers and operators can request Conservation Technical Assistance from NRCS. This free assistance includes natural resource inventories, the development of conservation planning alternatives, and the formulation of a conservation plan and plan map.

Land occupiers and operators can also sign program applications on a voluntary basis. A program application is the formal process by which an owner/operator expresses interest in a federal program, such as EQIP or CSP.

ORGANIZATION, LOCATION, AND ACREAGE

The Carter County Conservation District was first organized on August 28, 1941, as the result of petitions to the State Soil Conservation Committee. A hearing and referendum were held, and it was determined that the Conservation District would include that portion of Carter County lying within the Box Elder Creek drainage, excepting those areas included in the National Forest and the Chalk Buttes Grazing district. Additional land was brought into the district through application for certificate of inclusion on January 14, 1944 and September 12, 1963, as well as July 24, 1970, when the incorporated town of Ekalaka was included. These actions brought the total land area within the district to 2,210,320 acres.

The District's name was "Box Elder Soil Conservation District" until 1962, when it was changed to "Box Elder Soil and Water Conservation District." In 1972, the name was changed to "Box Elder Conservation District." In 1976, it became the "Carter County Conservation District" to better describe the area within the district boundaries. These changes came about as the District assumed greater responsibility for the conservation and development of an increasingly larger area, in response to changing conservation legislation.

The first Soil Conservation Service (SCS) District Conservationist to serve the Carter County Conservation District in the Ekalaka Field Office was Sam McIlvaney (Nov. 14, 1941 to March 3, 1943). Since then, 12 individuals have served in the capacity of District Conservationist.

See *Appendix A: County Resource Maps and Charts* for county maps.

SECTION II | INVENTORY

OVERVIEW

KEY INVENTORY RESOURCES

The 2003 Carter County Soil Survey | When possible, information on the county's geological and ecological profiles has been quoted directly from the 2003 Carter County Soil Survey, the completion of which was one of the primary goals of the 1976 Carter County Conservation District Long Range Plan. The survey was completed in 1990 and published in 2003. This document refers to it as "the 2003 Carter County Soil Survey."[1]

The 1976 CCCD LRP | The 1976 CCCD Long Range Plan was remarkably clear and concise. When appropriate, sections of that document have been incorporated here. Those who do not have a firm backing in the sciences may find the 1976 overviews useful in understanding the more detailed 2003 data. More information on the 1976 CCCD LRP can be obtained through the CCCD or local field office staff.

"Botanical and Vegetation Survey of Carter County, Montana: Bureau of Land Management-Administered Lands" | In 1998, the BLM, in cooperation with the Montana Natural Heritage Program, compiled detailed descriptions of Carter County's vegetation types (plant associations). Links to full descriptions of key plant associations can be found in the Plants section. For survey extracts that have been condensed and edited for clarity, please see *Appendix C: Extracts from "Botanical and Vegetation Survey of Carter County, Montana: Bureau of Land Management-Administered Lands" (1998).*

ORDERING

1. **Physical and biological resources |** General overviews of the county's physical and biological resources, including local climate, county-wide geology, water resources, mineral resources, plants, and fish and wildlife.
2. **Major Land Resource Area descriptions[2] |** Detailed descriptions of the county's Major Land Resource Areas (MLRAs), including extensive information on the physical and biological resources and land capacities of specific areas within the county. MLRA descriptions have been linked out to *United States Department of Agriculture Handbook 296: Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin* (2006). Full descriptions can also be found in *Appendix B: County MLRA Descriptions*.

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[1] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part I* (Washington, D.C.: National Cooperative Soil Survey, 2003), https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/montana/MT011/0/PartI.pdf, ii.

[2] MLRA descriptions are lengthy but make up for it by having more useful information about management strategies for and specific landscapes. They include the same information given in the General Overviews, but they are useful for understanding local landscapes because they are broken out by area.

3. **Human resources |** Human resources, including the county's history, recreational opportunities, agricultural operations, and demographics.

CLIMATE

OVERVIEW

This section contains average climate data for Ekalaka and county-level information on plant hardiness zones, annual precipitation ranges, and relative effective precipitation (REAP). More detailed climate information can be found at NOAA's website or in this document's MLRA section.

CLIMATE SUMMARY FOR EKALAKA, MONTANA

The following chart has been adapted from the most recent climate data available from the Western Regional Climate Center. It includes data from 11/23/1896 to 06/10/2016.[3]

AVERAGES	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
Max. Temp.	29.7	33.3	42.8	56.6	67.1	76.5	85.9	84.5	73	59.4	43.2	32.9	57.1
Min. Temp.	7.5	10.9	19.6	30.5	40.4	49.7	56.3	54.3	44	33	20.7	11.5	31.5
Total Precip. (in.)	0.46	0.43	0.73	1.39	2.53	3.13	1.84	1.33	1.36	1.03	0.53	0.42	15.19
Total Snow Fall	5.4	5.7	6.1	3.1	1.1	0	0	0	0	1.7	4.5	4.6	32.1
Snow Depth	3	3	2	0	0	0	0	0	0	0	1	2	1

More detailed weather and climate information can be accessed through NOAA's website. Instructions can be found at this link: https://www.ncei.noaa.gov/news/noaa-offers-climate-data-counties.

PRECIPITATION INFORMATION

Please see *Appendix A: County Resource Maps and Charts* for annual precipitation ranges and relative effective precipitation (REAP) information. More precipitation information can also be found in the MLRA section.

PLANT HARDINESS INFORMATION

Carter County plant hardiness zones range from 4a to 4b. This means that negative temperatures range from -20°F to -30°F.[4] For Montana's Plant Hardiness Zones Map, see *Appendix A: County Resource Maps and Charts*. The mapping was created by the PRISM Climate Group – Oregon

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[3] "EKALAKA, MONTANA (242689): Period of Record Monthly Climate Summary," Western Regional Climate Center, Accessed May 10, 2020, https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?mt2689. Temperatures are in Fahrenheit. Precipitation and snowfall information is in inches. Note from the WRCC on data: "Percent of possible observations for period of record. Max. Temp.: 94.8% Min. Temp.: 94.7% Precipitation: 95.7% Snowfall: 30.6% Snow Depth: 30.7%" See website for more information on data completeness and collection.

[4] USDA and Prism Climate Group – Oregon State University, "USDA Plant Hardiness Zone Map," USDA Agricultural Resource Service, accessed May 10, 2020. https://planthardiness.ars.usda.gov/PHZMWeb/Default.aspx.

State University. Plant hardiness information for all zones can be found at https://planthardiness.ars.usda.gov. Maps can be generated at https://planthardiness.ars.usda.gov/PHZMWeb/#.

GEOLOGY

OVERVIEW

Summary

Carter County's geology is the product of several different processes. In chronological order, it was formed through the following events: 1) marine sediment deposition from a transcontinental sea; 2) volcanic activity; 3) river sediment depositions caused by water movement from the Rocky Mountain Uplift; and 4) folding and faulting caused by the Black Hills Uplift.

These processes each left behind different things. Some sediment deposition is marked by dinosaur fossils. Volcanic activity created bentonite. River sediments became coal. Folding and faulting led to oil deposits.

Over time, these layers eroded differently. This created the terrain we see today. Many of the county's distinctive features (e.g. Chalk Buttes, Medicine Rocks) were formed because the material they were made of eroded at a different rate or in a different manner from that of other materials in the area.

A note on source information

There are two different extracts included below. They are useful for different reasons. The 2003 Soil Survey Geology section covers how the county formed over time (i.e. chronological events). The 1976 LRP Geology section covers why we see what we see today (i.e. landscape formation).

Map information

A map of Carter County's Geology can be found in *Appendix A: County Resource Maps and Charts*.

Additional Resources

More information on physiography and geology can be found in the MLRA section below.

For a more general overview of Montana's geography, please see the Montana Bureau of Mines and Geology's "Geologic Map of Montana: Edition 1.0" (2007). The full document can be found at https://www.mbmg.mtech.edu/pdf/GM62_2007Booklet.pdf.

EXTRACT FROM 2003 CARTER COUNTY SOIL SURVEY | GEOLOGY TIMELINE (HOW IT WAS FORMED)[5]

The oldest rocks exposed in Carter County belong to sedimentary formations deposited during the Cretaceous Period. At that time, a transcontinental sea covered the area between the Gulf of Mexico and the Arctic Ocean. Thick sequences of sediments were deposited on coastal plains and shallow sea floors during alternating periods of emergence and submergence. These repeated marine invasions created a thick sequence of marine shales deposited on the sea floor. Brackish shales, freshwater shales, and sandstones were deposited on the coastal plains. These sandstone and shale beds grade both vertically and horizontally into each other.

Marine migrations continued without interruption until the Late Cretaceous Period, when uplift of the Rocky Mountains began in western Montana. Marine deposition ended in Carter County at the end of Pierre Shale time. The overlying Hell Creek Formation was the last unit to be deposited in the Late Cretaceous Period. The extinction of dinosaurs, approximately 65-million years ago, marked the end of the Cretaceous Period. At this time, fossils changed dramatically, but the character of the sediments remained the same.

Volcanism occurring to the west, during the Cretaceous Period, spread thick layers of volcanic ash over the area. Bentonite, which is derived from vitrified volcanic ash, occurs in many of the Cretaceous sediments, particularly the marine shales. Bentonite is found in layers from a few inches thick to mineable beds with thicknesses up to 10 feet.

Deposition of massive amounts of sediments from the Rocky Mountain Uplift continued during the Tertiary Period. Sluggish rivers meandering across the coastal plains deposited these sediments. The coastal plains were swampy and covered with lush vegetation. These marshes were eventually buried by accumulating sediments and converted to coal.

Approximately 50-million years ago, uplift and granitic intrusions occurred in the Black Hills area to the southeast. This igneous activity was accompanied by regional folding and faulting, including the formation of the Cedar Creek anticline and the adjacent Ekalaka syncline, between the Powder River Basin and the Williston Basin, and the Black Hills Uplift to the east of the Power River Basin. The Black Hills Uplift domed the overlying sedimentary formations upward as it rose. These sediments currently surround it in a concentric pattern of decreasing age. In general, rocks of southern Carter County influenced by the Black Hills Uplift occur in an arcuate pattern typical of an anticlinal fold, with age decreasing to the north.

Note: The full description includes more information on individual rock units, and can be found here:

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[5] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part I,* 2-4. Section quoted in full.

https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/montana/MT011/0/PartI.pdf#page=22

1976 LRP Overview | Exposed Geology (What You See)[6]

Gravel deposits found in the county lie at different levels indicating several stages of an old erosion and sedimentation cycle. The highest deposits are perhaps a million years old (i.e. from the Miocene time). Gravel somewhat lower in early Pliocene time and deposits near the river in early Pleistocene are the more recent stages of the erosion cycle.

The sedimentary rocks exposed in this region consist of strata laid down relatively late in geologic time. In central and southern Carter County older formations, such as the Bearpaw shale, appear at the surface. Near Ekalaka, high hills are locally capped by strata of the White River and possibly the Arikaree formations, the youngest consolidated sediments in Southeastern Montana.

The White River formation in-Carter County is commonly called the "Chalk Buttes". These deposits are the last of the thick fresh-water sedimentary series which were deposited in Montana and Wyoming in early and middle Tertiary time.

The Fort Union formation consists of 1,500 feet or more of alternating beds of sandstone and shale with occasional beds of coal. It underlies the surface in parts of the northeastern upland region of the district. It has been separated into two divisions: an upper (Tongue River) member in which massive sandstone is plentiful, and a lower (Lebo) shale member.

A. The Tongue River member is exposed at the surface in an area around the northern edge of the Ekalaka Hills. Its most distinguishing characteristic is the bright red scoria beds. The Tongue River member is the chief coal bearing formation in Southeastern Montana. Sandstone is the most conspicuous rock in this member with an excellent example being the "Medicine Rocks."
B. The Lebo shale member at the base of the Fort Union is 150-300-foot-thick and weathers to a gumbo soil. This formation is found in the northeastern portion of the district. Its most distinguishing characteristic is its somber, drab color, the barren treeless surface, and the numerous zones of "iron stone" concretions.

The Hell Creek formation is a member of the Lance formation. This formation rises to the surface in the Powder River breaks and continues in a band below the forested zones to the South Dakota line. Because the member consists primarily of shales, where the slopes are steep a badland topography may develop. The Fox Hills sandstone is a massive persistent layer lying just below the Lance formation. This sandstone formation is

[6] The following section has been quoted in full from the 1976 CCCD LRP.

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The Fox Hills sandstone is a massive persistent layer lying just below the Lance formation. This sandstone formation is probably the most important water-bearing horizon in the region. It lies in a narrow band south of the forested area and along the west boundary of the district.

The Pierre Shale formation, which lies below the Fox Hills formation, is a layer of compact marine strata approximately 1,000 feet deep. This formation takes water very slowly and is subject to rapid erosion. It surfaces over much of the south- central area of the district.

The Colorado group consists of a Niobrara shale overlying a Benton shale. The most distinguishing characteristic of the Niobrara shale is that it is a calcareous shale about 175 feet thick. The Benton shale as a whole consists of dark marine shale. This group is just below the Pierre Shale. It is exposed in the south-central portion of the district.

WATER RESOURCES

OVERVIEW

The water resources of the district are one of its most important assets. Water is essential for domestic, agriculture, industrial, wildlife and recreational uses. As demand for multiple usages increases, it will be essential to continue planning for water use.

In recent years, increased funding from the USDA-NRCS office has allowed for the drilling of deep wells (up to 3,000 feet) on Pierre Shale formations in the south of the county that lack surface water and readily accessible groundwater. These deep wells have been especially important to operating units that formerly lacked the consistent water supply needed to develop sustainable livestock management plans and implement other conservation practices, including those essential to wildlife.

Recharges for aquifers, especially the Fox Hills aquifer, are beginning to show overdrawing. Moving forward, it will be important to manage water take to preserve aquifers. Water contamination in old, unused wells is a water quality concern, and should be addressed by ensuring that old wells are decommissioned.

The north and south of the county tend to access water differently. For more information, see *Section III: Analysis of Existing Conservation Activity: County Water Access*.

EXTRACT FROM 2003 CARTER COUNTY SOIL SURVEY | PHYSIOGRAPHY AND DRAINAGE[7]

[7] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part I,* 22. Section quoted in full.

The entire county is located within the Missouri Platea physiographic province. The county is divided into two physiographic sub provinces by a northwest-trending line that runs through the center. This line separates the Montana Plains Province to the north from the Central Rocky Mountain Foreland Province to the south. The Black Hills Uplift begins in the southeast corner of the county and extends into the Black Hills of Wyoming and South Dakota.

The county consists primarily of gently rolling plains with shallow creek valleys and broad flat badland areas. Remnants of younger, relatively resistant sandstone formations form the prominent pinnacles and ridges of the Ekalaka Hills, Long Pine Hills, and Chalk Buttes. Landscapes typical in the northeastern part of the county are flat-topped buttes and summits capped by sandstone or resistant baked shale and clinker (scoria) beds. Topography in the central portion of the county is more subdued, containing large flat areas with little relief.

Relatively resistant reddish baked shale beds can be seen capping summits in the northeastern part of the county; these beds were formed by burning underground coal seams. Burning coal baked the surrounding sediments and made them more resistant to erosion.

In this semiarid climate, landscape is directly controlled by the characteristics of underlying bedrock. Elevations range from a low of 2,760 feet above sea level to a high of 4,450 feet. The lowest point is located where Spring Creek exits the county at the western county line. West Butte, located 6 miles north of the southwestern border, is the highest point in the county.

The major northeast flowing drainages are Box Elder Creek and the Little Missouri River. Box Elder Creek drains the central portion of the county. It is perennial north of the town of Ridgway. The Little Missouri River is located to the southeast of Box Elder Creek and is perennial throughout Carter County. The northwestern corner of the county is drained by O'Fallon Creek, draining to the northwest. The extreme southeastern corner drains southeast, toward the Belle Fourche River, which is located in Wyoming and South Dakota.

Major streams, with numerous ephemeral tributaries arranged in a relatively linear dendritic pattern, follow meaning courses in wide, nearly level valley bottoms. The pattern is approximately parallel to the strike of the formations.

EXTRACT FROM 2003 CARTER COUNTY SOIL SURVEY | GROUND-WATER RESOURCES[8]

Usable ground-water aquifers occur at the surface only in the northern and northeastern portions of Carter County. The remaining shale formations, exposed to the south, are generally impermeable. They contain only small amounts of saline water, which are often

[8] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part I,* 5-6. Section quoted in full.

too mineralized for any use. Drill depths to underlying artesian aquifers can be quite deep.

Sandstone beds occur in the Pierre Formation and the underlying Newcastle, Muddy, and Lakota Sandstones. Deep wells have been successfully completed on these sandstone beds. Because of structural configuration, wells occur under artesian considerations. Some wells may flow depending on their location.

Ground water in northern Carter County is obtained primarily from the Fox Hills-Lower Hell Creek aquifer wherever the overlying Fort Union Formation is not too thick. Total dissolved solids concentration from this aquifer are generally low, ranging from well under 500 to 2,000 mg/l. The best quality water is found near recharge areas. Average yields are 10 gallons-per-minute (gpm), though yields of as high as 40 gpm are possible.

In the Fort Union Formation, the Tongue River Member typically yields 8 to 15 gpm, and the shale-like Ludlow Member typically yields 3-8 gpm. Water is produced from frequently occurring sandstone and baked shale beds. These beds occur as discontinuous lenses with limited areal extent. Their exact locations are impossible to predict at a site. After years of use, shallow wells often fail when the limited sandstone lens is completely drained.

Water in the Fort Union Formation contains total dissolved solids concentrations (TDS) ranging from 400 to 2,000 mg/l. In general, the best quality water is obtained from baked shale beds. The Environmental Protection Agency has recommended a maximum TDS concentration of 500 mg/l for human consumption. Water with greater than 7,000 mg/l TDS is generally considered unfit for any use.

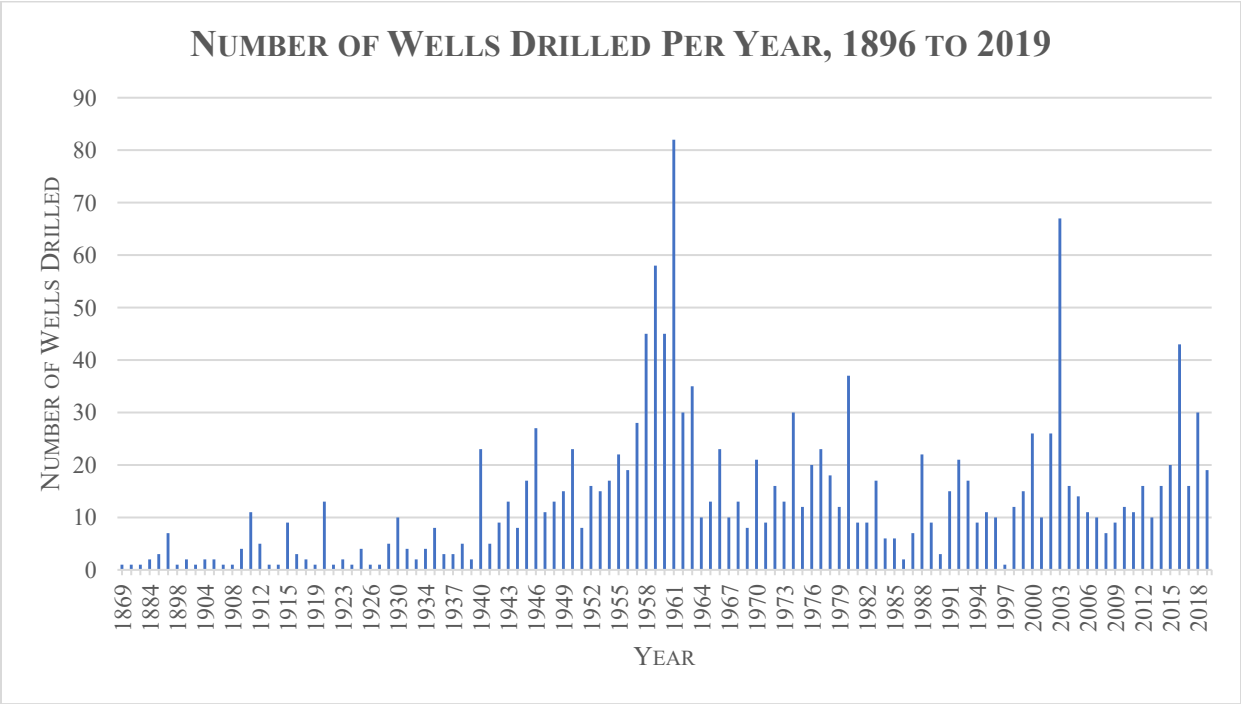
Unconsolidated deposits of alluvium occur in the valleys of larger streams. These deposits, consisting of interbedded clay, silt, sand, and gravel, have thicknesses up to 50 feet and are commonly used for ground-water development. They produce average yields of 15 gpm. TDS concentrations range from 450 to 6,000 mg/l.

WELL TYPES AND DISTRIBUTION | MONTANA BUREAU OF MINES AND GEOLOGY, GROUND WATER INFORMATION CENTER

The Montana Bureau of Mines and Geology's Ground Water Information Center reports a total of 1,530 wells in Carter County as of June 2019. The deepest well on record is 2,903 feet, and the shallowest is 6 feet. The oldest well on record is dated January 1, 1875.[9]

[9] Ground Water Information Center Online, "Overview of CARTER county," Ground Water Information Center | MBMG Data Center, 2020, http://mbmggwic.mtech.edu/sqlserver/v11/reports/CountyStatistics.asp?MTCounty=CARTER.

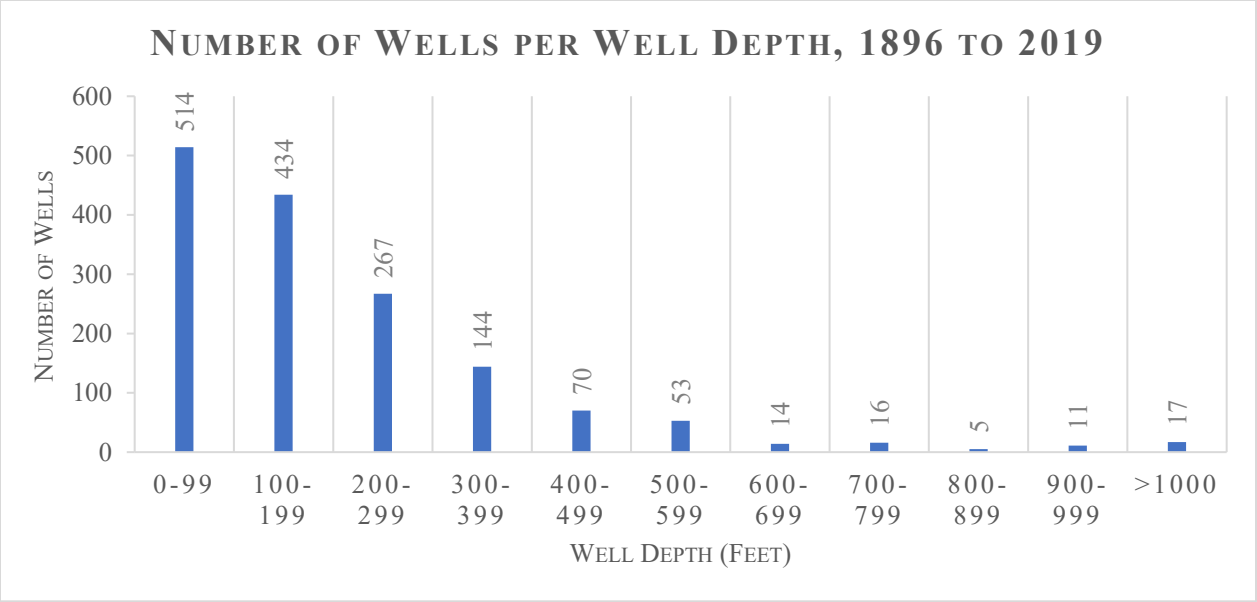
The highest number of wells drilled was 82 in 1961. The year 2003 had 67 wells, and 2016 had 43.[10] Many wells have been put in during the last decade as a result of droughts and increased program funding.



