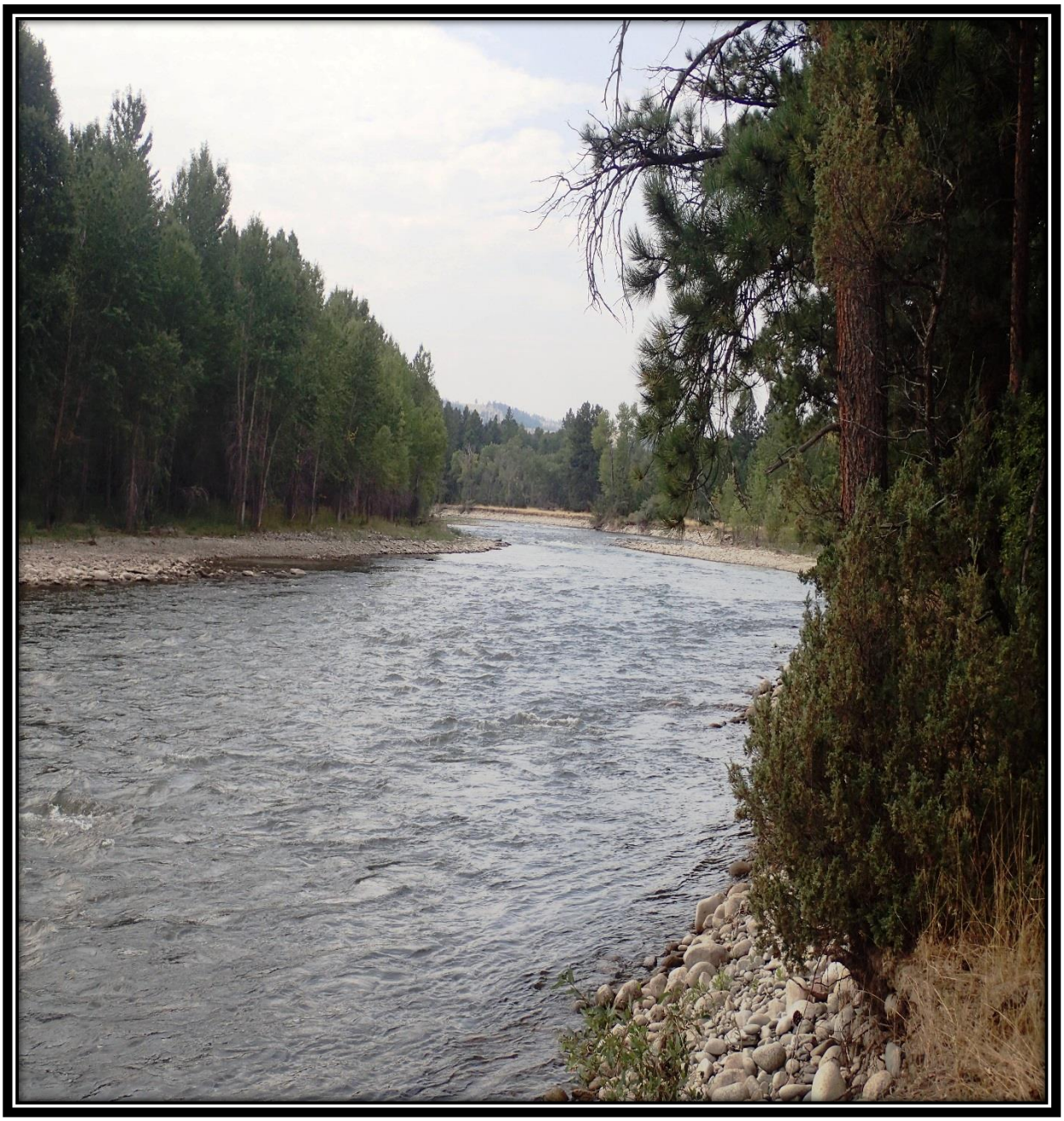
Lower Stillwater River Assessment



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January 2018

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1. Introduction

The Stillwater Valley Watershed Council (SVWC) officially formed in 2010. The Council is a volunteer group of residents working together to enhance the quality of their rural Montana lifestyle by protecting, restoring and conserving their abundant natural resources through good stewardship and community involvement for this and future generations.

They are committed to the following mission:

> *The Stillwater Valley Watershed Council will provide an open forum in which all interested parties may work in a collaborative effort to sustain our rural quality of life and protect and enhance our natural resources. We seek to understand all points of view, come to a common goal and work for practical solutions. We are committed to research and educating our valley residents and the public about our watershed and the steps we can take to preserve and maintain the integrity of the river, the land and the beauty of our valley. We will endeavor to bring together public, private and government resources, funding, and grants to achieve our goals.*

1.1 Purpose of the Assessment

As part of their mission, the SVWC has completed comprehensive stream corridor assessments on the upper Stillwater River, Rosebud Creek drainage, and other tributaries beginning in 2013. This report continues that effort by summarizing assessment results on the lower 14 miles of the Stillwater River beginning at the Johnson Bridge and ending at the Stillwater River confluence with the Yellowstone River. The primary objectives for the assessment were to:

- Compile and summarize all existing resource data and information that complement and direct the field assessment.
- Collect and summarize resource information with special attention given to irrigation infrastructure, riparian forest condition, and noxious weed infestations.
- Provide conceptual recommendations and prioritizations of restoration opportunities. The recommendations will serve as the foundation for future analyses and cost estimates for selected restoration projects.

1.2 Acknowledgements

The members of the Stillwater Valley Watershed Council are commended for their time and dedication in providing leadership and direction for this assessment. The people listed below were especially helpful in completing the field work. More so, their hospitality and friendship made it a pleasure to work on this project.

- Raymond Lien
- Sandra Peck
- Tim Thompson
- Butch Behrent
- Lindsey Clark, SVWC Coordinator

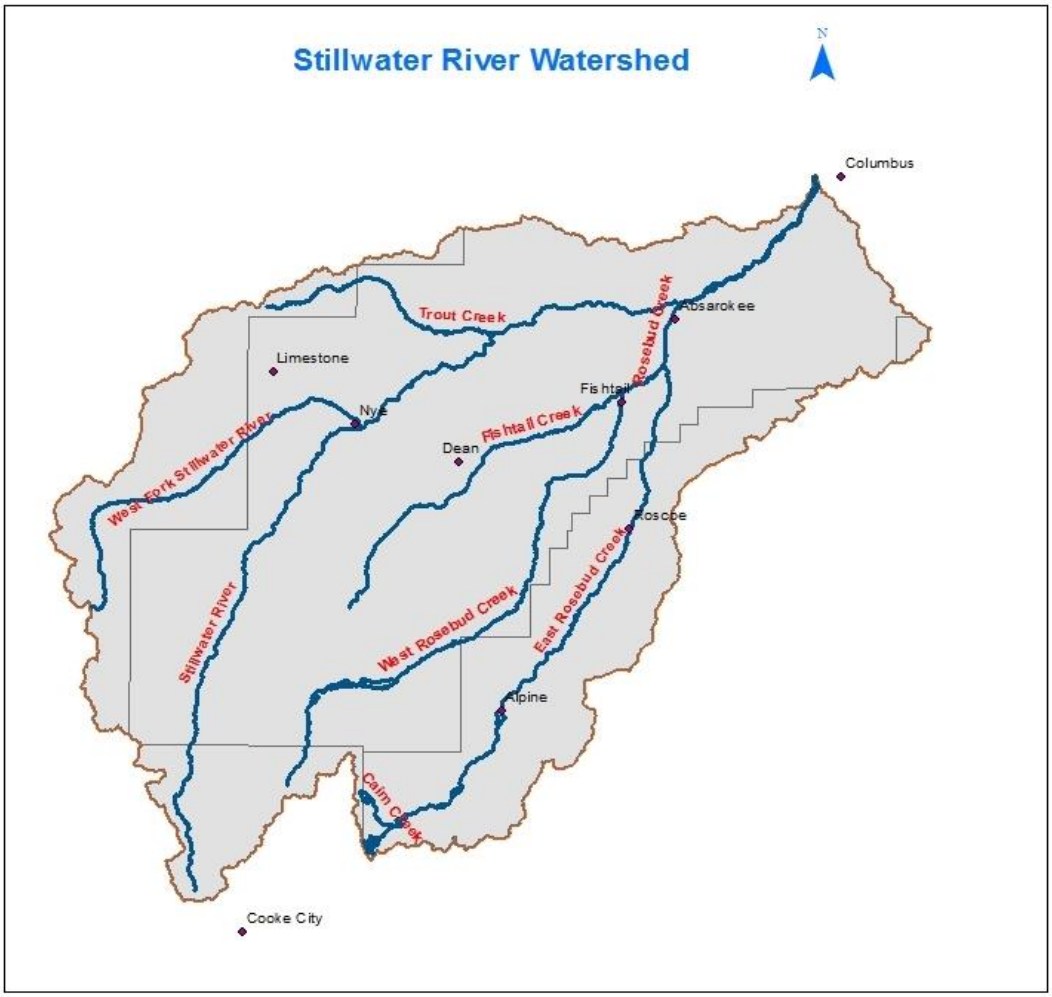
2. Background Information

2.1 Stillwater River

The Stillwater River was named Buffalo-Jumps-Over-The-Bank River by the Crow, probably because one of the best buffalo jumps in the Crow area was in the Stillwater Canyon near Nye. Other accounts of the origin of the river's name are many. Captain William Clark named the Stillwater River "Rose bud river" on July 19, 1806. In the 1860s, John Bozeman named it Stillwater River because there was a quiet, sandy ford across the river near where it leaves the mountains. Another story claims the river was named by the Indians after they went out to find its source. When they returned, another party asked if they found its source and the Indians answered, "No, still water." Since that time, the river was called the Stillwater. Who's to really say how the Stillwater River came by its name.