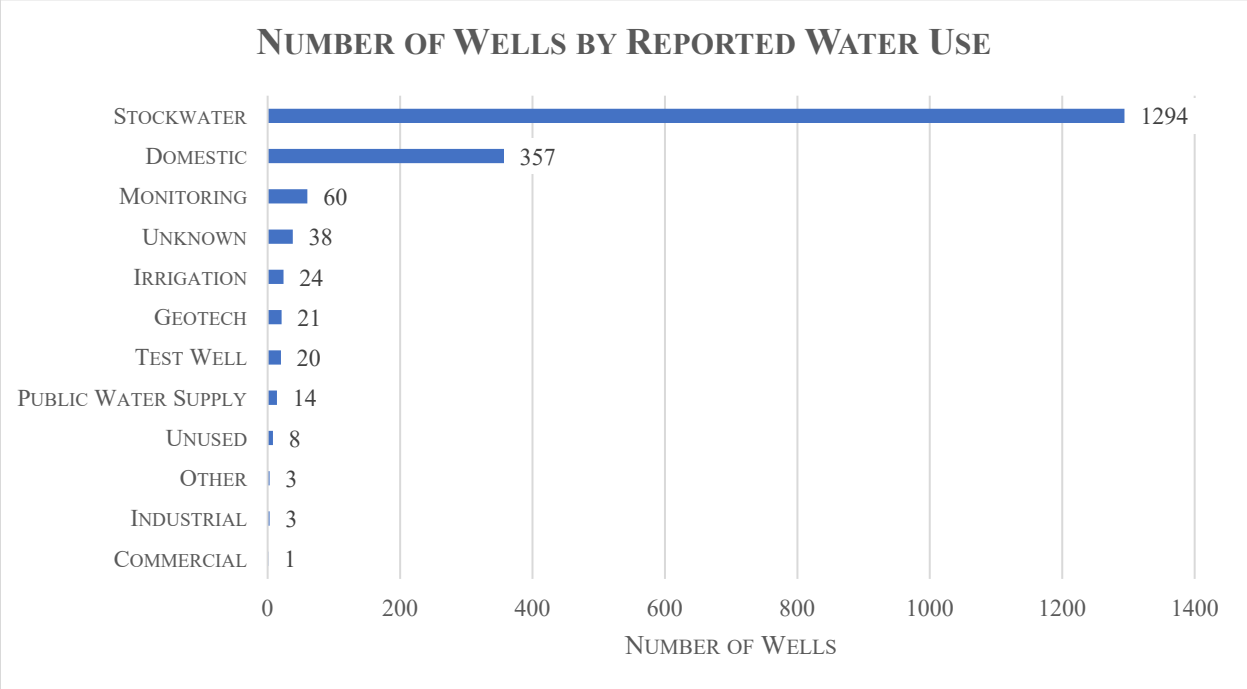
Although there are now deep wells in the south of the county, about a third of all wells are less than 100 feet deep, and over 60% are less than 200 feet deep.[11]

[10] Ground Water Information Center Online, "Overview of CARTER county."

[11] Ground Water Information Center Online, "Overview of CARTER county."



The following chart illustrates reported uses for Carter County wells. Stockwater is by far the largest well category, followed by domestic and monitoring. It should be noted that wells often have multiple reported uses, so this graph's total differs from the county's total number of wells.[12]



MINERAL RESOURCES

[12] Ground Water Information Center Online, "Overview of CARTER county."

OVERVIEW

Carter County has few mineral resources. There are no lode-type metallic mineral deposits. There is little gas and oil. There are some deposits of lignite coal and uranium, but they are not profitable to mine. Bentonite, on the other hand, has been successfully mined in the south of the county. Sand and gravel are widely present.

On the other hand, utility pipelines have long been a presence in the county. Pipeline developments provide periodic, temporary economic "booms" that support local lodging and food industries. The additional taxes generated are often used to improve local infrastructure, for example through the construction of roads, new schools and new medical facilities.

EXTRACT FROM 2003 CARTER COUNTY SOIL SURVEY | MINERAL RESOURCES [13]

Carter County is located within eastern Montana's oil and gas producing region. Oil and gas are produced from different stratigraphic horizons. Oil and gas accumulation is a factor of both geologic structure and porosity variations within individual formations.

Two oil and gas fields have been developed in the county. Hammond Field is located northwest of Alzada, and Repeat Field is located south of the Humbolt Hills near the South Dakota border.

In the Repeat Field, oil and associated gas are produced from the Red River Formation. This formation is of mid-Ordovician-age and consists of limestone and dolomite. The Red River Formation is one of the most widespread formations in the Williston Basin and is one of its main hydrocarbon reservoirs. The Repeat Field is associated with the Fallon County fields along the crest of the Cedar Creek anticline to the east.

Hammond Field produced natural gas from the Muddy Sandstone Member of the lower Cretaceous Colorado Group. In the past several years (as of 2003), there has not been any production from this field.

Carter County contains significant exposures of formations that are known to contain mineable beds of bentonite. Bentonite beds occur in the Arikaree Formation, the Monument Hill Bentonic Member of the Pierre Formation, and the Belle Fourche and Mowry Shales.

Potentially economic deposits of lignite are present in Carter County. Lignite is soft and crumbly and contains significant moisture. It has the lowest heat content of coal types. These deposits have undergone little development. They occur in relatively thin, less than 10-feet thick, beds in the Tongue River Member. A few thin beds also occur in the underlying Ludlow Member and Hell Creek Formation.

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[13] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part I,* 24-25. Section quoted in full.

The Ekalaka Lignite Field produced 2,250 tons of lignite between 1926 and 1934. There has been no further reported development of this field.

Current economic geology maps do not designate "strippable coal reserves" in Carter County. Minor amounts of uranium have been found in lignite beds that crop out along the Ekalaka Hills and Long Pine Hills. Uranium was leached by ground water from windblown tuffs or weathered igneous rocks and deposited in organic-rich lignite. Most uranium in the county has been found in the Fort Union Formation and the overlying Arikaree Formation. Uranium also occurs at depth in lower Cretaceous Formations that do not crop out in the area.

Aggregates, such as sand and gravel, used to make concrete occur in mineable quantities within the county.

CURRENT PIPELINE DEVELOPMENTS

Denbury Resources – Greencore CO2 Pipeline & Hammond Oil Field Remediation

Denbury Resources plans to extend its current Wyoming-based Greencore CO2 pipeline by 110 miles to reach the Cedar Creek Anticline, passing through the Carter County in the process.[14]

To offset the impact of this pipeline, Denbury Resources is remediating the Hammond Oil Field as greater sage grouse habitat, at a cost of around $900,000. The reclamation project will provide for the removal of old equipment and wells, grading of the area, reseeding to grassland, and weed spraying costs.[15]

As of July 2019, the Denbury Resources CO2 pipeline construction in Carter County has been delayed by a year due to lack of lodging in the area.

ONEOK – Elk Creek Pipeline

The ONEOK Elk Creek Pipeline is planned to extend through Carter County, paralleling existing pipeline that is at capacity. Construction has already begun. Following the original line, the Elk Creek Pipeline will begin in Richland County, Montana, and end over 900 miles later in Kansas.

In addition to pipeline, ONEOK will install a pump and pigging station. According to the DEQ Montana Air Quality Permit, this station will include "three (3) electric pumps; one (1) meter skid; one (1) sampler; one (1) pig receiver; one (1) pig launcher; various piping components; and

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[14] Denbury Resources Inc., "Greencore Pipeline," Denbury, 2017, https://www.denbury.com/operations/rocky-mountain-region/COsub2-sub-Pipelines/default.aspx.

[15] Brett French, "Ahead of new pipeline construction, oil company restores old Eastern Montana gas field for sage grouse," *Billings Gazette*, October 28, 2018, https://billingsgazette.com/outdoors/ahead-of-new-pipeline-construction-oil-company-restores-old-eastern/article_e48ac6a8-76ce-5076-9ccd-fe8a40d92f56.html.

a flare, to which pigging blowdowns and pump and valve blowdowns will be routed to."[16] The installation area is sage grouse habitat. To offset changes, and in contrast to Denbury Resources, ONEOK has opted to contribute $169,622.12 to the Montana Sage Grouse Oversight Team's Stewardship Account instead of developing a land restoration package.[17]

Recent Issues

In recent years, pipeline development across the county has led to a marked increase in revenue. Funds from projects have been used to build the new elementary school and will also help build the new critical access hospital. Lodging and food industries have benefited from increased traffic through the area.

Pipeline activity across roads in the area, especially Hwy 7 and Hwy 323, has led to infrastructure concerns. The state needs to repair the roads.

Housing for out-of-town crews (and teachers) is a matter of concern. In the future, additional housing locations, such as an apartment complex or the renovation or removal and replacement of run-down houses, would supplement county income through tax increases and provide lodging for large seasonal labor crews here to work on pipelines and roads.

The CCCD and NRCS may wish to promote sustainable, weed-controlled development of various roads, campground sites, RV hookups, and additional permanent housing in the region as these sites increase in response to seasonal need.

Plants

Overview

Carter County is unique in both geography and geology. Its setting at the periphery of the tall grass prairie and on the edge of the Black Hills lends itself to unique geologic and climate features that have served to shelter and preserve unusual plants and plant communities. Warm season species, including C4 grasses, are abundant and even co-dominant on certain ecological sites. The mix of warm and cool season plants results in a diverse, productive and resilient landscape. Plant identification is challenging here due to the wide array of plant species and the occurrence of multiple species within one genus. To give just one example, there are at least four commonly known milkweeds in Carter County.

Botanical Information Resources

Locally, *Vascular Plants of Montana* (Robert D. Dorn), *Flora of the Pacific Northwest* (C. Leo Hitchcock, Arthur Cronquist) and *Flora of the Great Plains* (Great Plains Flora Association) are

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[16] Julie A. Merkel and Shawn Juers, "Preliminary Determination on Permit Application," DEQ: Montana Department of Environmental Quality, June 10, 2019, https://deq.mt.gov/Portals/112/Air/AirQuality/Documents/ARMpermits/5225-00_PD.pdf, 1.

[17] Julie A. Merkel and Shawn Juers, "Environmental Assessment (EA)," in "Preliminary Determination on Permit Application," 3. Note that page numbers restart for the enclosed EA: page 3 of the EA is found on what would otherwise be page 19 of the document.

useful taxonomic references. For the novice botanist, *Grassland Plants of South Dakota and the Northern Great Plains* (James R. Johnson, Gary E. Larson) and *Plants of the Black Hills and Bear Lodge Mountains* (James R. Johnson, Gary E. Larson) are outstanding plant identification resources.

The best written resource for understanding the riparian and wetland sites in this area is *Classification and Management of Montana's Riparian and Wetland Sites* (Paul L. Hansen, Robert D. Pfister, Keith Boggs, Bradley J. Cook, John Joy, and Dan K. Hinckley). This manual was published in 1995 by the Montana Forest and Conservation Experiment Station and the University of Montana School of Forestry (Miscellaneous Publication No. 54).

Classification and Management of Montana's Riparian and Wetland Sites has been especially useful when inventorying riparian areas, wetlands and woody draws associated with grazable forestlands near the Ekalaka Hills, Long Pines, Opeeche Park and the Chalk Buttes. The publication best describes plant associations common on United States Forest Service (USFS) lands. Examples of plant associations include green ash (*Fraxinus pennsylvanica*) and common chokecherry (*Prunus virginiana*); quaking aspen (*Populus tremuloides*) and creeping Oregon grape (Berberis repens); and ponderosa pine (*Pinus ponderosa*) and common chokecherry (*Prunus virginiana*), among others.

The Montana NRCS Ecological Site Descriptions for 58A are a valuable resource for Carter County and happen to work well in the 60B MLRA as well. What has been particularly useful is the 13-14-inch precipitation category built into the stocking rate guides. The pictures that illustrate the transitional phases of each ecological site are a great visual resource.

In 1998, a systematic baseline botany and vegetation inventory was conducted on BLM-administered lands in Carter County to document the rarest plant associations, sensitive plant species, and outstanding examples of relatively common plant associations. The study was supported and funded by the Bureau of Land Management and the Montana Natural Heritage Program. The report, "Botanical and Vegetation Survey of Carter County, Montana," was compiled by Jim Vanderhorst, Stephen V. Cooper, and Bonnie L Heidel. The complete document can be found http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf.

CARTER COUNTY PLANT RESOURCES, AS IDENTIFIED IN THE 1998 BLM SURVEY

Significance

In 1998, the BLM observed that "Carter County has some of the most extensive, unbroken range landscapes in Montana, with rangeland comprising roughly 89% of the landscape."[18] Species on

[18] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County, Montana: Bureau of Land Management-Administered Lands* (unpublished report to Bureau of Land Management: Montana Natural Heritage Program, 1998) http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf, 2.

these landscapes are astonishingly diverse: in 1998, the 507 vascular plant species identified in Carter County represented over 20% of the species identified in Montana.[19] In addition to this astonishing diversity, Carter County has a uniquely high number of rare plants. During their survey, the BLM team found 18 Montana plant species of special concern in the county. At the time, this was the highest number of plant species of concern in any county in the state. Most of these species are documented in Carter County at the western limits of their range; three "live in this area of the Great plains and nowhere else in the world."[20]

The BLM report concludes that given the number, diversity, and rarity of observed species, "the lands [of Carter County] may represent something unusual." As an "unusual" place, Carter County is uniquely well-suited to assist in conservation efforts across the Great Plains. The BLM team proposed that observations of the biological diversity here could "potentially be used to avert endangerment, maintain the vigor of species at geographic outposts that are integral to overall conservation, and come to better terms of appreciation for the diversity scattered across the plains."[21] The county continues to harbor a large number of species of concern.

At the time of this writing, 22 years after the initial preliminary flora list was completed, 22 plant Species of Concern and 7 Potential Species of Concern are documented for Carter County on the Montana Natural Heritage Program Website. (For a complete list with rankings, see http://mtnhp.org/SpeciesOfConcern/.)

Key plant associations

Carter County is set "in the middle of mixed-grass prairie (steppe) which extends from the Rocky Mountains to the Dakotas, where mid-sized grasses and grass-like plants predominate over short-grass or tall-grass species."[22] Within the county, shrub and grassland steppes are predominant. The BLM team hypothesized that the compositions of these steppes are primarily determined by slope position, past fires, grazing practices, growing season drought, and precipitation timing.[23]

Common steppe communities across different soil types were characterized as follows:

> Grasslands on clay soils are usually dominated by rhizomatous wheatgrasses (genera including *Elymus* and *Pascopyrum*) while those on sandy soils generally have a higher component of needle-and-thread (*Stipa comata*). Communities dominated by the warm season grass little

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[19] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 108.

[20] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 67.

[21] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 108.

[22] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 7.

[23] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 7.

> bluestem (*Schizachyrium scoparium*) are most common on sandy substrates, but may also occur on alluvial substrates eroded from shales. Shrub steppe communities on alluvial terraces that have fine textured soils are usually dominated by black greasewood (*Sarcobatus vermiculatus*) or Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), while similar positions with sandy soils support silver sagebrush (*Artemisia cana*). Eroded shale-ridge systems and slope outwash support plant communities dominated by specialized, drought- and/or salt-tolerant shrubs or herbs.[24]

Other plant communities of note included bur oak and ponderosa pine stands: "Bentonite and shale ridge systems and adjacent river terraces near Alzada support Montana's only oak woodlands. Ponderosa pine (*Pinus ponderosa*) grows mainly on sandstone outcrops."[25] Overall, over seventy plant associations were documented in the 1998 report. Nineteen plant associations, representing the most common associations in the county, were sampled and described in detail. Two bur oak associations were also included in the report: they represented the only occurrences of their type in the state.[26]

Links to full descriptions for these 21 notable associations can be found below. For abbreviated extracts that have been edited and condensed for clarity, please see *Appendix C: Extracts from "Botanical and Vegetation Survey of Carter County, Montana: Bureau of Land Management-Administered Lands" (1998)*.

Forest and Woodland Vegetation Types

*Rocky Mountain juniper (*Juniperus scopulorum*) + little seed ricegrass (*Piptatheropsis micrantha*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=30

ponderosa pine (Pinus ponderosa*) + common juniper (*Juniperus communis*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=32

*ponderosa pine (*Pinus ponderosa*) + bluebunch wheatgrass (*Pseudoroegneria spicata*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=34

*ponderosa pine (*Pinus ponderosa*) + creeping juniper (*Juniperus horizontalis*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=35

*ponderosa pine (*Pinus ponderosa*) + little bluestem (*Schizachyrium scoparium*)*

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[24] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 7.

[25] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 7.

[26] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, iii.

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=35

*plains cottonwood (*Populus deltoides*) + western snowberry (*Symphoricarpos occidentalis*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=38

*bur oak (*Quercus macrocarpa*) + sun sedge (*Carex inops *ssp.* Heliophila*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=40

*bur oak (*Quercus macrocarpa*) + western snowberry (*Symphoricarpos occidentalis*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=42

SHRUB AND DWARF SHRUB-DOMINATED VEGETATION TYPES

*silver sagebrush (*Artemisia cana*) + western wheatgrass (*Pascopyrum smithii*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=44

*Wyoming big sagebrush (*Artemisia tridentata *ssp.* Wyomingensis*) and thickspike wheatgrass (*Elymus lanceolatus*) and/or western wheatgrass (*Pascopyrum smithii*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=46

*Wyoming big sagebrush (*Artemisia tridentata *ssp*. Wyomingensis*) + pricklypear cactus (*Opuntia polyacantha*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=49

*Gardner's saltsage (saltbush) (*Atriplex gardneri*) + thickspike wheatgrass (*Elymus lanceolatus*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=51

*rubber rabbitbrush (*Chrysothamnus nauseosus*) + few flowered buckwheat (*Eriogonum pauciflorum*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=53

*black greasewood (*Sarcobatus vermiculatus*) + thickspike wheatgrass (*Elymus lanceolatus*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=55

GRAMINOID AND FORB-DOMINATED VEGETATION TYPES

*longleaf wormwood (*Artemisia longifolia*) + indian ricegrass (Oryzopsis hymenoides)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=58

*prairie sandreed (*Calamovilfa longifolia*) + sun sedge (*Carex inops *ssp*. Heliophila*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=60

*spikerush (*Eleocharis palustris*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=62

*western wheatgrass (*Pascopyrum smithii*) + thickspike wheatgrass (*Elymus lanceolatus*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=64

*thickspike wheatgrass (*Elymus lanceolatus*) + western wheatgrass (*Pascopyrum smithii*) + green needlegrass (*Nasella viridula*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=66

*little bluestem (*Schizachyrium scoparium*) + threadleaf sedge (*Carex filifolia*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=68

*prairie cordgrass (*Spartina pectinata*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=70

*needle-and-thread (*Stipa comata*) + threadleaf sedge (*Carex filifolia*)*

Description: http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf#page=72

Fish and Wildlife

Overview

Hunting and trapping have long been part of the county's economy.

Recently, elk, black bear, and wolves have moved into the area.

The Greater Sage Grouse has been identified as a wildlife species of concern. There has been much discussion and action in regard to its potential listing as a T & E species. Carter County lies within the boundaries of Core Area 13 (priority habitat for sage grouse).

Predator control, especially for coyotes, remains an issue in the county. Carter County maintains an active Predator Control Program governed by a Predator Control Board. The Board employees at least three trappers, one of which is an aerial gunner.

Summary | Modified from the 1976 LRP[27]

The wildlife resources of the district include a varied array of big game animals, upland game birds, grassland birds, waterfowl, fur bearers, and predators. Mule deer, whitetail deer and antelope are the most common big game animals. Sharp-tail grouse, sage grouse, Merriam Turkey, Hungarian Partridge and pheasant are the upland game birds found in Carter County. Ducks, Canadian Geese and Sand Hill Cranes are common to this corner of the state along with bald and golden eagles, turkey vultures, hawks, owls, falcons, merlins and a variety of other raptor species. Beaver, muskrat, racoons, badgers, mink and weasels are the common fur bearer

[27] Unpublished interviews with producers for the Roots project provide excellent context for wildlife changes and past predator control. Material from interviews has been incorporated into this section. For more information, contact the CCCD and Field Office.

species. Coyote, red fox, swift fox, mountain lion and bobcat are the common predators of the county.

There are occasional sightings of elk, black bear, wolves and moose. Bison are present in the county but are managed as livestock. A general bison ordinance has been passed by the Carter County Conservation District in order to prevent the introduction of unmanaged herds.

Practically all the land in the district can be considered habitat for wildlife. Hunting season is important to the county economy. Turkey, deer, antelope and upland game bird hunting brings people into Ekalaka every fall and spring. Elk were once introduced into Carter County, and now more elk are moving into the area. Licenses are now being issued in this hunting region. Elk are large animals that can potentially consume much forage while damaging haystacks and fences. Therefore, there is some landowner concern about this species.

Within the district, fish and wildlife resources can be roughly divided into several broad habitat areas. The first of these is formed by upland plains, which are used primarily for livestock grazing. These areas provide preferred habitat for mule deer, antelope, sharp- tail grouse, gray (Hungarian) partridge, and sage grouse.

The second habitat occurs along the brushy stream bottoms and draws and the timbered areas of the district. These areas provide preferred habitat for whitetail deer, pheasants, and turkeys.

Fur-bearing species such as beaver, muskrat and mink prefer riparian and mesic habitat along the main drainages. Catfish occur in the main stems of Box Elder Creek and the Little Missouri River. Northern pike, bullheads, carp, mudpuppies, painted and snapping turtles and a variety of minnows are also common. Generally, these are considered warm water fisheries.

The numerous reservoirs, ponds and pits in Carter County provide nesting and rest areas for migratory waterfowl such as ducks and geese.

EXTRACT FROM 2003 CARTER COUNTY SOIL SURVEY | WILDLIFE OF CARTER COUNTY[28]

> Carter County provides a variety of habitats for wildlife, including brushy draws, croplands, ponderosa pine woodlands, ponds, rangelands, reservoirs, rough breaks, and streams.
>
> Mule deer, white-tailed deer, and pronghorn antelope inhabit the county. Mule deer occur in many of the breaks, brushy draws, and rangelands. White-tailed deer inhabit the

[28] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part II* (Washington, D.C.: National Cooperative Soil Survey, 2003), https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/montana/MT011/0/PartII.pdf, 172. Section quoted in full.

bottomlands along Box Elder Creek, the Little Missouri River, and the Custer National Forest. Pronghorn antelope occur on prairie grasslands.

The bottomlands of Box Elder Creek and the Little Missouri River support habitat, in the form of brushy draws, croplands, ditchbanks, and riparian thickets, for ring-necked pheasant.

Hungarian partridge, an introduced game bird from Europe, is associated with croplands and grasslands throughout the county. The Hungarian partridge shares its range with the native sharp-tailed grouse. Sharp-tailed grouse occur throughout the prairie uplands where brushy thickets, with an abundance of fruit-bearing shrubs, provide quality habitat.

Sage grouse are scattered throughout much of Carter County on sagebrush-covered rangelands. Communities of big sagebrush and silver sagebrush, with a variety of forbs and grasses, characterize optimum sage grouse habitat.

Turkeys inhabit the wooded draws and uplands throughout the county. Vegetative cover consists of ponderosa pine and deciduous trees and brush in scattered small openings and drainageways. Turkeys were introduced into the Long Pine Hills, near Capitol Rock, in 1955.

Many marshes, ponds, potholes, and reservoirs scattered throughout the county provide habitat for waterfowl during both spring and fall migrations and during the summer production period.

Beaver, mink, and muskrat inhabit the many creeks and intermittent streams of the county. Badger, bobcat, coyote, fox, and a variety of small mammals occur throughout the county.

Populations of game and nongame species can be enhanced through the application of conservation practices to improve habitat. Among these practices are the development of odd or irregularly shaped areas in or near farmland to provide food and cover. Protection of habitat areas from fire or grazing and the establishment of woody vegetation assist in the habitat improvement process. Wildlife habitat may also be enhanced through the application of commonly employed conservation practices, such as the construction of ponds, minimum tillage, planned grazing systems, shelterbelts, and windbreaks.

PREDATOR CONTROL BOARD[29]

Originally created to address problems with severe predation of local sheep herds, the Predator Control Board is a local predator control organization that taxes ranchers a certain amount per head of livestock in order to manage coyote populations. Aerial hunting, trapping, and annual predator hunts have all contributed to management.

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[29] Information for this section has been compiled from interviews conducted with local producers for the Roots project. For more information, contact the CCCD or local NRCS staff.

Before being outlawed, 1080 was one of the main methods used to control coyote populations.

Recent wolf territory expansions and the rebound of the bald eagle have created the need to work more closely with Fish, Wildlife & Parks in order to document and manage populations and livestock impacts.

SPECIES OF CONCERN | GREATER SAGE GROUSE[30]

Of concern as of late is the greater sage grouse, a species of upland bird dependent on sagebrush habitat. The species is archaic and has a difficult time adapting to changes within a preferred landscape. Conversion of sagebrush grasslands to cropland, introduced pastureland and forestland has had a major impact on the species. Further fragmentation of the landscape through rural developments and the associated infrastructure (ex. powerlines, mining, oil field development, etc.) has led to the decline of the species. Sage grouse rely on leks, where they gather annually to dance and mate. Sage grouse are known to return to the same lek each year. When lek habitat disappears or changes, sage grouse have a difficult time breeding, nesting and raising broods.

In 2010, the Greater Sage Grouse was a candidate for listing on the ESA's Threatened and Endangered Species list. NRCS, along with partner agencies and NGO's developed a nation-wide initiative called Working Lands for Wildlife in the hopes of sustaining both agriculture and wildlife populations. The Sage Grouse Initiative (SGI), is one program under the umbrella of WLFW. In the western states, SGI provided staff and funding for counties with core sage grouse habitat to improve rangeland quality and address threats to sage grouse (e.g. fence markers). SGI Conservation Plans consider wildlife in the planning process and focus on preserving and restoring core sage grouse areas by improved grazing management. Common practices include wells, livestock pits, pumping plants, livestock pipelines, stock tanks, wildlife escape ramps, fence, fence marking, obstruction removal (includes the removal of woven wire fences), forage and biomass plantings, range plantings, fabricated livestock shelters, grazing land mechanical treatment, herbaceous weed control, prescribed grazing, forage harvest management, integrated pest management, and upland wildlife habitat management.

See *Appendix A: County Resource Maps and Charts* for Sage Grouse core area information.

For a general introduction to the program, see the Sage Grouse Initiative website at https://www.sagegrouseinitiative.com/.

OTHER RESOURCES

More information on documented animal species and species of concern can be found through the Montana Natural Heritage Program, at http://mtnhp.org/SpeciesSnapshot/?Vector=COUNTY|Carter|&Species=&Rank=.

MAJOR LAND RESOURCE AREAS (MLRAS)

[30] Information for this section has been collected through discussions with local field staff.

Overview

There are four MLRAs in Carter County. Each of these MLRAs was formed and eroded differently, so each has a distinct climate, is suitable for different types of agriculture, and has different wildlife, water, and mineral resources.

For ease of use, MLRAs have been hyperlinked to their descriptions in the United States Department of Agriculture Handbook 296, *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin* (2006). Full text descriptions have also been included in *Appendix B: County MLRA Descriptions*.

See *Appendix A: County Resource Maps and Charts* for more information on MLRA extents.

58B—Northern Rolling High Plains, Southern Part

Description link: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf#page=169.

58D—Northern Rolling High Plains, Eastern Part

Description link: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf#page=172.

60A—Pierre Shale Plains (Labelled on map as Pierre Shale Plains & Badlands)

Description link: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf#page=174.

60B—Pierre Shale Plains, Northern Part (Labelled on map as Pierre Shale Plains, East)

Description link: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf#page=176.

Historic Areas

Overview

Carter County is an area rich in history stretching back thousands of years. Ekalaka, the county seat, is named after an Oglala Sioux woman, Ijkalaka, the wife of David Russell.

Many more small towns were present in this area in the 19th and 20th centuries than remain today.

Common artifacts include medicine wheels, tipi rings, wagon trails, and abandoned homesteads.

HISTORY | ADAPTED FROM THE 1976 LRP[31]

Carter County, like other counties in eastern Montana, is known for its open space. From vantage points, broad eye-catching expanses with numerous promontories and apparently endless rolling prairies extend as far as the eye can see.

Carter County was created by an act of the state legislature on February 22, 1917. It was named in honor of Thomas Henry Carter, Montana's first representative in Congress (1891) later a U.S. Senator.

Ekalaka was named for Ijkalaka, an Oglala Sioux woman who was also the niece of Red Cloud, famous for closing the Bozeman Trail between Montana and Wyoming. She married David Russell, and when the town was established in 1885, he gave it her name.

The early settlement of this area began with the first trail herd of Texas cattle in 1881 when the Continental Land and Cattle Company (Hash Knife) turned 3,000 head loose on the Little Missouri. From 188l to 1886 many additional outfits such as 101, MC, 22, TD, WL and Flying E brought many thousands of head into the country.

This era lasted until the early 1900's when the railroad brought the homesteaders in and the day of the open range and large cow outfits were over.

Numerous small communities sprang up as trade centers for these new settlers. Albion, Alzada, Belltower, Boyes, Capitol, Chalk Buttes, Ekalaka, Hammond, Mill lron, Piniele, Ridge, Ridgway were thriving villages during this period, but times change and many of these small towns no longer exist. What remains are old foundations and in some cases a schoolhouse, church or community hall.

The presence of early settlers still makes itself felt in stage roads and freight trails to pioneer ranch headquarters, homesteaders' cabins, and the Carter County Museum, which all afford a look back into the history of this area.

Medicine wheels and tipi rings are found throughout the county, as well as smaller artifacts like spearheads, arrowheads, beads and scrapers. In addition, sage grouse mating dances have been identified as sources of inspiration for local tribal dances, making their preservation a matter of cultural as well as ecological significance.

RECREATION

OVERVIEW

Carter County has ample opportunities for recreation, but since tourism is becoming an initiative for most of southeastern Montana, there is hope of expanding available resources. The County

[31] Modified from the original 1976 LRP, with the permission of the CCCD, in order to include more recent developments (e.g. the significance of sage grouse mating dances).

Commissioners, Conservation District, Town of Ekalaka, and Chamber of Commerce are all implementing projects designed to preserve the character of the area.

CURRENT ISSUES

In the past, the geographical location of Carter County and a lack of public transportation have led to relative isolation. However, recent developments – including the establishment of a paved road through to Rapid City and increased non-hunting tourism numbers – indicate that the county will likely need to tailor its recreational features to the needs of tourists and their season in the future.

Until recently, hunting was the prime tourism season for the County. However, increased programming and seasonal events at the Carter County Museum have supplanted hunting season as a source of revenue for the county.[32] For more on the CCM's impact, please see "Paleontology Resources" below.

In addition to hunting and dinosaur tourism, Carter County offers wonderful opportunities for hiking, camping, and birding. The extensive trails and numerous camping areas found in Custer-Gallatin National Forest and Medicine Rocks State Park provide excellent opportunities for recreation. Water areas like MacNab Pond in the Custer-Gallatin National Forest create chances for activities like fishing, birding and ice skating.

RECENT DEVELOPMENTS

The County Commissioners have expressed an interest in expanding opportunities for tourism and recreation in the area. What they would really like is a reservoir. However, they are also excited about possibilities for expanding tourism related to Native American artifacts, medicine wheels and sun dance sites, and trails in the area.[33]

The Conservation District is currently engaged in an oral history project. As part of this, they are researching the locations of old schools, post offices, and other public buildings. Establishing a map of important historic and cultural sites, to include both Native American and settler traces, seems to be a goal of not only the District, but also the CCM and the County Commissioners. Coordinating with these organizations would be an excellent way to facilitate county-wide planning across several organizations.

The Town of Ekalaka is currently interested in 1) redefining flood plain areas, 2) redoing sewer lines, and 3) improving the atmosphere of Main Street. They hope to improve opportunities for recreation by establishing a veteran's memorial park and making improvements to the town park. They have also applied for a grant that would provide funds for improvements to Main Street.

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[32] Carter County Museum staff, in discussion with Alissa Wolenetz, July 2019.

[33] Carter County Commissioners, in discussion with Alissa Wolenetz, July 2019.

Grant monies could be used for anything from new paint for business owners to attractive streetlights.[34]

Paleontology Resources

Overview[35]

The Carter County Museum (CCM) has long been an excellent resource for the area. It has started several new initiatives in recent years, including the "Dino Shindig," which have greatly increased tourism to the county. The CCM is also providing more and more local educational resources, especially through workshops and community dinosaur digs.

The CCM has set paleontology tourism goals that it would like to implement in conjunction with local, state, and federal agencies. In particular, the museum hopes to 1) work with producers to quickly identify and conserve fossils, and 2) use fossil-related tourism to diversify income sources for local landowners.

The Carter County Museum[36]

In recent years, the CCM has begun to bring significant tourism revenue to the county. Notably, the Shindig – an annual weekend paleontology event – draws speakers from around the world and tourists from across the country. In 2018, the Shindig had over 900 attendees over the course of the weekend, 450 of which attended the talks. Hotels were booked out as far as Miles City, as demand surpassed the lodging provided in Ekalaka and Baker. Revenue from the Shindig weekend has now outpaced revenue from hunting.

The Shindig is part of the Museum's wider aim to promote better appreciation of place while providing regular cultural activities. These activities include opportunities for high-school teachers to use collections to supplement classroom activities, regular workshops for teachers from around the region, summer classes, field schools and internships for MSU students, in-depth classes on collections, an astronomy outreach program (Star Lab), and the development of toolkits for agriculture and paleontology education.

Paleontology Tourism Goals[37]

The CCM anticipates continued growth for both the Shindig and the number of paleontology digs across the county, particularly in the south. In anticipation of this growth, the museum hopes to implement the following goals in coordination with the Carter County Conservation District and other local organizations and agencies:

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[34] Vicki Fix (Ekalaka mayor), in discussion with Alissa Wolenetz, July 2019.

[35] Carter County Museum staff, in discussion with Alissa Wolenetz, July 2019.

[36] Carter County Museum staff, in discussion with Alissa Wolenetz, July 2019.

[37] Carter County Museum staff, in discussion with Alissa Wolenetz, July 2019.

A. Develop infrastructure plans for Ekalaka and Carter County to improve housing, roads, and signage, and make these resources effective in managing annual summer tourism influxes.

B. Encourage the development of local cultural activities and craft industries in order to attract and keep young families in the area. Possible craft industries include A) the repurposing of amber extracted and stabilized for fossil research that does not contain fossils as a conflict-free gem and B) the production of hand-carved elements for paleontology education kits from local sub-industry-grade timber, which could dually serve as a form of fuel mitigation.

C. Conduct tourism-related trainings on a local level to help the county successfully manage the anticipated seasonal and permanent influx of non-residents.

D. Encourage all land managers to establish estate plans in order to keep property within the community during a possible influx of non-residents, and coordinate with local organizations in order to retain tourist capital within the county. *Note: In Ekalaka, Jennifer Williams currently offers free estate planning.*

E. Work with the CCCD in order to 1) develop a guide that local land managers can refer to when they encounter fossils in the field, and 2) develop a plan to uniformly manage fossil resources across the county's public and private lands.

F. Increase communication with local, state, and federal agencies present in Carter County, including the Carter County Conservation District, NRCS, Forest Service, BLM, and private landowners, in order to 1) mitigate potential impacts of legal tourism, such as noxious weed dispersal, erosion, and littering, and 2) address ongoing poaching of fossils and other natural resources.

G. Use increased "boots-on-the-ground" related to the museum and paleontology digs to promote education about noxious weeds, sustainable agriculture, and land use, and potentially conduct localized land remediation efforts while in the field (e.g. weed pulling).

H. Work with local schools, agencies, youth education groups, and targeted MSU programs in order to increase agricultural education and provide more opportunities for local and regional students, including 1) school-to-work positions; 2) summer jobs and internships with the museum and local ranches; and 3) concrete educational resources (toolkits, curriculum) geared toward students in rural areas (MAIA: Mobile Science Lab, and other teaching toolkits).

I. Establish alternative sources of income for producers affected by severe flooding by creating tourism opportunities based on fossils unearthed during flood events.

J. Promote our national forest and encourage related tourism, especially by increasing information available in Ekalaka (e.g. trail maps, etc.).

FARMS | TYPES, SIZE, AND PROFITABILITY

OVERVIEW

Farm size has decreased over time, while both the number of farms and the land in farms have increased.

Government payments have recently increased by several times over. This is in part due to increased NRCS SGI EQIP funding.

Demographics show the need for more young producers in the county.

DEFINITION OF "LAND IN FARMS" | 2017 CENSUS OF AGRICULTURE

> *The acreage designated as ''land in farms'' consists primarily of agricultural land used for crops, pasture, or grazing. It also includes woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm producer's total operation. Large acreages of woodland or wasteland held for nonagricultural purposes were deleted from individual reports during the edit process. Land in farms includes CRP, WRP, FWP, and CREP acres.*
>
> *Land in farms is an operating unit concept and includes land owned and operated as well as land rented from others. Land used rent free was reported as land rented from others. All grazing land, except land used under government permits on a per-head basis, was included as ''land in farms'' provided it was part of a farm or ranch. Land under the exclusive use of a grazing association was reported by the grazing association and included as land in farms [….]*[38]

CHANGES IN FARM NUMBERS, ACRES, SALES, AND GOVERNMENT PAYMENTS, 1997-2017

The Census of Agriculture is fully conducted every 10 years. The following chart shows changes to farm numbers, acres, sales, and government payments in Carter County from official censuses over the last 30 years. Note increases in the number of farms, acres operated, median acres/operation, and market value of products sold. Government payments have also more than tripled.

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[38] USDA NASS, *2017 Census of Agriculture: Appendix B. General Explanation and Census of Agriculture Report Form* (Washington, D.C.: USDA NASS, 2019), https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usappxb.pdf, B – 13.

KEY FARM CHANGES FROM 1997-2017	*1997* [39,40]	*2007* [41]	*2017* [42]
FARM OPERATIONS			
No. of Farms	305	308	323
Land in Farms (Acres)	1,589,372	1,698,363	1,767,723
Median size of Farm (Ac.)	3,470	3,330	4,085
COUNTY COMMODITY TOTALS ($)			
Market Value of Agricultural Products Sold	26,991,000	42,812,000	70,628,000
Crop Sales	3,739,000	8,497,000	5,998,000
Livestock Sales	23,251,000	34,315,000	64,630,000
Average Sales Per Farm	88,494	139,001	218,664
COUNTY GOVERNMENT PROGRAMS			
No. of Operations	193	184	222
Government Payments ($)	2,301,000	1,766,000	7,229,000

CHANGES IN FARM SIZE AND PROFITABILITY, 2012-2017

Smaller data releases, including Census of Agriculture County Profiles, are released every five years. The following chart has been modified from the 2017 profile. It shows changes to farm size and profitability from 2012 to 2017.

FARM INCOME, EXPENSE, AND SIZE[43]	2017	% CHANGE SINCE 2012
FARM SUMMARY		
Number of Farms	323	-1
Land in Farms (Acres)	1,767,723	-1

[39] USDA NASS, "County Summary Highlights: 1997," USDA Census of Agriculture Historical Archive, Cornell University, accessed May 10, 2020, http://usda.mannlib.cornell.edu/usda/AgCensusImages/1997/01/26/1600/Table-01.pdf, MT-164. Ag Census information for 1997 is hosted at Cornell instead of NASS. Unlike the 2007 and 2017 surveys, government program information is in a separate document than the general summary (see below).

[40] USDA NASS, "Net Cash Return From Agricultural Sales, Government Payments, Other Farm-Related Income, Direct Sales, and Commodity Credit Corporation Loans: 1997 and 1992," USDA Census of Agriculture Historical Archive, Cornell University, accessed May 10, 2020, http://usda.mannlib.cornell.edu/usda/AgCensusImages/1997/01/26/1600/Table-04.pdf, MT-196.

[41] USDA NASS, "County Summary Highlights: 2007," USDA NASS, accessed May 10, 2020, https://www.nass.usda.gov/Publications/AgCensus/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Montana/st30_2_001_001.pdf, MT-249.

[42] USDA NASS, "County Summary Highlights: 2017," USDA NASS, accessed May 10, 2020, https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Montana/st30_2_0001_0001.pdf, MT-231.

[43] USDA NASS, "2017 Census of Agriculture, County Profile: Carter County," USDA NASS, accessed May 10, 2020, https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Montana/cp30011.pdf.

Average Size of Farm (Acres)	5,473	+1
TOTALS ($)		
Market Value of Products Sold	70,628,000	-15
Government Payments	7,229,000	+260
Farm-Related Income	4,923,000	+4
Total Farm Production Expenses	56,878,000	-1
Net Cash Farm Income	25,902,000	-21
PER FARM AVERAGE ($)		
Market Value of Products Sold	218,664	-14
Government Payments (Average per Farm Receiving)	32,565	+208
Farm-Related Income	26,466	(Z)
Total Farm Production Expenses	176,094	+1
Net Cash Farm Income	80,193	-20

However, we should note that 2012 was an exceptional year for wheat and cattle prices, which explains much of the net cash income difference between the two years. In 2012, total crop sales for the county were $12,429,000, or more than double those from 2017. Livestock sales were also higher: they were $70,770,000 in 2012, but $64,630,000 in 2017. In addition to price changes, 2017 saw an awfully high number of hailed out farms.

On a more positive note, government payments increased 260% from 2012 to 2017. Much of this was due to the hard work the NRCS field office put toward securing Sage Grouse Initiative funds.

2017 FARM PRACTICES AND CHARACTERISTICS

The 2017 County Profile also provides some information on farm practices and farm characteristics. Cover crop use and till reduction practices most certainly have room to grow. However, their numbers might also be so low because of the small amount of land in farms in Carter County used for crop production (14%).

PRACTICES AND CHARACTERISTICS[44]	2017
IRRIGATION	
Number of Acres Irrigated	2,312
LAND USE PRACTICES (% OF FARMS)	
No Till	7%
Reduced Till	3%
Intensive Till	16%
Cover Crop	5%
FARM CHARACTERISTICS	
Percent of Farms with Internet Access	80%
Percent of Farms that are Family Farms	90%

[44] USDA NASS, "2017 Census of Agriculture, County Profile: Carter County."

Percent of Farms that Hire Labor	46%

PRODUCER DEMOGRAPHICS | AGE, RACE, SEX, AND OTHER CHARACTERISTICS

The following chart summarizes the producer demographics for the county as of 2017. We should note the low number of producers 35 and younger; the high number of new and beginning farmers; and the ratio of male to female producers (399:245, or 62 % male and 39% female).

CARTER COUNTY PRODUCER DEMOGRAPHICS[45]	2017
TOTAL PRODUCERS	644 (max. 4 producers per farm)
SEX	
Male	399
Female	245
AGE	
<35	59
35-64	408
65 and older	177
RACE	
American Indian/Alaska Native	---
Asian	1
Black or African American	---
Native Hawaiian/Pacific Islander	---
White	638
More than One Race	5
OTHER CHARACTERISTICS	
Hispanic, Latino, Spanish Origin	10
With Military Service	29
New and Beginning Farms	144

LAND OWNERSHIP

Carter County has large amounts of public lands. These are concentrated in the south of the county and are often comprised of badlands or areas unsuitable for farming and ranching. Fortunately, the underlying geologic formations that make these areas unsuitable for agricultural development are often rich in fossils. Consequently, fossil hunting on public lands by large museums and institutions have led to income for the county and producers as well as the dispersal of Carter County fossils across the state and nation. The wealth of public lands in the county also provides ample opportunities for hunting, fishing, and other recreation.