2.2 General Watershed Description

The Stillwater River Watershed comprises approximately 684,000 acres. The river originates in the Absaroka-Beartooth Wilderness in southern Park County near the state line with Wyoming and the boundary of Yellowstone National Park. It flows northeast for 70 miles, between the Absarokee Range to the west and the Beartooth Mountains to the east, through the Custer National Forest, past Nye and Absarokee, and joins the Yellowstone River just west of Columbus.



This assessment focuses on the lower Stillwater River mainstem from the Johnson Bridge to the Yellowstone River. The stream corridor is largely in private ownership, interspersed with parcels of State and Federal lands.

Land use in the lower Stillwater River valley is predominately irrigated hay and pasture that supports livestock production. There are also several small tract subdivisions scattered along the river corridor.

2.3 Hydrology

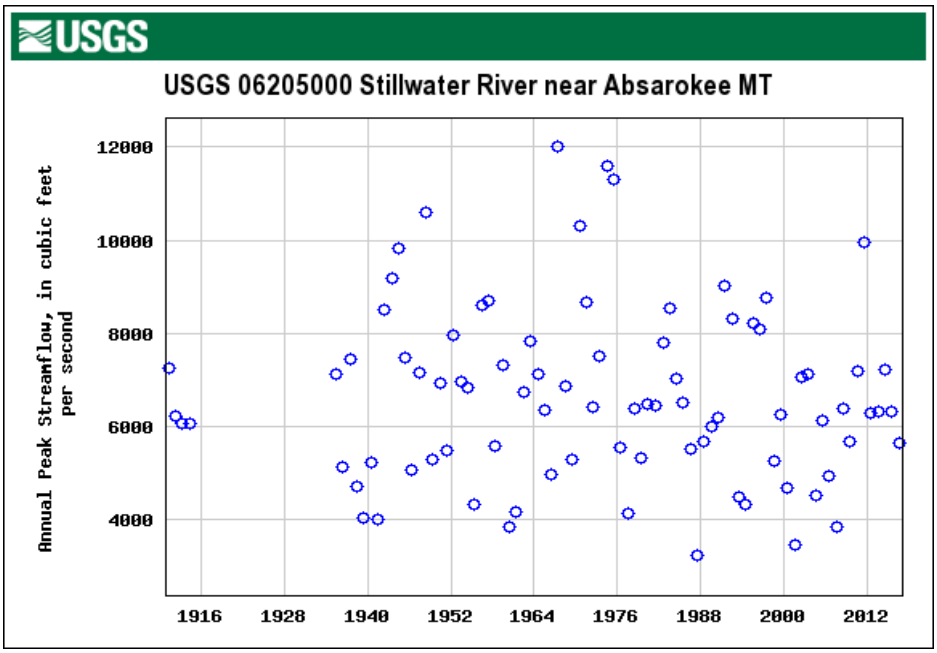
A limited amount of stream flow data is available for the lower Stillwater River. There is one active USGS Gage Station on the Stillwater River at the Riverside Inn Bridge (Site LSR-15). The gage station is designated *"Stillwater River near Absarokee (06205000)."*

USGS Gage Station: Stillwater River near Absarokee (06205000)

Period of Record: Flow measurements have been recorded from July 1910 to September 1914 (no winter records), March 1935 to September 1995 (year-round), October 1995 to September 2000 (seasonal records), and October 2000 to the present (year-round).

Peak Discharges: The highest peak flows over the last 107 years were:

- June 3, 1948: 10,600 cfs
- June 15, 1967: 12,000 cfs
- June 28, 1970: 10,300 cfs
- June 18, 1974: 11,600 cfs
- June 6, 1975: 11,300 cfs
- June 30, 2011: 9,950 cfs



Mean Monthly Discharges: Over the recorded history of this station, June has the highest mean monthly discharge at 3,390 cfs and February has the lowest at 270 cfs. Flow is affected by multiple

irrigation diversions that serve ~ 24,000 acres of irrigated land upstream from the gage station. Flow is partially regulated by Mystic Lake on upper West Rosebud Creek.

Rosebud Creek enters the Stillwater River at the end of Reach LSR1. The Rosebud Creek drainage area (~400 square miles) is approximately 40% of the drainage area above this gage station. During high-water run-off months (May and June), Rosebud Creek contributes, on average, about 40% of the flow to the lower Stillwater River. Throughout the rest of the year, it is closer to 50%.