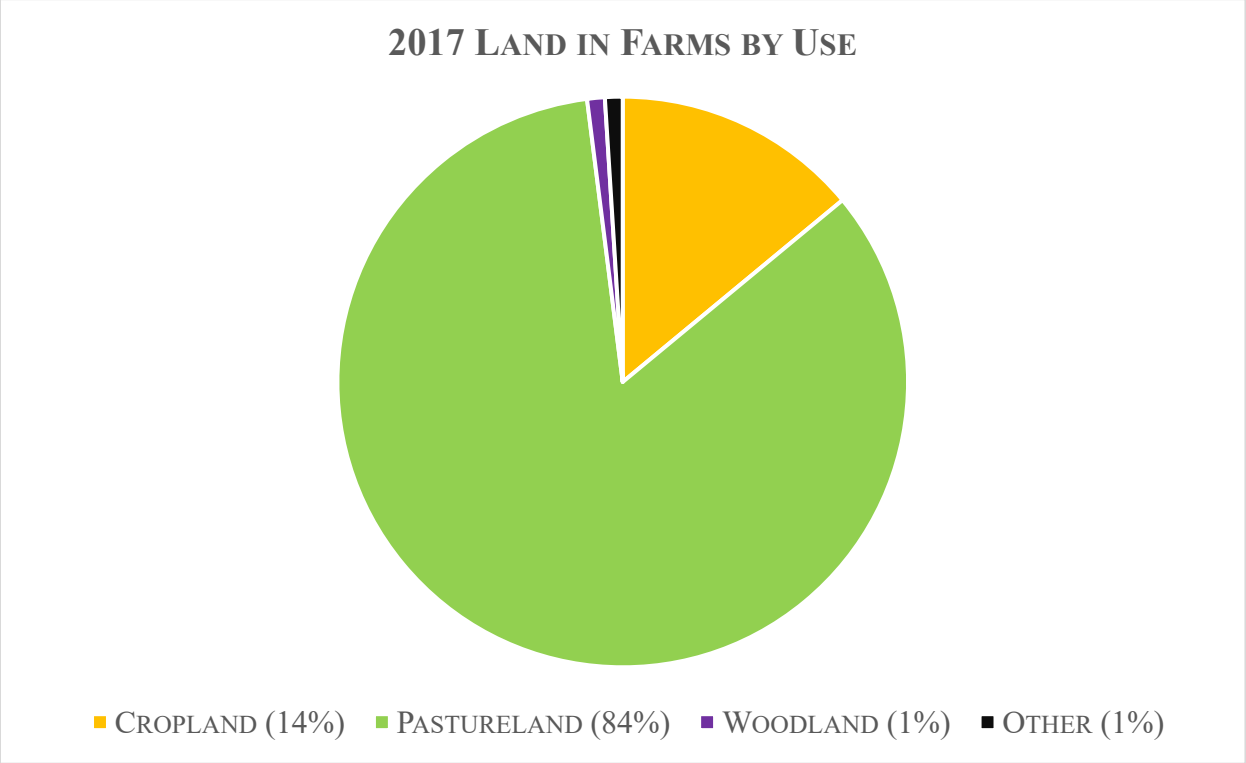
See *Appendix A: County Resource Maps and Charts* for more information on land ownership.

[45] USDA NASS, "2017 Census of Agriculture, County Profile: Carter County."

Land Use

In 2017, of the 2,139,300 acres in the county, 1,767,723, or approximately 83%, were identified as land in farms. An overwhelming majority of this is used for livestock grazing.

The following chart illustrates the uses of Carter County's Land in Farms, as per the 2017 Agricultural Census.[46]



In sharp contrast to most of the nation, most of the land in Carter County has been retained as native range. According to the Carter County Soil Survey, "Range makes up about 90 percent of the land in Carter County. Of the 90 percent, 71 percent is under private ownership, 21 percent is Federal land administered by the Bureau of Land Management and the Forest Service, and 8 percent is under state ownership."[47] Since most of the county is comprised of rangeland, noxious weed management, grazing management plans, and erosion prevention are crucial.

See *Appendix A: County Resource Maps and Charts* for more information on land use and cover, including detailed descriptions of land cover components.

Prime Farmland

An overwhelming majority of the land in Carter County is not suitable for farming. Currently, many operations across the county are in the process of seeding marginal farmland back to

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[46] USDA NASS, "2017 Census of Agriculture, County Profile: Carter County."

[47] USDA-NRCS et al., *MT011 – Soil Survey of Carter County, Montana: Part II*, 77.

pasture or rangeland to prevent erosion. Irrigation is rare. Prime farmland present along the creek systems is often dedicated hay production versus annual cropland. Some of the prime farmland is not cropped due to access concerns or the need to preserve woody, riparian habitat for local wildlife and winter cover for livestock.

See *Appendix A: County Resource Maps and Charts* for prime farmland locations.

County Resources

Overview

Carter County and the Town of Ekalaka have retained a remarkable number of public facilities. These include a wonderful museum, a remodeled town office building, a remodeled county courthouse, modern fairground facilities, a new elementary school, a scheduled critical access hospital, a nursing home, a high school, a new senior center, a remodeled library and an updated town park. The town is also raising funds to construct a new swimming pool.

There has recently been a surge in the number of small businesses in the area. Pipeline construction crews, Dino Shindig attendees, and hunters have been good sources of income for these businesses.

Despite all this, Carter County has a higher percentage than surrounding areas of youth and children in poverty, and median household income is lower than national levels.

Access to mental health care remains an issue. Compared to other states, Montana has long had high suicide rates.[48] This seems to be in part due to the isolation of many rural communities, and there is room to improve access to care and community services.

Public Facilities

Many small communities in Eastern Montana no longer have grocery stores, libraries, medical facilities, schools or county fairs. Ekalaka has retained these facilities and tends to support local businesses. This has perhaps influenced the number of young people returning home, in part because there are jobs and some conveniences.

According to the 2017 Census of Agriculture, one in five farms in the county do not have internet.[49] Expanding local internet access could open new opportunities for not only teleworking, but also telemedicine for mental health.

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[48] Juliana Sukut, "Montana dips in suicide rank nationwide but rate still trends up," *Billings Gazette*, February 28, 2020, https://billingsgazette.com/news/state-and-regional/montana-dips-in-suicide-rank-nationwide-but-rate-still-trends/article_2a5d6464-fdfd-54c3-ba78-b11062662af6.html.

[49] USDA NASS, "2017 Census of Agriculture, County Profile: Carter County."

Finally, increasing public parks, RV hookups, and campgrounds could provide increased recreational opportunities as well as needed lodging for pipeline construction crews or tourists.[50]

POVERTY

Estimates for poverty in the county and school district can be generated through the Small Area Income and Poverty Estimates (SAIPE) web application. Carter County's information can be found at https://www.census.gov/data-tools/demo/saipe/#/?map_geoSelector=aa_c&s_county=30011&s_year=2018&s_measures=aa_snc&s_state=30.

SAIPE data seem to indicate that Carter County experiences higher poverty rates than surrounding counties. The following table introduces 2018 estimated poverty rates for Carter and surrounding counties. More information on data collection and confidence intervals can be found through the SAIPE application.

ESTIMATED POVERTY RATES (2018) BY COUNTY[51]	ALL AGES (%)	AGES 5-17 IN FAMILIES (%)
CARTER	**13.7**	**22.7**
Fallon	9.2	11.0
Powder River	12.2	15.6
Custer	12.5	15.7

Continuing to provide educational opportunities to producers and youth could aid in reducing Carter County's poverty rate. For more information on current and potential future programs, please see *Section III: Analysis of Existing Conservation: Conservation Outreach and Education* and *Section IV: Natural Resource Problems and Desired Future Outcomes: Outreach and Education.*

TRANSPORTATION AND MARKETING[52]

Regional livestock auction yards provide ranchers with good livestock marketing facilities. Some of the calves are sold directly from the ranch to feeder buyers. Superior Livestock provides online auction services. Regional livestock auction yards can be found in Miles City, MT; St. Onge, SD; Belle Fourche, SD; Newell, SD; Lemmon, SD; Bowman, ND; and Dickinson, ND.

Locally produced small grains and specialty crops are also marketed regionally. Baker, MT has been the closest grain elevator facility for some time. Due to pricing, much of the local grain is

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[50] Carter County Commissioners, in discussion with Alissa Wolenetz, July 2019.

[51] United States Census Bureau, "SAIPE Interactive Tool: Small Area Income and Poverty Estimates (SAIPE): Montana: Carter County," United States Census Bureau, accessed May 11, 2020, https://www.census.gov/data-tools/demo/saipe/#/?map_geoSelector=aa_c&s_county=30011&s_year=2018&s_measures=aa_snc&s_state=30.

[52] Information for this section has been collected through discussions with local field staff.

hauled by trucks to larger facilities that can efficiently blend grain and rapidly access railroad transportation.

Alzada is an important bentonite mining area. The bentonite mined in Carter County is shipped via truck to the Colony, Wyoming, area for refining. There is a railroad at Colony.

SECTION III | ANALYSIS OF EXISTING CONSERVATION ACTIVITY

OVERVIEW[1]

The Ekalaka NRCS has a long history with water concerns, as water is limited in southern Carter County, where the Pierre Shale surfaces. This area is geographically like the defined expanse of Sage Grouse Core Area 13.

The Field Office has retained historic planning material in producer files. A study of mapping, inventory and planning documents reveals that water quality and quantity have been prevalent natural resource concerns in Carter County through time.

The oldest planning materials reveal a strong conservation focus on irrigation and water spreading system development. Boxes of technician notebooks document the planning and installation of irrigation reservoirs, diversions and dike work in the county.

COUNTY WATER ACCESS

IRRIGATION

Key points | Irrigation has been gradually phased out of the county, but obsolete systems remain. The few irrigation systems that have been recently installed are experiencing salinification issues.

In the early 1990s, participants were still actively maintaining existing irrigation systems and applying new flood irrigation and water spreading systems. (Note that irrigation in Carter County generally coincides with high water events.) The Ekalaka Field Office is no longer able to assist technically or financially with irrigation or water spreading projects in Carter County. Old systems are now falling into disrepair. At their own expense, local producers have recently installed several irrigation pivots along Box Elder Creek. The pivots seem to create salinity issues due to the nature of the associated soils.

DIFFERENCES IN COUNTY WATER SYSTEMS

Key point | Differing soils and geology throughout the county have led to varying water access.

The north end of the county can readily access groundwater-bearing geologic formations. Therefore, livestock pipeline work started much earlier in the 58A MLRA portion of the county. Prior to 1980, the producers in the northern end of the county relied heavily on stock water wells pumped with windmills or pump jacks, as well as developed springs and reservoirs. Due to soil characteristics, there are few suitable reservoir sites in northern Carter County. In the few places where there are suitable soils, reservoirs tend to last longer as there is typically more vegetative cover in the drainage area and less silt deposition. Around 1980, PVC pipe became readily available and more pipelines were installed. Prior to that time, contractors had worked with a

[1] Unless otherwise noted, all material in this section has been compiled from local field staff knowledge.

smaller diameter black PE pipe that did not have much flow capacity and was not rated for high pressures.

The south end of the county has always relied on pits and reservoirs. There were also shallow wells along creek systems, but much of this water was utilized at farmsteads and for winter use, not in summer pastures. Southern Carter County is dominated by clay-textured soils, so it is much easier to find a suitable location for a pit or reservoir. Unfortunately, vegetation is often sparse on the ecological sites associated with 60B, which results in increased sediment transport and deposition within drainages. Therefore, impoundments silt in faster, reducing the long-term water holding capacity of the structures.

Program Utilization History

Overview

Key point | Conservation in Carter County reflects a long history with a large number of conservation and cost-share programs.

The Ekalaka Field Office has worked with many different conservation and cost-share programs through the years. These include the Agriculture Conservation Program (ACP), Emergency Conservation Program (ECP), Great Plains Conservation Program (GPCP), Conservation Reserve Program (CRP), Long Term Agreements (LTA's), Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), Conservation Securities Program (CSP), Conservation Stewardship Program (CStP) and various conservation easements. Note that the Ekalaka Field Office was ushered into the HEL (Highly Erodible Lands) compliance era following the passing of the 1985 Farm Bill. All of these programs have different emphases. They were initiated by various agencies, in several different conservation eras, and their philosophies differ accordingly. Brief explanations have been provided below, with program names and key changes in **bold**.

Program Overviews

The Agriculture Conservation Program (ACP) was administered by the ASCS (now FSA) with the SCS (now NRCS). It provided technical assistance for conservation planning and design. Almost all the ACP work focused on irrigation and water spreading, and then in later years on reservoir and pit construction and livestock pipeline systems.

The Emergency Conservation Program (ECP) focuses on reducing the impacts of natural disasters (floods, droughts, fires, etc.) on Carter County producers. ECP is still occasionally used to address flooding and drought disasters by repairing reservoirs that have been damaged by flooding and by installing wells, pumps, livestock pipelines and stock tanks to provide emergency livestock water. As with ACP, ECP is administered by FSA, with NRCS providing technical assistance.

The Great Plains Conservation Program (GPCP) was administered through the SCS (now NRCS). $50,000 was the maximum cost-share extent and contracts lasted for 10 years. GPCP was unique in that it addressed resource concerns across entire operating units, included

management practices, and required follow up in the form of annual status reviews (field reviews). Through the GPCP, there was much more infrastructure put in place to facilitate prescribed grazing management. Wells, pumping plants, livestock pipelines, storage tanks, stock tanks, water spreading systems, pits, reservoirs, fences, range plantings and pasture plantings were common practices installed through the GPCP.

In the late 1980s, **the Conservation Reserve Program (CRP)** brought many changes to the landscape. Much of the remaining annual cropland in Carter County was seeded to permanent forage for the intent of soil conservation and wildlife habitat enhancement. In fact, producers in the county had already been seeding marginal annual cropland back to grass, as the soils were better suited to hay and pasture production. After CRP there was very little annual cropland left in the county. Unfortunately, most of the CRP acres were seeded to four pounds per acre of crested wheatgrass and one pound per acre of alfalfa or yellow sweet clover. As a result, the county has plenty of crested wheatgrass, which is difficult to manage in a timely manner and negatively affects diversity across the landscape.

Long Term Agreements (LTAs) were administered by ASCS (FSA), with SCS (NRCS) providing conservation plans and technical assistance for designs. LTAs typically had 5-year contract periods and tended to address resource concerns across an entire operating unit. Practices implemented through LTAs were similar to those installed with GPCP funds.

The Environmental Quality Incentives Program (EQIP) is an NRCS cost-share program that came into existence in the late 1990s. The first EQIP contracts were smaller in scope and cost and could address a single resource concern. For example, an EQIP contract could address livestock water quantity in one field on an operating unit, which was problematic for several reasons. For example, if the pipeline was designed for one field, without considering expansion, there was nothing in the design parameters to facilitate future extensions. Management practices were often tied to just one field, which made designing a comprehensive grazing system difficult. The advantages of the early EQIP program were that money was spread out over more agricultural operations, and contracts could be developed quickly and implemented rapidly.

Eventually, the EQIP planning emphasis in Montana shifted back to Resource Management System (RMS) conservation plans. These were comprehensive plans that covered an entire operating unit and included management practices. RMS plans could be progressively implemented over time. This philosophy led to better quality plans, like those written in the Great Plains Conservation Program era. The disadvantage was that more time was required to inventory and plan an entire operating unit, and it was difficult to find enough funding to implement the entire plan.

Around 2014, EQIP payment limitations were raised to $450,000 per the Farm Bill. This change was especially beneficial for landowners in southern Carter County, who needed extensive water development prior to installing cross-fences and applying grazing management. In 2014, Carter County also started to utilize **SGI (Sage Grouse Initiative) EQIP funds**. This improved the likelihood of an EQIP application being funded. From 2011-2019, 86 EQIP

contracts were funded in Carter County, covering 447,488 acres for an obligation total of $15,404,871. There are currently 65 active EQIP contracts in the county.

The WHIP (Wildlife Habitat Incentives Program) was used successfully in Carter County to enhance wildlife habitat. Locally, the program primarily focused on the construction of ponds and riparian fences with upland wildlife habitat management applied to the landscape. After some years, funding for WHIP was no longer prioritized or available in Montana, and the program was officially terminated in 2014.[2]

In 2002, CSP (Conservation Securities Program) started on a watershed basis. Carter County first wrote contracts when the Powder River and O'Fallon watersheds were nationally prioritized. The original CSP program focused on rewarding landowners who had achieved a certain pre-defined level of management on their operating units. Therefore, NRCS staff inventoried and accessed operating units prior to determining eligibility for the program. In 2005, eight Carter County CSP contracts were signed and set to expire in 2014 (10-year contracts). The objective of these plans and contracts was to maintain the existing level of conservation.

The CStP (Conservation Stewardship Program) arrived with the 2008 Farm Bill, and was not as selective as its predecessor, the 2002 CSP. It established base management thresholds to be met at the time of application with participants agreeing to implement additional enhancements to improve the level of conservation through the duration of the contract. In 2010, the first CStP contracts were funded. From 2011-2019, 80 CStP contracts have been funded over 463,690 acres for an obligation total of approximately $9,511,888. As of May 2020, there are 57 active CStP contracts in Carter County. CStP has served to enhance grazing management, forage harvest management, nutrient and pesticide management and upland wildlife habitat management across Carter County. CStP has also encouraged the establishment of resource monitoring systems.

The newest version of CStP was rolled out in 2017. It is more complex, and like EQIP in that practices as well as enhancements can be applied to address resource concerns and improve the level of stewardship.

The Ekalaka Field office has assisted with one **Farm and Ranch Lands Protection Program (FRPP)** easement and one potential **Agricultural Land Easements (ALE)** easement**.** There is some interest in these easements, but very little threat of development or subdivision. Aside from sage grouse habitat considerations, this landscape has not been a high priority for easements.

PRACTICE INFORMATION CHARTS

CARTER COUNTY EQIP/CTA PRACTICE IMPLEMENTATION

Practice Code	*Practice Name*	*Units*	*1992-2020*	*2011-2020*

[2] USDA-NRCS, "Wildlife Habitat Incentives Program," USDA-NRCS, accessed May 11, 2010, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs141p2_024540.

472	Access Control	Ac.	6,661.00	5,138.00
100	Comprehensive Nutrient Management Plan	Ac.	2.00	0.00
327	Conservation Cover	Ac.	20,990.00	18,211.00
328	Conservation Crop Rotation	Ac.	8,292.00	2,564.00
340	Cover Crop	Ac.	1,373.00	1,373.00
342	Critical Area Planting	Ac.	2.00	2.00
362	Diversion	Ft.	630.00	630.00
382	Fence	Ft.	1,515,892.00	1,141,442.00
512	Forage and Biomass Planting	Ac.	8,376.00	4,130.00
511	Forage Harvest Management	Ac.	15,133.00	10,072.00
561	Heavy Use Area Protection	Ac.	5,750.00	5,750.00
315	Herbaceous Weed Treatment	Ac.	228.00	227.00
441	Irrigation System, Microirrigation	Ac.	1.80	1.80
770	Livestock Confinement Facility	No.	1.00	1.00
516	Livestock Pipeline	Ft.	1,572,401.00	940,546.00
576	Livestock Shelter Structure	No.	4.00	4.00
590	Nutrient Management	Ac.	1,270.00	922.00
500	Obstruction Removal	Ac.	96,165.00	96,165.00
595	Pest Management Conservation System	Ac.	112,869.00	111,080.00
378	Pond	No.	28.00	7.00
462	Precision Land Forming	Ac.	2.50	2.50
528	Prescribed Grazing	Ac.	439,828.00	347,015.00
533	Pumping Plant	No.	69.00	62.00
550	Range Planting	Ac.	3,113.00	830.50
329	Residue and Tillage Management No-Till	Ac.	2,982.00	947.00
574	Spring Development	No.	7.00	1.00
587	Structure for water control	No.	1.00	1.00
649	Structures for Wildlife	Ac.	78,556.00	78,556.00
612	Tree/Shrub Establishment	Ac.	2.40	2.40
645	Upland Wildlife Habitat Management	Ac.	275,188.00	237,813.00
635	Vegetated Treatment Area	Ac.	0.20	0.20
614	Watering Facilities	No.	505.00	339.00
642	Well	No.	57.00	43.00
351	Well Decommissioning	No.	29.00	13.00
380	Windbreak/Shelterbelt Establishment	Ea.	26,251.00	19,054.00

EQIP/CSP - PLANNED ACTIVITIES – 2017-2030

Practice Code	*Practice Name*	*Units*	*Quantity*	*Count*
340	Cover Crop	Ac.	2,820.00	43
342	Critical Area Planting	Ac.	24.60	5
382	Fence	Ft.	1,335,187.00	298
512	Forage and Biomass Planting	Ac.	7,487.00	58
511	Forage Harvest Management	Ac.	1,941.00	16
383	Fuel Break	Ac.	195.50	7
315	Herbaceous Weed Treatment	Ac.	919.00	14
441	Irrigation System, Microirrigation	Ac.	0.80	1
516	Livestock Pipeline	Ft.	1,573,374.00	461
576	Livestock Shelter Structure	No.	51.00	
590	Nutrient Management	Ac.	298.00	
500	Obstruction Removal	Ac.	138,046.00	194
378	Pond	No.	6.00	
528	Prescribed Grazing	Ac.	507,890.00	162
533	Pumping Plant	No.	86.00	
550	Range Planting	Ac.	153.00	
574	Spring Development	No.	3.00	
649	Structures for Wildlife	Ac.	46,183.00	181
645	Upland Wildlife Habitat Management	Ac.	20,103.00	22
614	Watering Facilities	No.	483.00	
642	Well	No.	12.00	
351	Well Decommissioning	No.	3.00	
380	Windbreak/Shelterbelt Establishment	Ea.	3,084.00	4
E528, 528	Prescribed Grazing	Ac.	27,224.00	25
E612, 612	Tree/Shrub Establishment	Ac.	6.60	8
E595, 595	IPM	Ac.	57,574.00	45
E590, 590	Nutrient Management	Ac.	1,679.00	7
E550, 550	Range Planting	Ac.	64.80	5
E512, 512	Forage and Biomass Planting	Ac.	221.00	9
E511, 511	Forage Harvest Management	Ac.	7,682.00	15
E472, 472	Access Control	Ac.	462.20	2
E386, 386	Field Border	Ac.	12.60	9
E340, 340	Cover Crop	Ac.	129.60	4
E327, 327	Conservation Cover	Ac.	4.50	5

Conservation Outreach and Education

Carter County does not have a full-time MSU Extension Office, resulting in additional Conservation Technical Assistance (CTA) work relative to agronomy, entomology, agriculture business, soil fertility, livestock health and nutrition and water quality. This business creates additional program opportunities as producers are accustomed to working closely with the staff here on a voluntary basis.

The CCCD and the Ekalaka NRCS are striving to expand conservation education opportunities for agriculture producers and youth in Carter County. We are refining a youth range education event that coincides with a youth weed pull event each summer.

The CCCD hosts a Ladies Day on the Range each fall and a Conservation Day in the Ekalaka Elementary School in the spring. This year, the NRCS hosted an engineering workshop in the spring. We hope to address financial planning, estate planning, forestry planning, riparian/mesic restoration, and adaptive grazing management in future workshops.

The Ekalaka NRCS assists as needed with FFA and 4-H activities. Local staff members coach agronomy and range teams and provide technical assistance for agronomy and range contests. We also assist with plant identification/verification for students building plant collections. We are also working with another conservation district on a grant for equipment to provide digitized agronomy and range plant collections to FFA chapters and 4-H clubs for reference purposes.

SECTION IV | NATURAL RESOURCE PROBLEMS AND DESIRED FUTURE OUTCOMES AS IDENTIFIED AND PRIORITIZED BY THE LWG, CCD, AND OTHER LOCAL ENTITIES

SUMMARY

KEY GOALS

The Ekalaka NRCS office and the Carter County Conservation District will continue to work toward:

> Encouraging and assisting local agriculture producers and planning boards to formulate a plan for the orderly development and conservation of natural resources in the county.
>
> Emphasizing the total benefits of conservation planning to all landowners in the CCCD and NRCS information program.

In order to meet these goals, our most important objective is to increase Resource Management System (RMS) level planning. Our vision is for local resource concerns to be identified and resolved through comprehensive RMS planning, which covers all land uses and all resource concerns. This is opposed to fragmented conservation efforts, like those that resolve livestock water problems but do not address more overarching range health issues. Targets for RMS-level planning are listed below.

RESOURCE MANAGEMENT SYSTEM (RMS) LEVEL PLANNING GOALS

By 2030 . . .

> 60% of operating units (not including public lands) will have implemented RMS level conservation plans which include focused, but flexible grazing management systems and grazing land monitoring.
>
> 25% of operating units will have RMS level Conservation Plans and be utilizing progressing implementation strategies to eventually achieve objectives for grazing management and sustainability.
>
> The remaining 15% of operating units will have been contacted by the CCCD or local NRCS staff regarding conservation planning opportunities and potential funding sources.

CURRENT RESOURCE PROBLEMS AND DESIRED FUTURE OUTCOMES

In addition to the goals above, we have developed more specific targets to address current resource problems. These include expanding outreach and education, engaging historically underserved producers, increasing planning capacity, preserving historical and cultural resources, preserving and improving grazing and hay land resources, implementing RMS-level conservation plans, enhancing wildlife habitat, improving crop land soil heath, improving water

and air quality, creating more opportunities for recreation, and fostering cooperation between agencies.

Priorities for these target areas are outlined below. Sections highlight goals and methods. More complex sections include sub-sections that outline additional goals.

Issues prioritized by local organizations have been marked accordingly.

[LOCAL PRIORITY] GRAZING LAND RESOURCES

OVERVIEW

Note: Objectives for grazing land resources are detailed in three sections: 1) riparian areas, mesic areas, and woody draws; 2) invasive species; and 3) plant species diversity and drought resiliency. Local context is provided as needed.

Vision | Improve grazing land resources (pastureland, rangeland, grazable forestland and the associated wetland and riparian areas). Our vision is that by 2030, 70% of private grazing lands will be managed strategically and adaptively to improve grazing land health attributes.

Key objectives |

Reduce erosion | Improve species composition, forage production and residual cover (reduce the potential for soil erosion)

Improve plant health | Utilize adaptive grazing management strategies to enhance the density, diversity, structure, vigor and forage production of native and introduced upland plant communities.

Enhance infrastructure | Develop and improve infrastructure on the landscape to support the implementation of adaptive grazing management.

Develop water | Develop well-distributed upland water resources.

Increase fencing | Apply strategically placed cross-fences (permanent and temporary) for the purpose of protecting sensitive areas and/or balancing field size with herd size to maximize grazing efficiency.

GRAZING LAND RESOURCES: RIPARIAN AREAS, MESIC AREAS AND WOODY DRAWS

Context | Carter County producers are concerned about the general health of riparian areas, mesic areas and woody draws. They are aware of down-cutting along creek systems, and are alarmed by the prevalence of aggressive, introduced, cool-season grass species and noxious weeds, as well as the lack of woody species regeneration. Woody species, especially trees, along major creek and river drainages are aging out and there is no longer a diverse age class.

Vision | Improve the function and quality of riparian areas, mesic areas and woody draws. Utilize grazing management, in combination with upland water development, riparian fences and low-tech/low-cost structures (if needed) to improve and restore the functionality and quality of mesic and riparian areas for the benefit of livestock, wildlife and aesthetic value.

Objectives

Apply fencing | Permanent or temporary fences should be encouraged so that producers can properly apply grazing management treatments to these areas.

Manage invasive species | Chemical treatment of invasive species management should be thoughtfully designed to minimize chemical damage to woody plant seedlings.

Manage grazing | Grazing treatments should be thoughtfully designed to provide native range plants a competitive, long-term advantage over cool-season introduced grasses.

GRAZING LAND RESOURCES: INVASIVE SPECIES

Context

There is local concern regarding invasive forb and grass species such as Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), whitetop (*Cardaria draba*), spotted knapweed (*Centaurea stoebe*), dalmatian toadflax (*Linaria dalmatica*), hoary alyssum (*Berteroa incana*), Japanese bromegrass (*Bromus japonicus*), Kentucky bluegrass (*Poa pratensis*), smooth bromegrass (*Bromus inermis*) and ventenata (*Ventenata dubia*).

Local landowners also wish to manage encroaching ponderosa pine (*Pinus ponderosa*) stands and to a smaller extent Rocky Mountain juniper (*Juniperus scopulorum*). In the Chalk Buttes area, there is a group of producers that has been meeting to determine what technical and financial resources might be available to address ponderosa pine and Rocky Mountain juniper encroachment. There is similar interest in the Sheep Mountains, along Tie Creek, in the Mill Iron area and along Speelmon Creek. The producers would like to utilize EQIP funding for the development of Forestry CAP plans and for implementation of the recommended practices which might include Forest Management, Forest Stand Improvement, Firebreak, Fuel Break, Herbaceous Weed Control, Critical Area Planting, Restoration and Management of Rare and Declining Habitats, Prescribed Grazing Management and the associated practices necessary for 528 (642, 533, 516, 614, 382). They are open to working with various NGO's, DNRC, BLM and USFS to achieve similar objectives on private and adjoining public lands to make a greater impact across the landscape.

Vision | Reduce the establishment and encroachment of invasive species. Utilize monitoring systems and management plans from multiple agencies to reduce encroachment by invasive and undesirable species and prevent decadence.

Objectives

Reduce decadence | Species such as little bluestem (*Schizachyrium scoparium*) and Kentucky bluegrass (*Poa pratensis*) will be monitored and managed to prevent decadent, unusable stands and encroachment that negatively affect stocking capacity.

Manage grazing | Grazing management will focus on increasing stock density and rotating season of use to facilitate recovery periods, improve livestock distribution and grazing utilization and to reduce plant decadence.

Facilitate interagency cooperation | The Ekalaka NRCS and CCCD will work interactively with the Carter County Weed Board to share and consolidate resources for the development of effective weed management plans and grant proposals for producers in Carter County.

See the Wildfire Resilience section for more information on fire management initiatives.

GRAZING LAND RESOURCES: PLANT SPECIES DIVERSITY AND DROUGHT RESILIENCY

Vision | Enhance the diversity and drought resiliency of the plant species composition by managing for plant health, especially expansive root systems.

Objectives

Manage grazing | Encourage grazing systems which integrate conservative stocking thresholds, annual weather-related management "triggers" planned chaos periodic rest and/or deferment treatments.

Improve the Similarity Index of communities | Improve the Similarity Index (SI) of native plant communities and overall range health with respect to ecological site potential.

SI Targets for 2035

25% of native range (private acreages) will be in an SI range of 76-100%.

60% of native range (private acreages) will be in an SI range of 51-75%.

15% of the native range acreage will have progressed to a SI rating of 26-50% rating, through the utilization of adaptive grazing management strategies and/or the acceleration of practices.

Native range and pastures will be producing 25% more usable forage.

[Local Priority] Wildfire Resilience

For context, see Grazing Lands Resources: Invasive Species.

Vision | By 2030, 35% of the grazable forestland (private) acres will be managed to reduce the risk of catastrophic fire events and improve the grazing capacity.

Objectives

Thin stands | Strategic thinning techniques will be used to create effective fuel breaks and re-create natural meadows to allow for fire management and improve forage resources.

Rejuvenate woody draws | Strategic thinning and felling techniques will be used to reduce ponderosa pine (*Pinus ponderosa*) canopies in woody draws and encourage deciduous tree regeneration (green ash (*Fraxinus pennsylvanica*), quaking aspen (*Populus tremuloides),* paper birch (*Betula papyrifera*), American elm (*Ulmus americana*), which will aid in fire management.

Control invasive species | Thinning treatments will be followed with herbaceous weed control to minimize the threat of Canada thistle (*Circium arvense*) and leafy spurge (*Euphorbia esula*) infestations following the disturbance activity and to control new ponderosa pine (*Pinus ponderosa*) seedlings.

Maintain healthy forestlands | Adaptive grazing management and limited, responsible cultural and chemical controls will be utilized to maintain healthy grazable forestlands post-treatment.

[Local Priority] Soil Health on Annual Cropland Acres

Vision | Improve soil health and quality on the remaining annual cropland acres in Carter County.

Objectives

Encourage no-till and rotations | Encourage no-till farming methods and/or the use of longer cropping rotations that utilize perennial species for organic operators. Work with the CCCD to purchase a no-till drill that could be used by Carter County producers who wish to experiment with no-till cropping methods.

Encourage forage conversions | Encourage the conversion of marginal cropland acres to permanent forage. Utilize NRCS seeding initiatives and/or NGO funding to provide cost-share for seedings.

Increase crop and rotation diversity | Encourage the use of diverse cover crop mixes and crop rotations. Work with the CCCD to establish some cover crop demonstration plots for Carter County operator to tour and view.

Encourage soil testing | Encourage producers to soil test and thoughtfully plan nutrient management practices. Have basic soil testing equipment and information available through the Ekalaka Field Office and the CCCD. Continue to invite producers to work with Mark Henning to properly interpret/analyze soil test results.

Use livestock in cropping systems | Incorporate livestock into annual cropping systems. Plan livestock water developments and temporary or permanent cross fence to manage crop aftermath and cover crop grazing efficiently and in a way that enhances soil health.

[LOCAL PRIORITY] INTRODUCED HAY LAND RESOURCES

Vision | Improve introduced hay land resources across the landscape. Encourage the establishment of diverse plant mixtures and flexible management in hay land, pastureland and naturalized pastureland to improve soil quality, reduce pests and diseases, maximize long-term production, improve forage quality and enhance wildlife habitat on the Carter County landscape.

Objectives

Use flexible management | Encourage agricultural operators to flexibly manage hay land and pastureland acres to incorporate livestock into all systems to improve soil health.

Use no-till | Utilize no-till techniques to renovate older hay stands that are no longer productive or diverse in species composition.

Encourage cover crops | Encourage cover crops as part of the renovation cycle.

Manage grazing | Apply water and cross fence on hay land (cropland) as well as expiring CRP to facilitate grazing.

Encourage soil testing | Encourage agricultural operators to monitor the soil health of hay land through soil testing. Have basic soil testing equipment available through the Ekalaka Field Office and the CCCD.

OUTREACH AND EDUCATION

Vision **|** Carry out a continuous education and information program to reflect changing needs.

Objective | Continue to develop education programs. Topics may include:

- Adaptive grazing management
- Grazable forestland management
- Mesic/riparian area restoration
- No-till renovation of pastureland and hay land
- Plant materials for forage and biomass plantings, range plantings, critical area seedings, wildlife plantings and cover crops
- Engineering livestock pipeline systems
- Youth range and agronomy education
- Estate planning and financial planning
- Ag enterprise development

Engaging Historically Underserved Producers

Vision | Encourage historically underserved producers to engage with the CCCD and local NRCS field office.

Objectives

Engage historically underserved producers | Increase outreach to female producers, beginning farmers, veteran farmers, socially disadvantaged farmers. Encourage engagement with producers from outlying communities in Carter County, including Hammond, Albion, Alzada, Boyes, Capitol, Mill Iron, Ridgeway, and Ridge.

Continue outreach to women producers | Continue Ladies Day on the Range.

Increase educational opportunities | Provide local educational opportunities for high school students and beginning farmers/ranchers to learn about agriculture enterprise development, agriculture finance/business/marketing, generation transfer, and estate planning.

Continue youth engagement | Continue youth range and agronomy education.

See Section III: Analysis of Current Conservation Efforts: Conservation Outreach and Education for more information on current programs.

Increasing Conservation Technical Assistance (CTA) Capacity

Vision | Develop CTA conservation plans – voluntary, non-programmatic planning for free – at the most rapid pace allowed by available TA funding, workload, and current personnel.

Objectives

Increase personnel | Encourage volunteers and/or retired workers to work with local agencies. Maintain a SWAT or similar partner position in the Ekalaka Field Office.

Increase grant funding | Actively seek out available grant funding for all aspects of the CCCD and NRCS conservation implementation activities.

Increase NGO partnerships | Vet and work cooperatively with NGO's to provide additional sources of funding for conservation activities in Carter County.

Historical and Cultural Resources

Vision | Preserve the historical and cultural resources of the area.

Objectives

Collect interviews and video footage from producers | Complete "Roots that Bind Us" documentary by 2021.

Support local documentary and archival work | Support, when possible, other local projects, such as documentaries like "Feek's Vision" or works like *Shifting Scenes*.

Preserve significant cultural and historic sites | Work with other organizations to document and preserve sites of cultural or historical significance, including Native American campsites and trails, homesteads, buildings, and other areas.

WILDLIFE HABITAT

Vision | Improve wildlife habitat by increasing species diversity and reducing threats to wildlife across landscapes.

Objectives

Increase diversity | The landscape-level wildlife habitat values of grazing lands will be enhanced by improving the richness and diversity of native and introduced vegetation to provide additional pollinator habitat, and additional food, cover habitat and continuity for a variety of wildlife species.

Reduce threats | Threats to sage grouse and other wildlife species will be addressed. Continuity habitat should be addressed when and where it is practical to do so by removing and replacing aged woven wire, 5-6 barbed wire fences, un-used power infrastructure, debris/junk piles, etc.

WATER RESOURCES

Vision | Monitor water resources to assure maximum beneficial use of water within each total watershed area and to maintain or improve the quality of water in Carter County

Objectives

Review projects within individual drainage basins | Review water development projects (ex. drainage area assessments prior to livestock pit construction) as needed to ensure a proper balance of available water and developments within each drainage basin.

Facilitate inter-agency cooperation | Continue working cooperatively with the CCCD and MT DEQ on water quality monitoring and reference stream data collection in Carter County.

Responsibly manage pests | Work cooperatively and progressively with landowners and the Carter County Weed Board to develop Integrated Pest Management plans that consider water quality.

Screen for pesticides | Utilize the Windows Pesticide Screening Tool (WIN-PST) program to screen pesticides for potential water quality hazards and develop mitigation strategies if necessary.

Increase buffers along riparian areas | Encourage the application of vegetative or woody buffer practices along cropland and grazing land fields that border riparian areas.

The buffers would consist of dense, diverse vegetation that is left standing for the purposes of capturing, filtering and diverting runoff, utilizing excess nitrogen and providing additional high-quality wildlife habitat.

Relocate facilities | Encourage agriculture operators with aging AFO (Animal Feeding Operation) infrastructure alongside or within riparian areas to relocate the facilities to a position higher on the landscape with the appropriate diversions and vegetative buffers to prevent point-source pollution during time periods when livestock are confined.

AIR QUALITY

Vision | Maintain a high air quality standard.

Objective | Discourage all projects that will reduce air quality. Encourage operators to use pesticides and fertilizers responsibly, minimizing drift and volatilization of the products applied.

RECREATION

Vision **|** Encourage development of land recreation potential within CCCD boundaries with priorities placed on meeting the needs of local people.

Objective **|** Work with the CCCD, County Commission, the Carter County Chamber of Commerce and the CCM to promote nature tourism and educational events.

INTER-AGENCY COOPERATION

Vision | Work with local, state, and federal agencies more frequently.

Objectives

Establish joint committee(s) | Set up a joint committee between federal agencies, county entities and local land and economic development organizations to address overarching issues like county-wide conservation planning, recreation, tourism, small business promotion, and infrastructure development. Examples of possible committee members include – but are by no means limited to – the County Commissioners, the Carter County Weed Board, the Carter County Planning Board, the Carter County Conservation District, the Chamber of Commerce, the City of Ekalaka, the local school district, the Carter County Museum, the Montana Department of Natural Resource and Conservation (DNRC), the United States Forest Service (USFS), the NRCS, and the BLM.

Manage noxious weeds | Develop streamlined processes for managing noxious weeds in disturbed lands (primarily trails and roads).

Reduce habitat fragmentation | Create more wildlife-friendly road and resource development plans to reduce habitat fragmentation and prevent animal and plant introduced species encroachment.

Increase education | Create educational opportunities for business management trainings, including estate planning, in order to ensure that county resources stay within

the county, local businesses are sustainable, and that family operations can successfully transfer from one generation to the next.

Encourage field days and increased meetings | Meet regularly with BLM, USFS and DNRC to communicate important information regarding joint projects. Have more frequent field days to cooperatively inventory and plan projects (more specific to NRCS, CCCD and Carter County Weed Board work).

Improve plans across public and private lands | Work cooperatively to improve grazing management plans for agriculture operators with both private and publics lands within their operating units.

Establish county-wide fire prevention plans | Develop county-wide grazable forestland management strategies as well as fuel reduction strategies to attempt to prevent catastrophic fires while improving the productivity, health and aesthetic value of this land use.

Reduce erosion from road culverts | Work with the Carter County Commission and the Carter County Road Department to develop best management practices for installing road culverts and in a manner that prevents severe erosion in the associated drainages.

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[1] For more information on Chicago-Style Citations, see the Chicago Manual of Style (https://www.chicagomanualofstyle.org/tools_citationguide.html) or the Purdue Owl's Chicago Style Guide (https://owl.purdue.edu/owl/research_and_citation/chicago_manual_17th_edition/chicago_style_introduction.html). Although hyperlinks are conventionally removed in notes and bibliographies, they have been left here for ease of use.

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APPENDIX A: COUNTY RESOURCE MAPS AND CHARTS

OVERVIEW

- ✓ There are four MLRAs in Carter County. See Appendix A: County Resource Maps and Charts for more information on their extents.

- ✓ The MLRA descriptions below have been edited for clarity. References to figures have been removed, and scientific names have been included for local plant life.

58B—NORTHERN ROLLING HIGH PLAINS, SOUTHERN PART[1]

This area [. . .] is in Wyoming (95 percent) and Montana (5 percent). It makes up about 19,265 square miles (49,915 square kilometers). The cities of Sheridan, Gillette, and Casper, Wyoming, are in this MLRA. Interstate 90 crosses the northern third of this area from east to west, and Interstate 25 crosses the western third from north to south. The Naval Petroleum Reserve Military Reservation and the Thunder Basin National Grasslands are in this area. Most of the Powder River Basin is in this area. This basin contains important coal, oil, and gas deposits.

PHYSIOGRAPHY

This area is in the Missouri Plateau, Unglaciated, Section of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Elevation generally ranges from 2,950 to 5,900 feet (900 to 1,800 meters), increasing gradually from north to south. On a few buttes, it is as high as 6,890 feet (2,100 meters). Typically, local relief is about 150 to 250 feet (45 to 75 meters). Slopes generally are gently rolling to steep, and wide belts of steeply sloping badlands border a few of the larger river valleys. Terraces are common along most of the major river systems in the area. In places flat-topped, steep-sided buttes rise sharply above the general level of the plains.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Powder-Tongue (1009), 49 percent; Cheyenne (1012), 34 percent; North Platte (1018), 16 percent; and Missouri-Little Missouri (1011), 1 percent. The North Platte River runs through the southern part of this MLRA. The upper reaches of the Powder, Tongue, Belle Fourche, and Cheyenne Rivers drain the northern half of the area.

GEOLOGY

The middle third of this area is underlain by Tertiary continental sediments consisting of shale, siltstone, and sandstone. Cretaceous marine and continental sediments underlie the north western third and southeaster third of the area. These older units consist of interbedded layers of shale,

[1] USDA-NRCS, *United States Department of Agriculture Handbook 296: Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin* (Washington, D.C.: USDA-NRCS, 2006), https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf, 159-60.

siltstone, and sandstone. This MLRA is an important mining (coal and uranium) and petroleum district. The largest deposits of coal in the United States occur in this area.

CLIMATE

The average annual precipitation is 9 to 27 inches (230 to 685 millimeters) in most of this area. It fluctuates widely from year to year. The higher precipitation occurs at the higher elevations. Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August, and some rain falls in autumn. Precipitation in winter occurs as snow. The average annual temperature is 41 to 48 degrees F (5 to 9 degrees C). The freeze-free period averages 145 days and ranges from 115 to 170 days.

WATER

Following are the estimated withdrawals of freshwater by use in this MLRA:

Public supply—surface water, 3.1%; ground water, 2.5% Livestock—surface water, 0.4%; ground water, 0.2%

Irrigation—surface water, 83.8%; ground water, 1.4%

Other—surface water, 6.9%; ground water, 1.7%

The total withdrawals average 715 million gallons per day (2,705 million liters per day). About 6 percent is from ground water sources, and 94 percent is from surface water sources. The surface water generally is suitable for all uses, but adequate supplies away from the North Platte, Powder, and Tongue Rivers are scarce. The low and erratic precipitation is the principal source of water for agriculture. Water for livestock is stored in small reservoirs, but supplies are inadequate for significant irrigation. Narrow strips of land along the perennial streams are irrigated with water from the North Platte, Powder, and Tongue Rivers and some of the larger tributaries of these rivers.

The Structural Basin aquifer underlies almost all of this area. This is the most extensively used aquifer in Wyoming. It consists of lenticular beds of sandstone, coal, and shale. The ground water is confined, so flowing wells are common. Because the median concentration of total dissolved solids is 1,100 parts per million (milligrams per liter), this water is unsuitable for drinking, but it is used for some irrigation and for livestock. The ground water is a sodium bicarbonate or sulphate type and is soft or moderately hard.

Small amounts of ground water are available in the alluvial and terrace deposits along the North Platte, Powder, and Tongue Rivers. This water is a sodium bicarbonate or sulphate type and is generally hard or very hard. The level of total dissolved solids typically exceeds drinking water standards. The ground water in Wyoming has naturally high levels of fluoride, iron, manganese, selenium, and radionuclides.

SOILS

The dominant soil orders in this MLRA are Aridisols and Entisols. The soils in the area dominantly have a mesic soil temperature regime, an aridic soil moisture regime that borders on ustic, and mixed or smectitic mineralogy. They are shallow to very deep, generally well drained, and loamy or clayey. Haplargids formed in alluvium (Cambria, Forkwood, and Ulm series) and in mixtures of alluvium, eolian sediments, and residuum (Bowbac, Cushman, and Hiland series). Torriorthents formed in alluvium on alluvial fan remnants, fan piedmonts, stream terraces, hills, and plateaus (Kishona series) and in residuum or colluvium on hills (Samday, Shingle, Tassel, and Theedle series). Mollisols and Alfisols occur in areas that have an ustic soil moisture regime that borders on aridic.

BIOLOGICAL RESOURCES

This area supports grassland vegetation. Rhizomatous wheatgrasses, green needlegrass (*Nasella viridula*), needle and thread (*Hesperostipa comate*), and blue grama (*Bouteloua gracilis*) are the dominant species on deep soils. Rhizomatous wheatgrasses, bluebunch wheatgrass (*Pseudoroegneria spicata*), Indian ricegrass (*Achnatherum hymenoides*), and needle and thread (*Hesperostipa comata*) are the major species on shallow soils on hills and ridges. Basin wildrye (*Leymus cinereus*), green needlegrass (*Nasella viridula*), rhizomatous wheatgrasses, and shrubs are dominant along bottom land and streams. Big sagebrush (*Artemisia tridentata*) is the dominant shrub.

Some of the major wildlife species in this area are elk, deer, antelope, coyote, beaver, muskrat, jackrabbit, cottontail rabbit, sage grouse, and turkey. The species of fish in the area include rainbow trout, brown trout, brook trout, and cutthroat trout.

LAND USE

Following are the various kinds of land use in this MLRA:

Cropland—private, 4%

Grassland—private, 76%; Federal, 16%

Forest—private, 1%

Urban development—private, 1%

Other—private, 2%

More than 90 percent of this area supports native grasses and shrubs grazed by cattle and sheep. About 4 percent is dry land farmed in a wheat-summer fallow rotation. The dry farmed areas occur mainly on gently sloping, deep soils. Narrow strips of land along the Tongue, Powder, and Platte Rivers and some of their tributaries are irrigated.

Alfalfa, other hay crops, and feed grains are the principal crops. Some tracts are used as tame pasture. Open stands of ponderosa pine (*Pinus ponderosa*) are on the higher buttes and steep slopes that receive higher amounts of precipitation.

The major resource concerns are the quantity and quality of water and soil quality. Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. The establishment of early and late season pastures supplements forage production and keeps livestock off the rangeland during critical growth periods. Conservation practices on cropland generally include those that minimize wind erosion and maximize the amount of soil moisture available for crops.

58D—Northern Rolling High Plains, Eastern Part[2]

This area [. . .] is in South Dakota (65 percent), Montana (21 percent), and North Dakota (14 percent). It makes up about 2,755 square miles (7,145 square kilometers). It has no major cities. U.S. Highway 85 traverses this area from north to south. The Little Missouri National Grasslands and Custer National Forest occur in this area.

Physiography

This area is in the Missouri Plateau, Unglaciated, Section of the Great Plains Province of the Interior Plains. Elevation ranges from 2,300 to 4,000 feet (700 to 1,220 meters), increasing gradually from east to west. Harding Peak, the highest point in the MLRA, reaches an elevation of 4,019 feet (1,225 meters). Slopes generally are gently rolling to steep.

Local relief is mainly 80 to 330 feet (25 to 100 meters). In places flat-topped, steep- sided buttes rise sharply above the general level of the plains. The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Little Missouri (1011), 52 percent; Missouri-Oahe (1013), 46 percent; and Lower Yellowstone (1010), 2 percent. The Little Missouri River and the headwaters of the major tributaries that eventually form the Grand and Moreau Rivers in South Dakota are in this area.

Geology

Cretaceous marine and continental sediments of shale, siltstone, and sandstone occur in the majority of this MLRA. The continental and marine Hell Creek Formation occurs in approximately 85 percent of the MLRA, and the Fox Hills Sandstone forms the southern boundary of the MLRA. Tertiary deposits also occur in scattered areas throughout the MLRA. These deposits are made up of the Paleocene Ludlow and Tongue River Formations, the Oligocene White River Group, and the Miocene Arikaree Group. These resistant Paleocene, Oligocene, and Miocene beds stand above the Cretaceous beds.

Ponderosa pine growing on these Tertiary beds further distinguishes them from the other formations in the MLRA. Quaternary river sand and gravel deposits occur on the valley floors

[2] USDA-NRCS, *Land Resource Regions and Major Land Resource Areas*, 162-64.

and on the terraces along the larger rivers in the area. A large Quaternary eolian deposit occurs directly south of the town of Buffalo.

CLIMATE

The average annual precipitation is 14 to 17 inches (355 to 430 millimeters) in most of this area. It fluctuates widely from year to year. Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August. Precipitation in winter occurs as snow. The average annual temperature is 42 to 45 degrees F (6 to 7 degrees C). The freeze free period averages 140 days and ranges from 130 to 150 days.

WATER

Following are the estimated withdrawals of freshwater by use in this MLRA:

Public supply—surface water, 0.0%; ground water, 0.0%

Livestock—surface water, 3.4%; ground water, 2.4%

Irrigation—surface water, 59.1%; ground water, 21.1%

Other—surface water, 8.7%; ground water, 5.3%

The total withdrawals average 2.5 million gallons per day (9.5 million liters per day). About 29 percent is from ground water sources, and 71 percent is from surface water sources. The low and erratic precipitation is the principal source of water for agriculture. Most of the surface water in this MLRA is of good quality and is used for limited irrigation on the flood plains and terraces along the major streams. Water for livestock is stored in small ponds or dugouts. Some wells in the Fort Union-Fox Hills- Hell Creek aquifer provide water for domestic use and livestock. High levels of total dissolved solids and salinity limit the use of this ground water for irrigation. Naturally high levels of selenium and molybdenum occur in the water from the Fort Union sediments. These elements can cause health problems in livestock.

SOILS

The dominant soil orders in this MLRA are Alfisols, Entisols, Inceptisols, and Mollisols. The soils in the area dominantly have a frigid soil temperature regime, an ustic soil moisture regime that borders on aridic, and mixed mineralogy. They are shallow to very deep, generally well drained, and loamy or clayey. Natrustalfs formed in residuum on hills and ridges (Bullock and Parchin series) and in alluvium or fluvial deposits on fans, terraces, and till plains (Absher and Gerdrum series). Ustorthents (Cabbart and Delridge series) and Torriorthents (Blackhall series) formed in residuum on hills and plains. Haplustepts (Twilight series) formed in alluvium or eolian sediments over residuum on hills and ridges. Argiustolls formed in alluvium or fluvial deposits (Assiniboine series) or mixed alluvium and colluvium (Eapa series) on fans, terraces, and till plains and in residuum on hills and ridges (Marmarth series). Haplustolls formed in residuum on hills and ridges (Rhame series).

BIOLOGICAL RESOURCES

The native vegetation in this area consists primarily of grasses and forbs. Some trees and shrubs are along streams. The area supports mixed prairie vegetation characterized by western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nasella viridula*), blue grama (*Bouteloua gracilis*), and buffalograss (*Buchloe dactyloides*).

Threadleaf sedge (*Carex filifolia*), buffalograss (*Buchloe dactyloides*), blue grama (*Bouteloua gracilis*), and some little bluestem (*Schizachrium scoparium*) grow on shallow soils. Needle and thread (*Hesperostipa comata*) and prairie sandreed (*Calamovilfa longifolia*) grow on sandy soils. Big bluestem (*Andropogon gerardii*) grows along streams, especially where the soil has an effective water table. The most common forbs are blacksamson echinacea (*Echinacea angustifolia*), prairie coneflower (*Ratibida columnifera*), American vetch (*Vicia americana*), dotted gayfeather (*Liatris punctata*), Missouri goldenrod (*Solidago missouriensis*), breadroot scurfpea (*Pediomelum esculentum*) , silverleaf scurfpea (*Pediomelum argophyllum*), scarlet globemallow (*Sphaeralcea coccinea*), heath aster (*Symphyotrichum ericoides*), desert biscuitroot (*Lomatium foeniculaceum*), and cudweed sagewort (*Artemisia ludoviciana*). Shrubs, such as silver buffaloberry (*Shepherdia argentea*), silver sagebrush (*Artemisia cana*), western snowberry (*Symphoricarpos occidentalis*), and chokecherry (*Prunus virginiana*) are common. Big sagebrush (*Artemisia tridentata*) grows in the driest areas of the western part of the MLRA. Boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and plains cottonwood (*Populus deltoides*) are the principal trees along streams and drainageways. Ponderosa pine (*Pinus ponderosa*) forests occur on the upper slopes and on the top of some of the higher buttes in Custer National Forest. These forests stand out from the normal native grass vegetation in the north western part of the MLRA. Silver sagebrush (*Artemisia cana*) and big sagebrush (*Artemisia tridentata*) grow on clayey soils in the western part of the MLRA.

Some of the major wildlife species in this area are mule deer, white-tailed deer, antelope, coyote, fox, bobcat, rattlesnake, badger, raccoon, porcupine, beaver, skunk, mink, jackrabbit, prairie dog, golden eagle, ferruginous hawks, pheasant, sharptailed grouse, sage grouse, gray partridge, magpie, and lark bunting.

LAND USE

Following are the various kinds of land use in this MLRA:

Cropland—private, 12%

Grassland—private, 81%; Federal, 3%

Urban development—private, 1%

Water—private, 1%

Other—private, 2%

More than four-fifths of this area is in private ranches. The dominant land uses are rangeland and hay land. Less than 5 percent of the area is federally owned. Most of the area supports native grasses and shrubs grazed by cattle and sheep. Gently sloping, deep and moderately deep soils, making up 10 to 15 percent of the area, are used for dry-farmed wheat or alfalfa. Some tracts are

used as tame pasture. Open woodland is on the upper slopes and the top of some of the higher buttes. The major soil resource concerns are wind erosion and soil quality on cropland, especially where wheat-fallow is the principal crop rotation. Surface water quality also is a resource concern. Wind erosion and soil quality are resource concerns on continuously overgrazed rangeland. The most important conservation practices on rangeland are prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. The establishment of early and late season pastures supplements forage production and keeps livestock off the rangeland during critical growth periods. The conservation practices that are important on cropland are no-till and other conservation tillage systems, contour farming, and crop residue management.

60A—Pierre Shale Plains (Labelled on map as Pierre Shale Plains & Badlands)[3]

This area [. . .] is in South Dakota (70 percent), Wyoming (20 percent), Nebraska (8 percent), and Montana (2 percent). It makes up about 10,150 square miles (26,295 square kilometers). It encircles the Black Hills and the Dakota Hogback. The eastern half of Rapid City and the town of Belle Fourche, South Dakota, are in this area. Interstate 90 bisects part of the area as it parallels the northern border of the Badlands National Park, near Cactus Flat, and enters Rapid City on the east. It then skirts the Black Hills as it leaves South Dakota and enters Wyoming in the northwest part of the area.

This MLRA includes the Oglala National Grasslands and parts of the Thunder Basin and Buffalo Gap National Grasslands. Small parts of the Pine Ridge Indian Reservation, the Badlands National Park, and the Black Hills National Forest occur in this MLRA. Ellsworth Air Force Base is just outside Rapid City.

Physiography

This area is in the Missouri Plateau, Unglaciated, Section of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Elevation is generally 2,620 to 3,610 feet (800 to 1,100 meters) on uplands, but it ranges to 4,260 feet (1,300 meters). The shale plains have long, smooth slopes and generally are gently sloping to strongly sloping. Slopes are moderately steep or steep along drainages and streams. Extensive terraces occur along many of the major streams draining the Black Hills.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Cheyenne (1012), 82 percent; Missouri-White (1014), 9 percent; Missouri-Oahe (1013), 5 percent; and Missouri-Little Missouri (1011), 4 percent. The Cheyenne and Belle Fourche Rivers occur in this MLRA.

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[3] USDA-NRCS, *Land Resource Regions and Major Land Resource Areas*, 164-66.

GEOLOGY

Cretaceous Pierre Shale underlies almost all of this area. This is a marine sediment having layers of volcanic ash that has been altered to smectite clay. This clay shrinks as it dries and swells as it gets wet, causing significant problems for road and structural foundations. Cretaceous shale of the Belle Fourche, Mowry, and Skull Creek Formations is adjacent to the Dakota Hogback. These formations, along with Newcastle Sandstone, make up what is called the Graneros Group. Tertiary river gravel, deposited by streams carrying erosional debris from the Black Hills following their uplift, caps the ridges separating the streams draining the Black Hills.

CLIMATE

The average annual precipitation in this area is 13 to 22 inches (330 to 560 millimeters). Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August.

Precipitation in winter occurs mainly as snow that usually is accompanied by high winds that cause much drifting. The average annual temperature is 43 to 49 degrees F (6 to 9 degrees C). The freeze-free period averages about 150 days and ranges from 130 to 170 days.

WATER

Following are the estimated withdrawals of freshwater by use in this MLRA:

Public supply—surface water, 0.9%; ground water, 5.4%

Livestock—surface water, 4.2%; ground water, 0.3%

Irrigation—surface water, 76.1%; ground water, 4.5%

Other—surface water, 7.5%; ground water, 1.2%

The total withdrawals average 110 million gallons per day (415 million liters per day). About 11 percent is from ground water sources, and 89 percent is from surface water sources. Because of the limited amount of precipitation, the production of dry-farmed crops is marginal. Most of the soils are moist or wet early in spring and are deficient in moisture during much of the growing season. In irrigated areas along the Belle Fourche River in the northern part of the area and the Cheyenne River in the southern part, surface water is drawn from the Belle Fourche and Angostura Reservoirs, respectively. Some areas along Rapid Creek are irrigated. Water for livestock comes mainly from runoff that flows into dams. Surface runoff from the forested Black Hills is of good quality. Stream runoff seeps into the cavernous Pahasapa limestone within the Black Hills.

Springs occur at the edges of the Black Hills when this water discharges at the surface. This water is of excellent quality and is used for public supply. Pierre Shale underlies almost all of this area, so ground water is scarce. A few areas have shallow water wells for domestic use, but the water is of marginal quality for drinking. Some shallow wells also draw domestic water from alluvial sand and gravel under the larger stream valleys. This water is of much better quality than the shallow ground water in the Pierre Shale.

SOILS

The dominant soil orders in this MLRA are Entisols, Alfisols, Vertisols, and Inceptisols. Mollisols are of lesser extent. The soils in the area dominantly have a mesic soil temperature regime, an ustic soil moisture regime, and smectite or mixed mineralogy. They are shallow to very deep, generally well drained, and clayey. Paleustalfs (Jaywest series) formed in alluvium on alluvial fans. Haplustalfs (Leiter series) formed in alluvium and residuum on hills, alluvial fans, and fan remnants. Ustorthents (Fairburn, Grummit, Lismas, and Samsil series) and Haplusterts (Pierre, Kyle, and Swanboy series) formed in residuum and local alluvium on plains and hills. Haplustepts formed in residuum and alluvium on stream terraces and uplands (Bufton series) and in alluvium and residuum on hills, alluvial fans, and fan remnants (Echeta and Cromack series). Argiustolls (Nunn and Satanta series) are on old alluvial terraces along many of the streams that drained the Black Hills.

BIOLOGICAL RESOURCES

The native vegetation in this MLRA consists primarily of grasses and forbs. Some trees and shrubs occur along streams. This area supports mixed natural prairie vegetation characterized by grasses, such as western wheatgrass, green needlegrass (*Nasella viridula*), blue grama (*Bouteloua gracilis*), and buffalograss (*Buchloe dactyloides*). Little bluestem (*Schizachyrium scoparium*), buffalograss (*Buchloe dactyloides*), and sideoats grama (*Bouteloua curtipendula*) grow on the shallow soils. Big bluestem (*Andropogon gerardii*) grows along streams, especially where the soils have an effective water table. The most common forbs are black sampson echinacea (*Echinacea angustifolia*), prairie coneflower (*Ratibida columnifera*), American vetch (*Vicia americana*), dotted gayfeather (*Liatrus punctata*), Missouri goldenrod (*Solidago missouriensis*), breadroot scurfpea (*Pediomelum esculentum*), silverleaf scurfpea (*Pediomelum argophyllum*), scarlet globemallow (*Sphaeralcea coccinea*), heath aster (*Symphyotrichum ericoides*), desert biscuitroot (*Lomatium foeniculaceum*), and cudweed sagewort (*Artemisia ludoviciana*). Shrubs include sand sagebrush (*Artemisia filifolia*) on sandy soils and silver sagebrush (*Artemisia cana*), western snowberry (*Symphoricarpos occidentalis*), and leadplant (*Amorpha canescens*) on clayey soils in the western part of the area. Big sagebrush grows in the driest part of the MLRA, in southwestern Fall River County and extending into Wyoming. Boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and plains cottonwood (*Populus deltoides*) are the principal trees along streams and drainageways. Eastern redcedar (*Juniperus virginiana*) occurs in scattered areas throughout the uplands, especially along the Cheyenne River. Bur oak (*Quercus macrocarpa*) and ponderosa pine (*Pinus ponderosa*) commonly occur in areas of the acid shale of the Graneros Group.

Some of the major wildlife species in this area are mule deer, white-tailed deer, antelope, coyote, bobcat, badger, beaver, raccoon, skunk, muskrat, mink, jackrabbit, cottontail, prairie dog, turkey, pheasant, sharp-tailed grouse, Hungarian partridge, sage grouse, mourning dove, mallard, long-billed curlew, killdeer, yellow-headed blackbird, and red-winged blackbird. The species of fish in the area include walleye, channel catfish, white bass, largemouth black bass, bluegill, and northern pike.

LAND USE

Following are the various kinds of land use in this MLRA:

Cropland—private, 11%

Grassland—private, 59%; Federal, 23%

Forest—private, 1%

Urban development—private, 1%

Water—private, 1%

Other—private, 4%

The dominant land uses are rangeland and hay land. Practically all of this area is in farms and ranches. Most of it supports native grasses and is grazed by livestock.

Approximately 10 percent of the area is used for small grain grown for grain and livestock feed. Some small areas of nearly level to moderately sloping soils are used for winter wheat or feed crops for livestock. The major resource concerns are wind erosion and surface water quality. The major soil resource concerns are wind erosion and soil quality on cropland, especially where wheat-fallow is the principal crop rotation. Wind erosion and soil quality also are concerns on continuously overgrazed rangeland.

Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. The establishment of early and late season pastures supplements forage production and keeps livestock off the rangeland during critical growth periods. Conservation practices on cropland generally include no-till and other kinds of conservation tillage, contour farming, and crop residue management.

60B—PIERRE SHALE PLAINS, NORTHERN PART (LABELLED ON MAP AS PIERRE SHALE PLAINS, EAST)[4]

This area [. . .] is almost entirely in Montana (94 percent) and Wyoming (6 percent). A very small part of the area is in North Dakota. The area makes up about 3,375 square miles (8,750 square kilometers). It occurs in the uplands between most of the major rivers in south eastern Montana and north eastern Wyoming. It has no major cities. U.S. Highway 212 cuts across the southern end of the area. The Custer National Forest occurs in this area.

PHYSIOGRAPHY

[4] USDA-NRCS, *Land Resource Regions and Major Land Resource Areas*, 166-68.

This area is in the Missouri Plateau, Unglaciated, Section of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Elevation ranges from 2,950 to 3,300 feet (900 to 1,005 meters) on uplands.

The shale plains have long, smooth, gentle to strong slopes. Slopes along drainage ways and streams are moderately steep or steep. The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Little Missouri (1011), 53 percent; Powder-Tongue (1009), 27 percent; and Lower Yellowstone (1010), 20 percent. The MLRA has no major rivers.

GEOLOGY

Marine and continental sediments of the Cretaceous Montana Group underlie most of this MLRA, generally at the higher elevations. The Montana Group in this part of Montana includes Fox Hills Sandstone and Pierre Shale. A group of younger Cretaceous sediments occurs at the lower elevations at the north and west ends of the area. These younger deposits include Hell Creek sandstone and shale, St. Mary River mudstone, and the volcaniclastics of the Livingston Group. The older Cretaceous Niobrara shale and chalk beds occur at the higher elevations in the southeast corner of this MLRA.

CLIMATE

The average annual precipitation in this area is 11 to 15 inches (280 to 380 millimeters). Most of the annual precipitation occurs as high-intensity, convective thunderstorms during the growing season. Precipitation in winter occurs mainly as snow, which usually is accompanied by high winds that cause much drifting. The average annual temperature is 43 to 46 degrees F (6 to 8 degrees C). The freeze-free period averages 140 days and ranges from 130 to 155 days.

WATER

Following are the estimated withdrawals of freshwater by use in this MLRA:

Public supply—surface water, 0.0%; ground water, 0.0%

Livestock—surface water, 0.3%; ground water, 0.7%

Irrigation—surface water, 62.9%; ground water, 31.4%

Other—surface water, 2.0%; ground water, 2.6%

The total withdrawals average 3 million gallons per day (11 million litres per day). About 35 percent is from ground water sources, and 65 percent is from surface water sources. Because of the limited amount of precipitation, the production of dry farmed crops is marginal. Most of the soils are moist or wet early in spring and are deficient in moisture during much of the growing season. The quality of the surface water is good, but the quantity typically is inadequate. Some limited irrigation occurs along the larger streams on the edges of this area. Water for livestock comes mainly from runoff that flows into dams.

Ground water is scarce in most of the area, but local deposits of sand and gravel in the Fox Hills Sandstone and Hell Creek Formation yield small to moderate amounts of domestic and livestock water. This ground water is a sodium bicarbonate or sulphate type and generally is hard or very hard. The level of total dissolved solids, typically more than 1,000 parts per million (milligrams per liter), exceeds the standards for drinking water. The water from alluvial deposits in areas of flood plains and terraces is of much better quality than the water in the bedrock aquifers. Shallow wells provide a limited amount of water for irrigation, domestic use, and livestock.

SOILS

The dominant soil orders in this MLRA are Alfisols, Entisols, and Vertisols. The soils in the area dominantly have a frigid soil temperature regime, an ustic soil moisture regime, and smectitic mineralogy. They are shallow to very deep, generally well drained, and clayey. Natrustalfs (Absher and Gerdrum series) formed in alluvium, glaciofluvial deposits, and till on alluvial fans, stream terraces, and plains. Haplusterts formed in alluvium and/or residuum on alluvial fans, stream terraces, and plains (Bascovy and Bickerdyke series) and in alluvium and lacustrine deposits on alluvial fans, stream terraces, and lake plains (Marias and Marvan series). Ustorthents formed in mixed residuum, alluvium, and colluvium on hills and plains (Neldore, Orinoco, and Yawdim series) and in alluvium, lacustrine deposits, and glaciofluvial deposits on alluvial fans, stream terraces, and plains (Vanda series).

BIOLOGICAL RESOURCES

This area supports mixed natural prairie vegetation characterized by western wheatgrass (*Pascopyrum smithii*), green needlegrass (*Nasella viridula*), and blue grama (*Bouteloua gracilis*). Little bluestem (*Schizachyrium scoparium*) and sideoats grama (*Bouteloua curtipendula*) grow on shallow soils. Some areas in the southern part of the MLRA support pine forests. Oak species grow in some protected draws.

Some of the major wildlife species in this area are mule deer, white-tailed deer, antelope, coyote, fox, bobcat, rattlesnake, badger, raccoon, porcupine, beaver, skunk, mink, jackrabbit, prairie dog, golden eagle, ferruginous hawks, pheasant, sharptailed grouse, sage grouse, gray partridge, magpie, and lark bunting.

LAND USE

Following are the various kinds of land use in this MLRA:

Cropland—private, 5%

Grassland—private, 63%; Federal, 29%

Forest—private, 1%; Federal, 1%

Urban development—private, 1%

Practically all of this area is in farms or ranches. Most of it is rangeland used for grazing by livestock. Some small areas of nearly level to moderately sloping soils are used for winter wheat or for livestock feed crops.

The major soil resource concerns are wind erosion, water erosion, maintenance of the content of organic matter and productivity of the soils, management of soil moisture, and control of saline seeps. Water resource concerns include failure to meet plant needs because of inefficient water use on irrigated cropland. They also include excessive amounts of pesticides, nutrients, and organic material in surface and ground waters. Plant resource concerns are deterioration of plant condition, productivity, health, and vigor; noxious and invasive plants; and wildfires. Animal resource concerns are inadequate food, cover, and shelter.

Conservation practices on cropland generally include crop residue management (especially minimum tillage), cover crops, stripcropping, nutrient management, soil salinity management, and pest management. Practices that improve water use and distribution on irrigated cropland generally include irrigation water management, irrigation water delivery systems, and on-farm irrigation practices, such as sprinklers. Noxious and invasive plants can be controlled by pest management and prescribed grazing. Forest stand improvement and firebreaks reduce the hazard of wildfires and improve forest growth, quality, health, and productivity.

Conservation practices on rangeland generally include prescribed grazing, fencing, and water developments. The establishment of food plots and range improvement practices benefit wildlife. The establishment of early and late season pastures supplements forage production and keeps livestock off the rangeland during critical growth periods.

APPENDIX C: EXTRACTS FROM "BOTANICAL AND VEGETATION SURVEY OF CARTER COUNTY, MONTANA: BUREAU OF LAND MANAGEMENT-ADMINISTERED LANDS" (1998)[1]

NOTES ON EDITING

- ✓ Extracts have been edited and condensed for ease of use. Elisions are marked with ellipses. Additions are marked with brackets [].

- ✓ In most cases, common plant names have been added in [brackets] prior to their scientific names. However, formatting throughout the original BLM document varies slightly by author. If authors have listed species as common name (*scientific name*), formatting has not been changed.

- ✓ Scientific names in the 1998 report that differ from current USDA standards have been updated. BLM coding has been removed. *Note that capitalizations and spellings vary across common plant names as listed in the USDA PLANTS DATABASE (e.g.* ***i****ndian ricegrass and silverleaf* ***I****ndian breadroot).*

- ✓ All titles have been modified.

- ✓ In-line citations from the original document have been included as necessary.

FOREST AND WOODLAND VEGETATION TYPES

ROCKY MOUNTAIN JUNIPER (*JUNIPERUS SCOPULORUM*) + LITTLE SEED RICEGRASS (*PIPTATHEROPSIS MICRANTHA*)[2]

. . . This is a localized woodland type that is found in breaks and badlands topography. . . . It is susceptible to fire under any burn regime. . . . The sampled stand has 80% canopy cover by [Rocky Mountain juniper] *Juniperus scopulorum,* forming dense stand conditions with many low, stiff branches. Like virtually all other Rocky Mountain juniper stands, it was logged in the past for fence posts. Moderately high cover (30%) by the palatable bunchgrass [littleseed ricegrass (*Piptatheropsis micrantha)*], the absence of [bluebunch wheatgrass (*Psuedoroegneria spicata)*], rich forb flora and the nearly closed canopy distinguish this association from other Rocky Mountain juniper types. . . .

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[1] All extracts have been edited from their originals. Citations for original descriptions have been footnoted from all description titles.

[2] J. Vanderhorst, S.V. Cooper, and B.L. Heidel, *Botanical and vegetation survey of Carter County, Montana* (unpublished report to Bureau of Land Management, Montana Natural Heritage Program, 1998), http://mtnhp.org/plants/reports/BnV_Survey_CarterCounty.pdf, 23-24.

. . . . The sampled stand and other observed stands occur on a shale substrate, with a distinct duff layer overlaying the clayey soils. Elsewhere in Carter County. . . this plant community occurs on sandstone derived soils (Hansen and Hoffman 1988). . . .

This plant association has among the highest numbers of vascular plant species and unique vascular plant composition among the plant associations documented. . . .The cover of mosses and lichens is important for retaining soil and stabilizing soil and is easily disturbed. The dense cover of Rocky Mountain juniper provides game habitat (Girard et al. 1988), including shelter and escape cover.

PONDEROSA PINE (*PINUS PONDEROSA*) + COMMON JUNIPER (*JUNIPERUS COMMUNIS*)[3]

. . . . [This association] is a recurrent forest type of the small BLM holdings on the periphery of the Custer National Forest units in Carter County, though it makes up a small area. . . . Stands are generally ensconced below rimrocks of sandstone capped tablelands, favoring steep (40% plus) northern aspects, representing small areas with natural firebreaks. . . . The presence of [common juniper] *Juniperus communis*, a species easily killed by fire, in this plant association is diagnostic (Hansen and Hoffman 1988). Absence of fire scars and development of a thick litter layer are indications of a long fire interval in this community. . . .

In the two plots sampled, cover by [ponderosa pine] *Pinus ponderosa* is about 50%. Cover by the dominant shrub [common juniper] *Juniperus communis*, [sic] ranges from 20 to 50%. The shrubs [Oregon grape] *Mahonia repens* and [chokecherry] *Prunus virginiana* are also well represented in both plots. Graminoid cover barely exceeds trace amounts, far less than that of shrubs, but includes species ([Back's sedge] *Carex backii*, [false melic] *Schizachne purpurascens*) which are not found outside of forest and woodland habitats in Carter County. Forb cover and diversity is also relatively low but includes species ([starry false lily of the valley] *Maianthemum stellatum,* [map lichen] *Disporum trachycarpum*) unique to these relatively mesic forest or woodland habitats.

. . . . Parent materials are sandstones or sandstones with some admixture of colluvial shale; they have weathered to sandy loams and sandy clay loams. As with most of the forested environments sampled soils are distinctly more acidic than those of rangelands (with exceptions for extraordinary substrates, such as bentonite clays). . . .

PONDEROSA PINE (*PINUS PONDEROSA*) + BLUEBUNCH WHEATGRASS (*PSEUDOROEGNERIA SPICATA*)[4]

. . . . This is the most xeric and perhaps widespread woodland type on BLM-administered lands in Carter County. It is not restricted to a single landform but is recurrent in a variety of broken topography settings, including the margins of escarpments and breaklands, and scattered knolls,

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[3] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 25-26.

[4] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 27.

particularly on warm, dry slopes with well-drained soils derived from sandstone, porcellanite, and limestone. It is most extensive in the northern end of the county.

. . . . This woodland type has open stand structure and conspicuous bunchgrass undergrowth. . . . [It] is present at the perimeter or interstices of most other coniferous woodland types in the county. It is also found apart from them in outlying scattered patches. It is maintained by low-intensity ground fires. . . .

PONDEROSA PINE (*PINUS PONDEROSA*) + CREEPING JUNIPER (*JUNIPERUS HORIZONTALIS*)[5]

. . . . This is a woodland type restricted to one corner of the county, sampled in two plots, and noted only in a small area of arid hills east of Mill Iron in northeastern Carter County. Here it is the predominant woodland type on BLM tracts and occupies slopes, usually with northerly aspects but extending to protected easterly and westerly positions, of the side ridges of dissected sandstone capped tablelands. . . .

. . . . The sampled stands have a relatively open canopy (about 30% cover) of smaller trees (estimated largest trees about 12" dbh, 40 ft. tall) and a low shrub layer clearly dominated by [creeping juniper] *Juniperus horizontalis* (70-80% cover). It is hypothesized that this ground hugging evergreen shrub becomes established in thin soil settings, possibly in blowouts, and serves as nursery cover for seedlings of [ponderosa pine] *Pinus ponderosa*. This is supported by the many pine seedlings and saplings observed in patches of creeping juniper outside the forest canopy. . . . Cover values of other understory graminoids and forbs are low, composed mostly of species found in neighboring range communities. . . .

. . . . Within Carter Co. and throughout the eastern-most portion of Montana this type is found on well-drained soils derived from sandstone or sandstone mixed with porcellainite (scoria), which weather to sandy loams and loams. . . .

PONDEROSA PINE (*PINUS PONDEROSA*) + LITTLE BLUESTEM (*SCHIZACHYRIUM SCOPARIUM*)[6]

. . . . One plot of [this association] was sampled on rolling sandstone-capped tablelands in the Ekalaka Hills. Very small stands of this type were noted elsewhere on warm slopes with mostly sandstone-derived, coarse textured substrates with considerable gravel content; often these sites were judged to be highly erosive.

. . . . The tree component consists of scattered (ca. 3% canopy cover) young trees about 20 ft. tall. The distinct herbaceous layer is dominated by the bunch-forming, warm season grass, [little bluesterm] *Schizachyrium scoparium* . . . with about 20% cover. Other common native graminoids in the plot are [sun sedge] *Carex inops* . . . and [western wheatgrass] *Pascopyrum smithii*. . ., both rhizomatous native species. The rhizomatous, introduced [Kentucky bluegrass]

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[5] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 28.

[6] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 29-30.

Poa pratensis [makes up about] 10% cover. . . . Forbs are relatively abundant, but most are increasers common in adjacent rangelands; [cudweed sagewort] *Artemisia ludoviciana* and [stiff sunflower] *Helianthus rigidus* are the most abundant. A trace of [yucca] *Yucca glauca* was the only shrub.

. . . . Soils are loamy and well drained. . . .

PLAINS COTTONWOOD (*POPULUS DELTOIDES*) + WESTERN SNOWBERRY (*SYMPHORICARPOS OCCIDENTALIS*)[7]

. . . . [Plains] cottonwood stands are found on alluvial bottoms. . . . Trees are large and provide a tall canopy with about 50% cover. The shrub layer is about 1 m tall and provides nearly complete cover, mostly by [western snowberry] *Symphoricarpos occidentalis*, but [prairie rose] *Rosa arkansana* is also common. Two rhizomatous grasses are well represented, the native [western wheatgrass] *Pascopyrum smithii* and the exotic [Kentucky bluegrass] [*Poa pratensisis*]. Forb cover is significant with the exotic species ([Canada thistle] *Cirsium arvense,* [black medick] *Medicago lupulina,* [alfalfa] *Medicago sativa),* [dandelion] *Taraxacum officinale,* [salsify] *Tragopogon dubius*) prominent. . . [However], the highest cover is attained by the natives [white prairie aster] *Aster falcatus* and [prairie coneflower] *Ratibida columnifera*.

Cottonwood stands are seral (community type), becoming established in response to deposition by shifting stream channels [during flood events]. They normally do not regenerate at the same spot except as exposed river channels adjoin the stand. . . .

BUR OAK (*QUERCUS MACROCARPA*) + SUN SEDGE (*CAREX INOPS* SSP. *HELIOPHILA*)[8]

. . . . A single stand [of this association] was sampled on BLM land on north aspect toe-slopes of a Mowry Shale ridge just north of the Wyoming border. This is the primary bur oak-dominated community type in the area, encompassing most of Montana's only population of bur oak (*Quercus macrocarpa*). It is restricted to the two parallel shale ridges that represent the only outcrops of Mowry Shale in the state. . . . Bentonitic shale is extensively exposed, and its high shrink-swell capacity gives the soil surface a fractured appearance through dry summer months. The ridges rise about 50 m (150 ft) above the surrounding plains with variable slopes across the broken topography, and this plant association prevails across the side slopes of the ridges, thinning out on top.

. . . . Except for discrete openings, these woodlands have a fairly dense canopy of short stature (about 20 ft. tall) trees, including about 60% cover by bur oak (*Quercus macrocarpa*) and variable cover (average about 20%) by Rocky [M]ountain juniper (*Juniperus scopulorum)*. The shrub layer is [sparse], but [gooseberry] *Ribes setosum* is well represented in patches (10% total cover in the plot) confined to canopy projections of oak trees. Grasses and sedges comprise the well-developed herbaceous layer with about 30% total cover; most abundant are sun sedge

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[7] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 31-32.

[8] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 33-34.

(*Carex inops* ssp. *Heliophila)*[,] a native rhizomatous sedge with about 10% cover, and major but variable cover by Kentucky bluegrass (*Poa pratensis),* an exotic rhizomatous grass with about 20% cover. Cover by forbs is relatively low (about 10%) while forb diversity is relatively high (18 species in the plot). . . . This community type had the highest diversity of fungi observed in Carter County.

This deciduous woodland type is incompletely documented in the literature and addressed in state classifications. . . . [and] is geographically restricted, barely entering Montana. . . .

. . . . The relatively high proportion of the sand fraction (38%) indicates that soils have not been derived from shale alone but are probably influenced by lenses of sandstone. Soil reaction is distinctly acidic as is known for some marine shales. . . . This area of shale ridges has been extensively altered by bentonite mining, associated haul roads, and grazing by sheep and cattle. Nevertheless, it is part of the westernmost stand [of bur oak] in the continent. . . .

BUR OAK (*QUERCUS MACROCARPA*) + WESTERN SNOWBERRY (*SYMPHORICARPOS OCCIDENTALIS*)[9]

. . . . This community type is documented solely on alluvial terraces of Arkansas Creek, a Little Missouri River tributary, representing a small valley and a sub-irrigated site on open plains. It occurs on a BLM tract about 1 mile south of Alzada and 1 mile north of the Wyoming border. . . .

. . . . The [community type] has a relatively open savanna-like tree canopy dominated by bur oak (*Quercus macrocarpa)* with about 30% cover; intermixed with lesser amounts of green ash (*Fraxinus pennsylvanica)* with about 10% cover. The largest oak trees are about 30 ft. tall, with 12" diameter at breast height (DBH). [In 1993, when] the largest tree (18”DBH) [was bored, the estimated] age was 110 years, dating to pre-settlement times. Sexual reproduction by bur oak appears to be limited. . . . [Green ash] *Frazinus pennsylvanica* trees in the plot are smaller (about 15 ft. tall) but reproduce more successfully. . . . The most abundant native understory species is the western snowberry (*Symphoricarpos occidentalis)* with about 20% cover. . . . [T]he entire area is dominated by a dense [stand] of introduced grasses. Smooth brome (*Bromus inermis)* is most abundant with about 60% cover, and quack grass (*Elytrigia repens. . .*), timothy (*Phleum pratense),* and Kentucky bluegrass (*Poa pratense*) are well represented with about 10% cover each. Native graminoids found in lesser amounts include [quill sedge] *Carex tenera*, and thick-spiked wheatgrass (*Elymus lanceolatus)*. Forbs are mostly exotic species, the most abundant being [curly dock] *Rumex crispus*.

. . . . The alluvial soils in this reach of the Little Missouri River are derived from Cretaceous shales and are dominated by the clay fraction. The high organic matter content of the upper horizon is indicative of a relatively productive site, which is confirmed by the [abundance] of knee-high introduced grasses.

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[9] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 35-36.

. . . . [T]he sole Montana collection of the wild lily-of-the-valley (*Maianthemum canadense)* was collected in 1948 from nearby this locality. Its habitat was described as rich soil in deep woods (Booth 1950), and this species is known from oak stands in adjoining states.

Shrub and Dwarf Shrub-Dominated Vegetation Types

Silver sagebrush (*Artemisia cana*) + western wheatgrass (*Pascopyrum smithii*)[10]

. . . . This habitat type occurs on level to gently sloping alluvial terraces receiving surface runoff, and on sandy upland slopes in water collecting positions. It is usually restricted to overflow range sites and is frequent on BLM land in the northwest and southwest corners of the county. It is a relatively dry form of riparian habitat (Hanson et al. 1995). . . .

. . . . The dominant [silver sagebrush] *Artemisia cana* is the only well represented shrub in the study area with about 20% cover. . . . The herbaceous layer is dominated by grasses with [western wheatgrass] *Pascopyrum smithii. . .* having about 20-30% cover. . . and [green needlegrass] *Nasella viridula* having about 3-10% cover. [Threadleaf sedge] *Carex filifolia* is well represented in the plot on an upland slope. The exotic grasses [Kentucky bluegrass] *Poa pratensis* and [Japanese brome] *Bromus japonicus* are present to varying amounts in the plots. Constant in the study area are [western yarrow] *Achillea millefolium,* [cudweed sagewort] *Artemisia ludoviciana,* [black sampson] *Echinacea angustifolia,* [owl clover] *Orthocarpus luteus,* [silverleaf scurfpea] *Psoralea argophylla,* [breadroot scurfpea] *P. esculenta,* [prairie coneflower] *Ratibida columnifera,* [salsify] *Tragopogon dubius* and [meadow deathcamas] *Zigadenus venenosus*. . . .

. . . . [Stands] are most extensive in Carter County on coarse textured alluvial soils. Soil profiles are poorly developed. . . .

Wyoming big sagebrush (Artemisia *tridentata* ssp. *wyomingensis*) and thickspike wheatgrass (*Elymus lanceolatus*) and/or western wheatgrass (*Pascopyrum smithii*)[11]

. . . . This sagebrush steppe type is probably the single most extensive plant community in Carter County. and is especially abundant on BLM lands. [It can often be found] extending uninterrupted for miles, in areas with soils derived from shale. [A] major vegetation type on shale ridge systems [clayey, shallow clay ecosites], particularly northerly slopes, which are less dissected than southerly aspects and have better developed soils. It occurs as the predominant shrubland association on alluvial terraces in areas of shale-derived soils . . . . and it is also found in areas associated with sandstone outcrops or at least coarser-textured soils (silt loams and loams) as shallow range sites. . . .

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[10] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 37-38.

[11] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 39-41.

. . . . Wyoming big sagebrush is well represented and there is an undergrowth dominated by thickspike wheatgrass (*Elymus lanceolatus*) and/or western wheatgrass (*Pascopyrum smithii*). Note: The common upland big sagebrush of Carter County is [Wyoming big sagebrush] *Artemisia tridentata ssp. Wyomingensis*, which is distinguished from other subspecies of big sagebrush by its low stature (< 5 dm tall) and by its relatively short (mostly < 12 mm long) persistent leaves which have incurved (convex) margins. . . . [T]he dominant rhizomatous wheatgrass [associated with this plant community in southern Carter County] . . . is [thickspike wheatgrass] *Elymus lanceolatus. . .* , however, [western wheatgrass] *Pascopyrum smithii* may grow intermixed or be the dominant grass at some sites. . . .

. . . . [In the six plots that were sampled,] [c]over by [big sagebrush] *Artemisia tridentata ssp. Wyomingensis* ranged from 10 to 25%. . . . The shrubs [fringed sagebrush] *Artemisia frigida* and [rubber rabbitbrush] *Chrysothamnus nauseosus* have greater than 50% constancy in the plots. Cover by [thickspike wheatgrass] *Elymus lanceolatus,* the dominant grass identified in six plots, ranged from about 10% to 60%. [Western wheatgrass] *Pascopyrum smithii* was identified as the dominant grass with to 50% cover in one plot. . . .

The grass [Prairie junegrass] *Koeleria macrantha* is 100% constant in our plots. [Sandberg bluegrass] *Poa secunda* and [green needlegrass] [*Nasella viridula*] have greater than 50% constancy, though *S. viridula* did not occur in greater than trace amounts. . . .

. . . . Parent materials are principally shales and mudstones, but this community type occurs as well on alluvium and sandstone, if there is a compensating factor such as shallow depth to bedrock, which perches water within reach of grass roots. Soil reaction is consistently mildly basic . . ., and conductivities are [mostly low]. Soil texture is typically heavy with the silty clay class dominating, but sandstones will weather to loams and silt loams [which also support this plant association].

. . . . It is possible that the potential vegetation type for many of the alluvial sites supporting this association is actually [Wyoming big sagebrush, thickspike wheatgrass and green needlegrass] but that concentrated livestock use has reduced the high canopy cover of [green needlegrass] *Nasella viridula*. . . . [I]n degraded examples of this type [Japanese brome - *Bromus japonicus*] often surpasses [thickspike wheatgrass] *Elymus lanceolatus* or [western wheatgrass] *Pascopyrum smithii* in cover. Cover and diversity of forbs is quite low; [western yarrow] *Achillea millefolium*. . . is the only forb with higher than 50% constancy. . . .

. . . .The soil lichen, *Parmelia chlorochroa*, which is favored by grazing [is common]. . . .

WYOMING BIG SAGEBRUSH (*ARTEMISIA TRIDENTATA* SSP. *WYOMINGENSIS*) + PRICKLYPEAR CACTUS (*OPUNTIA POLYACANTHA*)[12]

. . . . This highly localized community type occurs on nearly level valley floors and benches on erodible alluvial outwash materials weathered from shale. . . . It occurs as small patches (<< 1 acre) in matrices of sagebrush steppe [Wyoming big sagebrush/western wheatgrass] with higher grass cover, and in grasslands ([western wheatgrass] *Pascopyrum smithii* or [thickspike

[12] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 42-43.

wheatgrass] *Elymus lanceolatus*-dominated) which occupy less eroded substrates. Additional examination of the soil profile is needed to determine whether these settings represent pan spot range sites, often referred to as *scablands*.

. . . . The overall sparse canopy cover is dominated by [Wyoming big sagebrush] *Artemisia tridentata* ssp. *wyomingensis* (15-25%) with a stature considerably shorter (0.1560.25 m.) than specimens of the surrounding matrix communities (mostly 0.3-0.6 m). There are only eight other species [recorded.] [O]f these, the grass [thickspike wheatgrass] *Elymus lanceolatus*, the forb [bushy knotweed] *Polygonum ramosissimum,* and [pricklypear cactus] *Opuntia polyacantha* are constant. The relative [scarcity] of [thickspike wheatgrass] *E. lanceolatus* in these sites (not exceeding trace amounts) compared to its canopy cover in the surrounding matrix is significant. [Pricklypear cactus] *Opuntia polyacantha* has 10% cover in one plot, but much higher cover values were noted during reconnaissance. . . .

. . . . The [lack of] vegetation is reflected in the lack of litter and more than 80% exposed soil surface. Parent materials are alluvial outwash derived from shales. . . . [This community type has] higher pH values (all over 7. . .) and higher soluble sodium values (> 50%. . .).

GARDNER'S SALTSAGE (SALTBUSH) (*ATRIPLEX GARDNERI*) + THICKSPIKE WHEATGRASS (*ELYMUS LANCEOLATUS*)[13]

. . . . This is a distinctive community type which occupies relatively large areas on eroded, low relief bentonite/shale ridge systems in southern Carter County. [These systems] represent salt-affected upland range sites[, ... which are] mostly confined to ridgetops and southerly exposed side ridges and convex slopes. . . .

. . . . These highly erodible, sparsely vegetated sites are dominated by the low, mound-forming shrub [Gardner saltbush] *Atriplex gardneri* (syn. *A. nuttallii*). This species is salt and drought tolerant (Branson et al. 1970). While the landscape superficially appears barren, we recorded shrub cover values ranging from 30-50% canopy cover. Sometimes the shrubs grow in rows between shallow erosion gullies giving the community a distinctive vertically striped pattern visible from a distance. The grass component is sparse (up to about 10% cover) and patchy, dominated in our plots by [thickspike wheatgrass] *Elymus lanceolatus* and [bottlebrush squirreltail] *Elymus elymoides*. There is a low diversity of and only trace cover by forb species. . . .

. . . . [The] shale-derived soils supporting [Gardner's saltbush] *Atriplex gardneri* communities. . . . [usually] have high soluble salt and sodium content, high total moisture stress, and low infiltration rates. Derived primarily from bentonite. . ., study area soils have a high shrink-swell capacity and once wet, a very low permeability. Low infiltration rates result in extensive and intensive sheet, rill, and gully erosion and almost no soil profile development. The high, but less than 8.5 pH values, and electrical conductivities less than 4 mmhos/cm indicate, respectively, a high sodium content and. . . a non-saline condition, though values are approaching saline.

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[13] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 44-45.

RUBBER RABBITBRUSH (*CHRYSOTHAMNUS NAUSEOSUS*) + FEW FLOWERED BUCKWHEAT (*ERIOGONUM PAUCIFLORUM*)[14]

. . . . [This] early successional community type [appears] on eroded alluvial and residual soils with shale parent material. It occurs in small, scabby, eroded patches on hillsides dominated by grasslands. . . and in larger patches where it represents an edaphic climax on alluvial outwash flats and low gradient drainages surrounded by sagebrush. . . and greasewood. . . communities. Erosion, often severe, is evident at all sites, indicated by elevated rootstocks of the dominant subshrub, [few flowered buckwheat] *Eriogonum pauciflorum*.

. . . . These sparsely vegetated communities are typically dominated by evenly spaced plants of the low, mat-forming subshrub [few flowered buckwheat] *Eriogonum pauciflorum* with few other species present. . . .

[*Note: Plots for this description varied greatly. Species present have been condensed here for clarity.*

> Other plants noted include posion suckleya (*Atriplex suckleya*); rubber rabbitbrush (*Chrysothamnus nauseosus*); prairie junegrass (*Koeleria macrantha*); Canada bluegrass (*Poa compressa*); alkali bluegrass (*Poa juncifolia*); and sandberg bluegrass (*Poa secunda*). Thickspike wheatgrass (*Elymus lanceolatus)* and indian ricegrass (*Oryzopsis hymenoides)* were occasionally observed along with selenium indicator forbs, racemed poisonvetch (*Astragalus racemosus*) and desert princesplume (*Stanleya pinnata*).]

. . . .The visual impression of these sites is expanses of bare soil (90%) with scattered sub-shrubs, [and trace amounts of litter under the canopy that collects at the stem bases]. . . .

[S]oils. . . are at least slightly saline. . . . [T]hree plots are derived from acid shales and one from non-acidic shale. . . . Mechanical weathering of some shales results in it fissuring into small plates, which in aggregate mimic a coarse-textured soil (resulting in relatively high infiltration rates and low fertility). Note that the textural classes of [associated soils] are varieties of clays. . . .

BLACK GREASEWOOD (SARCOBATUS VERMICULATUS) + THICKSPIKE WHEATGRASS (ELYMUS LANCEOLATUS)[15]

. . . . [L]arge acreages of [this plant association] are found on Carter County BLM tracts. . . . [It is typically found] on saline lowland ecological sites in alluvial bottoms, but is also found on upland shale slopes. . . . in patchy mosaics [and]. . . . occupying the residuum of the eroding shale substrate. . . . [r]egardless of where it occurs [black greasewood] *S. vermiculatus* indicates the presence of unique soil properties indicating the plant associations present are edaphically conditioned.

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[14] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 46-47.

[15] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 48-50.

. . . . [Black greasewood] *Sarcobatus vermiculatus* is the dominant shrub with cover ranging from about 10 to 38%. The shrubs [Wyoming big sagebrush] *Artemisia tridentata* ssp. *Wyomingensis* and [broom snakeweed] *Gutierrezia sarothrae* have high constancy (75%) in the [study area]. . . .The rhizomatous grass [thickspike wheatgrass] *Elymus lanceolatus* was identified as the lower dominant layer with cover ranging from about 20 to 70%. The morphologically and ecologically similar [western wheatgrass] *Pascopyrum smithii* was also identified in trace amounts. . . . Other grasses with high constancy (>50%) include the natives [prairie junegrass] *Koeleria macrantha* and [alkali bluegrass] *Poa juncifolia* and the exotic annual [Japanese brome] *Bromus japonicus.* The latter and the exotic perennial grass [Kentucky bluegrass] *Poa pratensis* are common increasers in this association and may be persistent. . . . Cover and diversity of forbs is relatively low; the natives [western yarrow] *Achillea millefolium* and [purple milkvetch] *Astragalus agrestis* and exotics [dandelion] *Taraxacum officinale* (or *T. laevigatum*) and [salsify] *Tragopogon dubius* are the only species with greater than 50% constancy. . . .

. . . . All the sites sampled had non-saline soils. . . The soil of at least one site. . . with a pH in excess of 8.5 is classed as a *black alkali*; soils of this type typically occur in semiarid regions in small irregular polygons known as *slick spots*. . . . [With this exception,] pH values less than 8.5. . . point to non-alkali soils [for most sites with this plant association]. . . .

[*Note:* Bottomlands occupied by greasewood communities are often used intensely by livestock and may be cultivated. Although black greasewood (*Sarcobatus vermiculatus)* is toxic to both cattle and sheep, it may be browsed and, depending on season and intensity of use, may increase or decrease under grazing. The grass component of these communities is highly palatable and decreases under heavy grazing.]

GRAMINOID AND FORB-DOMINATED VEGETATION TYPES

LONGLEAF WORMWOOD (*ARTEMISIA LONGIFOLIA*) + INDIAN RICEGRASS (*ORYZOPSIS HYMENOIDES*)[16]

. . . . This plant community is a localized feature of breaks and badlands on slopes and benches. It was sampled . . . on barren, dissected, acid shale uplands above Keith Creek, a headwaters tributary of the Powder River in the west-central segment of the county. [It] occurs in very small bands and patches restricted to steep, eroding ridge shoulders. . . . on Pierre Shale formations directly overlying the erodible Hell Creek Formation. . . .

. . . . [The herbaceous sub-shrub] [Longleaf wormwood] *Artemisia longifolia*. . . dominates with about 30% cover, while [fewflower buckwheat] *Eriogonum pauciflorum* is codominant with about 10% cover. Also present in trace amounts are the short stature [prairie rose] *Rosa arkansana*, the only true-shrub present, and the forb [prairie thermopsis] *Thermopsis rhombifolia,* which are considered diagnostic of the type (Faber-Langendoen 1997). . . .

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[16] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 51-52.

[Povertyweed] *Iva axillaris* is common with about 3% cover. Grasses occur only in trace amounts.

. . . . All known occurrences of this community type are on acid marine shales or bentonite. . . . [The] pH is moderately acidic, the texture is clay, and the electrical conductivity indicates substantial amounts of salt, though not enough to qualify soils as being saline. . . .

In the study area, this type may be threatened by encroachment of introduced [yellow sweet clover] *Melilotus officinalis*, which is becoming dominant on much of the otherwise barren slopes in the vicinity. . . .

PRAIRIE SANDREED (*CALAMOVILFA LONGIFOLIA*) + SUN SEDGE (*CAREX INOPS* SSP. *HELIOPHILA*)[17]

. . . .This plant association occurs in small patches (fractions of an acre) with abrupt ecotones to associated grassland, shrub and forest types, but is widespread in Carter County on substrates derived primarily from sandstone. . . . It constitutes an edaphic climax in sandy range sites with coarse substrates and high infiltration rates. This plant association may also occur on shale, if the product of mechanical decomposition is dominated by sand-sized (and larger) platy particles.

. . . In southern Carter County this type was sampled at two sites in alluvial washes draining eroded ridges.

. . . . Respective cover by the two rhizomatous indicator species, [prairie sandreed] *Calamovilfa longifolia*. . . and [sun sedge] *Carex inops*. . . varies greatly between the two plots. At the site on sandstone, there is high cover by both grass (ca. 70%) and sedge (ca. 40%), and there is near total ground cover by litter. Except for the weedy exotic annual grass, [Japanese brome] *Bromus japonicus* (ca. 20% cover, in patches), other graminoids and especially forbs and shrubs are few and found only in trace amounts. Species richness (23) is the lowest of any type sampled except for the saline and alkali stressed types such as [the greasewood (*Sarcobatus vermiculatus*) and thickspike wheatgrass (*Elymus lanceolatus)* association]. . . . The site on shale substrate has much lower total cover, and here [sun sedge] *Carex inops* is dominant with about 40% cover; [prairie sandreed] *Calamovilfa longifolia* has only about 10% cover and [prairie rose] *Rosa arkansana* is also well represented with about 10% cover. . . .

. . . . In northern Carter County, it was sampled on BLM land near Mill Iron on resistant upland sandstone mesas, where it occurs in water collecting positions, within matrix grasslands of [needle-and-thread (*Stipa comata*) and threadleaf sedge (*Carex filifolia*)]. . . .

. . . . The coarse textured substrates (sandy loams) and leached nature of these sites is reflected in relatively low values for pH and conductivity. . . .

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[17] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 53-54.

SPIKERUSH (*ELEOCHARIS PALUSTRIS*)[18]

. . . .This wetland community type was sampled once. . . in west-central Carter County, where it occurs [after major precipitation events in seasonally flooded drainages]. This plant community prefers overflow ecological sites and will occupy the wettest microsites along the drainage channel.

[*Note:* Spikerush is a grass-like plant, provisionally identified as *Eleocharis xyridiformis* in the 1998 report. Taxonomy was unresolved at the time.]

. . . . This shallow marsh community type is dominated by spikerush. . . . Vegetation of the sample plot is dominated by dense patches of [spikerush] with about 70 percent total cover. Grasses include include [thickspike wheatgrass] *Elymus lanceolatus* (about 10% cover), [foxtail barley] *Hordeum jubatum* (about 3% cover) and [American sloughgrass] *Beckmannia syzigachne* (about 2% cover). The miniature spikerush *Eleocharis acicularis* is present, and a small patch of cattails, *Typha latifolia,* has become established. Forb diversity is low, but [bushy knotweed] *Polygonum ramosissimum* and [curly dock] *Rumex crispus* are common.

Wetland margins are dominated by [thickspike wheatgrass] *Elymus lanceolatus* communities. . ., a temporarily inundated meadow community with high cover by [foxtail barley] *Hordeum jubatum*.

Soils are fine textured, seasonally flooded, and extremely poorly drained. . . .

. . . . Wetlands and wetland habitat along watercourses are scarce in Carter County, found mostly as meadow and shallow marsh wetland associations. . . . The wetland where vegetation was sampled has been partially altered by changes to hydrology. There may also be alteration caused by cattle trampling and invasion by species such as [foxtail barley] *Hordeum jubatum,* [curly dock] *Rumex crispus,* and [cattails] *Typha latifolia.* . . . [S]pikerushes are unpalatable (Hansen et al. 1995) and their rhizomatous habit makes them resistant to grazing.

WESTERN WHEATGRASS (*PASCOPYRUM SMITHII*) + THICKSPIKE WHEATGRASS (*ELYMUS LANCEOLATUS*)[19]

. . . . This is a major plant association throughout the county and is the predominant grassland association of BLM lands in southern Carter County. It occurs on fine textured soils derived from shale parent materials, most commonly on lower slopes of rolling hills and along intermittent drainages. The association generally occurs in mesic (water collecting) topographic positions, and a small fraction of these sites may qualify as jurisdictional wetlands. It is perhaps most consistently found as a clayey range site, but is also found on shallow clay, overflow, silty, and other range sites. Floodplain examples of the type are seasonally flooded in most years and may be flooded intermittently after summer storms.

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[18] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 55-56.

[19] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 57-58.

. . . . This association is characterized by high cover (70-90% in the plots) of the rhizomatous wheatgrasses, [thickspike wheatgrass] *Elymus lanceolatus* and/or [western wheatgrass] *Pascopyrum smithii*. [Thickspike wheatgrass] *Elymus lanceolatus* was. . . probably more common in southern Carter County, but the two species may grow intermixed and are difficult to distinguish. . . . [Communities with either grass dominant are included in the same plant association.] . . . .

Under good range condition, other grasses are poorly represented, but [green needlegrass] *Nasella viridula* was present in trace amounts in all plots. . . . Most stands have been invaded by the exotic annual grasses [Japanese brome] *Bromus japonicus* or [cheatgrass] *B. tectorum*. These species are abundant in poor condition upland examples of this plant community type, and the exotic rhizomatous grass [Kentucky bluegrass] *Poa pratensis* is abundant in floodplain stands. Waif shrubs ([Wyoming big sagebrush] *Artemisia tridentata* ssp. *Wyomingensis,* [black greasewood] *Sarcobatus vermiculatus*) from surrounding communities occur in many stands, and the low shrub [prairie rose] *Rosa arkansana* had 30% cover in one plot. . . . Forb diversity is relatively low. . . . [In some test plots, 20-30% of cover was comprised of either yellow sweetclover (*Melilotus officinalis*) or Maximillian sunflower (*Helianthus maximiliani*)] . . . . Forbs with high constancy (75%) were [western yarrow] *Achillea millefolium,* [white prairie aster] *Aster falcatus,* [prairie thermopsis] *Thermopsis rhombifolia*, [salsify] *Tragopogon dubius*, and [American vetch] *Vicia americana.*

. . . . Due to high productivity of palatable grass and central position in the landscape, [these stands] usually receive heavy use by livestock. . . .

THICKSPIKE WHEATGRASS (*ELYMUS LANCEOLATUS*) + WESTERN WHEATGRASS (*PASCOPYRUM SMITHII*) + GREEN NEEDLEGRASS (*NASELLA VIRIDULA*)[20]

. . . . [This] is a distinctive but localized grassland type which was sampled twice in the South Cottonwood/Duncan Creek drainage, where it occupies both north and south aspect side slopes of low relief shale ridges in clayey range sites. . . .

. . . . The plots have moderate cover dominated by the grasses dominated by [thickspike wheatgrass] *Elymus lanceolatus*, with about 30% cover, and [green needlegrass] [*Nasella viridula*], with about 10% cover. Other grasses are limited to [indian ricegrass] *Oryzopsis hymenoides*. . . and [plains muhly] *Muhlenbergia cuspidata*. . . . The shrub [broom snakeweed] *Gutierrezia sarothrae* is present in both plots. There is high diversity and distinctive assemblage of forbs (14 and 20 species in the plots) with the following species constant: [white prairie aster] *Aster falcatus,* [miner's candle] *Cryptantha celosoides,* [white prarieclover] *Dalea candida,* [fewflower buckwheat] *Eriogonum pauciflorum,* [stemless hymenoxys] *Hymenoxys acaulis*, [Hood's phlox] *Phlox hoodii,* [wooly groundsel] *Senecio canus,* and [yellow salsify] *Tragopogon dubius*. The selenium indicators [racemed poisonvetch] *Astragalus racemosus*. . . and [desert princesplume] *Stanleya pinnata* were found in one plot and were observed in nearby similar habitat outside of the other plot.

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[20] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 59-60.

. . . . Presence of selenium at these sites is indicated by species which require high selenium in soil, and the related smell. . . .

. . . . We did not identify [western wheatgrass] *Pascopyrum smithii* in our plots, but its absence is not certain. [Thickspike wheatgrass] *Elymus lanceolatus* and [western wheatgrass] *Pascopyrum smithii* have similar ecological adaptations and may grow intermixed. . . . Abundance of [green needlegrass] [*Nasella virulais*] is thought to be indicative of fine- to medium-textured soils, mesic soil moisture regimes, and [better grazing management]. . . .

LITTLE BLUESTEM (*SCHIZACHYRIUM SCOPARIUM*) + THREADLEAF SEDGE (*CAREX FILIFOLIA*)[21]

. . . . [This community type] was sampled . . . in the northern part of the county east of Mill Iron and in the southwest corner of the county near Hammond. . . . Stands of [little bluestem] *Schizachyrium scoparium* observed in Carter County were usually small in size and limited to specialized topographic positions or disturbance regimes, primarily on substrates derived from sandstone. It was seen on ridge shoulders [steep (thin) ecological sites] above slumping escarpments, and on the toe slope deposits below. . . . [Little bluestem] is capable of colonizing areas of step-erosion on northerly slopes and is an effective competitor that, once established, [is not easily] replaced on these sites. . . .

. . . . Large bunches of the warm season grass [little bluestem] *Schizachyrium scoparium* are the distinctive visual indicator of this community type, taller than the codominant low, clump forming [threadleaf sedge] *Carex filifolia*. Either species may be dominant; cover of [little bluestem] *Schizachyrium scoparium* [ranged from 30-40%] and cover of [threadleaf sedge] *Carex filifolia* [ranged from 10% to 50%] in the two respective plots. The plots have a high diversity of grasses and forbs. In addition to the dominants, grasses in both plots include [prairie sandreed] *Calamovilfa longifolia,* [prairie junegrass] *Koeleria macrantha,* [needle-and-thread] *Stipa comata,* and [sixweeks fescue] *Vulpia octoflora.* There is a total of 28 species of forbs in the 2 plots but only [rush skeletonplant] *Lygodesmia juncea*, [white milkwort] *Polygala alba*, and [silverleaf Indian breadroot] *Psoralea argophylla* are in both. [Ponderosa pine] *Pinus ponderosa,* [fringed sagewort] *Artemisia frigida* and [yucca] *Yucca glauca* are present in trace amounts in both plots.

. . . . [We found this plant community] exclusively on coarse textured soils derived from sandstone parent materials. . . . A grassland community dominated by little bluestem is also documented on shale derived substrate in the Thompson Creek drainage west of Alzada (Ecological Consulting Service 1975). . . . DeVelice et al. (1995) noted that these non-sandstone occurrences can be explained by the fact that fissile shale can mimic sandstone in effective soil texture and water-holding capacity. . . .

. . . . [This plant community is considered to be] a topoedaphic climax type but [little bluestem] *Schizachyrium scoparium* may also be a seral dominant following erosion events and possibly fire. . . .

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[21] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 61-62.

PRAIRIE CORDGRASS (*SPARTINA PECTINATA*)[22]

. . . . This is perhaps the most abundant of naturally occurring wetland types on BLM land in Carter County. It occurs in ephemeral floodplains and along permanently flooded streams in subirrigated settings. In rangelands on shale substrates where there is little or no permanent standing water, intermittent drainages are usually [dammed] to create stockponds; narrow and patchy wetland habitat above and below stockponds is often dominated by the rhizomatous grass [prairie cordgrass] *Spartina pectinata.* Two relatively undisturbed examples of [this plant community] were sampled, one in an intermittent wash off a shale ridge system at the headwaters of Short Creek, and another in the permanently flooded canyon bottom of the East Fork of the Little Powder River. The Short Creek site occurs in a landscape of low-relief uplands dominated by [Wyoming big sagebrush and thickspike wheatgrass], while the Little Powder River site is in a box canyon which cuts through eroded break lands and bench lands dominated by [silver sagebrush] and [western wheatgrass] with scattered ponderosa pine. Adjacent wetland types at the Little Powder River site were dominated by [horsetail] *Equisetum laevigatum* and [three-square bulrush] *Scirpus pungens*.

. . . . The two sampled plots represent a broad range in hydrological conditions to which [prairie cordgrass] *Spartina pectinata* is adapted and functions as a dominant. The plot in an ephemeral wash has about 50% cover by prairie cordgrass with near complete cover (of both live foliage and litter) in patches which form terraces in a mosaic with bare soil of recent alluvial deposition. There is little cover by other species[;] the grasses [tickle-grass] *Agrostis scabra* and [alkali bluegrass] *Poa juncifolia* and forbs [white prairie aster *Aster falcatus,* [bushy knotweed] *Polygonum ramosissimum,* and [prairie thermopsis] *Thermopsis rhombifolia* form a distinctive assemblage, but occur in only trace amounts. The plot in the permanently saturated, low gradient floodplain contrasts by being less patchy and by having a taller, more dense [stand] of [prairie cordgrass] *Spartina pectinata* (about 90% cover), significant cover (about 10%) by [three-square bulrush] *Scirpus pungens* and a different assemblage of characteristic tall, wet-site forbs ([showy milkweed] *Asclepias speciosa,* [curly dock] *Rumex crispus*, and [Canada goldenrod] *Solidago canadensis*).

. . . . The floodplain site exhibited soils with strong gleying and no evidence of mottling. The other site, located in an intermittent wash, possessed neither wetland soil feature but, owing to its topographic position below and adjacent to an acid shale ridge system, its soil reaction was moderately acid, with a hydrogen ion concentration more than 100 times greater than any SPAPEC site sampled to date (Hansen et al. 1995). Conductivities indicate only mildly saline conditions. [Both soils hand-textured to] silt loams. . . .

NEEDLE-AND-THREAD (*STIPA COMATA*) + THREADLEAF SEDGE (*CAREX FILIFOLIA*)[23]

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[22] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 63-64.

[23] Jim Vanderhorst, Stephen V. Cooper, and Bonnie L. Heidel, *Botanical and Vegetation Survey of Carter County*, 65-66.

. . . . This is the predominant grassland type in Carter County on uplands with soils derived from sandstone parent materials; it occurs on planar surfaces, gently rolling plateaus, tops of buttes, and gentle slopes of all aspects, though it is more prevalent on warmer exposures. It is most consistently found in shallow to gravel range sites . . . . [and] is also consistently found in well-developed sandplains representing sands or sandy range sites, though such settings are nearly absent from BLM land in Carter County.

. . . . [In five study plots], 62 plant species were tallied. Although [needle-and-thread] *Stipa comata* is the more conspicuous of the codominant graminoids (both with an average cover of 36%), [threadleaf sedge] *Carex filifolia* had greater cover in three of the [five] plots. Cover by [needle-and-thread] *Stipa comata* ranged from 20 to 70% and cover by [threadleaf sedge] *Carex filifolia* ranged from 10 to 60%. . . .

No other grasses were 100% constant [but] a rhizomatous wheatgrass, either [western wheatgrass] *Pascopyrum smithii* or [thickspike wheatgrass] *Elymus lanceolatus*, and [blue grama] *Bouteloua gracilis* were sometimes well represented (up to 10% cover) and occurred in 80% of the plots. The subshrub [fringed sagewort] *Artemisia frigida* was the only woody species with over 50% constancy. The diversity of forbs varied greatly between plots and [may be a reflection of grazing]. One plot, apparently ungrazed in recent years, had 18 forb species, while a plot with evidence of heavy use by sheep in recent years had only 8 species. Forbs with high constancy (≥60%) included [wavyleaf thistle] *Cirsium undulatum,*[rush skeletonplant] *Lygodesmia juncea,* [prickly pear cactus] *Opuntia polyacantha,* [Hood's phlox] *Phlox hoodii,* [wooly plantain] *Plantago patagonica,* [silverleaf scurfpea] *Psoralea argophylla*], [scarlet globemallow] *Sphaeralcea coccinea,* and [yellow salsify] *Tragopogon dubius*. . . . [Dense clubmoss] *Selaginella densa* is 80% constant. . . .

. . . Plots were on residuum derived from what was judged to be sandstone, but the clay component was still appreciable (18-29%) and the textures ranged from loams to clay loams. With the exception of other community types developed exclusively on sandstone substrates . . .[,] soils of this association have the lowest electrical conductivities, reflecting both the nature of the substrate and the greater effective leaching associated with coarse substrates. . . .