2.4 Water Quality

The Montana Department of Environmental Quality (MDEQ) lists the Stillwater River (45.6 miles - USFS boundary to the Yellowstone River) as a Water Quality Category 5: *waters where one or more applicable beneficial uses are impaired or threatened and a TMDL is required to address the factors causing the impairment or threat*. The impairments are listed as not fully supporting drinking water and aquatic life. The probable causes are impacts from cadmium, chromium (total), copper, mercury, and nickel from abandoned mine lands. Impacts from cyanide are from unknown sources and nitrate-nitrite are from natural sources, permitted hardrock mining discharges, and post-forest fire run-off. All probable causes listed above are thought to adversely affect aquatic life. Mercury is the only probable cause that MDEQ associates with drinking water use.

2.5 Fisheries

Historically, the Stillwater River supported a healthy population of native Yellowstone cutthroat trout. Today, Yellowstone cutthroat trout are present in small remnant populations in upper tributaries and headwater lakes in the Beartooth Mountains. In the lower 14 miles of the Stillwater River, there are no Yellowstone cutthroat trout. They have been replaced by non-native brown trout and rainbow trout. Given the connectivity with the Yellowstone River, the lower Stillwater River has little to no potential for restoration of Yellowstone cutthroat trout.

The tributaries (i.e. Beaver, Mexican Joe, Joe Hill, Whitebird, and Shane Creeks) on the lower Stillwater have had little to no fish sampling. FWP fish biologists have determined that these tributaries are seldom used by trout due to intermittent flows and substrate siltation. Native minnows likely use the lowermost reaches and isolated perennial pools.

2.6 Brief History

The Stillwater Valley was historically part of the Crow Nation and later, in 1868, part of the Crow Reservation. In 1872, the Crow Agency was moved from its first location at Fort Parker near Livingston, Montana to the Rosebud River near the town of Absarokee. The agency remained at this site until it was moved in 1884 to its present location at Crow Agency.

On October 15, 1892, the federal government, through a Benjamin Harrison proclamation, opened the land around Absarokee for settlement as part of a 1.8 million-acre land cession agreed to by Crow tribal leaders two years earlier after giving in to political pressure.

<u>Halfway House:</u> In November 1892, W.W. Campbell purchased ceded Crow land between Absarokee and Columbus. His ranch was later purchased by Everett McBride. McBride had a house built there in 1907. Situated halfway between Absarokee and Columbus, the house became known as the Halfway House.

The house was an important landmark to residents and travelers in the area who used it to gauge distance and for shelter when road conditions were poor. It was also a resting place for stockmen who pastured and fed their cattle overnight at a nearby ranch.

A round trip to Columbus from Absarokee on the then dirt road took three days: one day down and two days back. If it was wet, it took longer because gumbo stuck to the wagon wheels and slowed them down. Automobiles got stuck in the mud and were even harder to get out. Horses had an easier time of traveling the wet muddy roads, even if the rider had to get off and walk.

The house was threatened to be destroyed when Highway 78 was reconstructed, but was relocated after the current owners were able to get it recognized as a historical landmark and was added to the National Register of Historic Places.

3. Assessment Methodology

The lower Stillwater River stream assessment was completed by walking both sides of the lower 14 river miles. Specific tasks included:

- compiling and summarizing pertinent scientific reports, resource data and historical information to complement the field assessment;
- collecting and summarizing resource information with special attention given to irrigation infrastructure, channel stability, native riparian forest, and noxious weed infestations;
- interviewing landowners to gather local perspective and historical context; and
- providing conceptual recommendations and prioritizations for restoration project opportunities.

Fieldwork was completed in July and August 2017 by Warren Kellogg (Watershed Consulting) under contract with the Stillwater Valley Watershed Council. Observations and restoration recommendations are based upon landowner input and the contractor's professional judgment.

The 2015 color aerial photography (NAIP – National Agricultural Imagery Program) was used as the base photography for the river assessment. Maps (scale 1:10,000) are included at the back of this report. Older aerial photography (1951 to 2015) and Government Land Office Survey Maps (1900) were frequently referenced to determine channel migration rates, land use trends, and riparian corridor extent over time.

Detailed notes and digital site photos were taken during the field assessment. Each site was documented with GPS coordinates and labeled on the maps. Appendix A summarizes site locations and recommended restoration priorities.

4. Observations and Planning Considerations

The Lower Stillwater River Assessment began at the Albert Johnson Bridge and ended nearly 14 miles downstream at the Stillwater River/Yellowstone River confluence. There are 4 reach descriptions and 47 site descriptions included in the assessment.

4.1 Reach LSR1

Site LSR-1 (Albert Johnson Bridge) to the Rosebud Creek Confluence (downstream from Site LSR-10) - 1.7 miles

(Lower Stillwater River – Map #1)

Geology/Soils: The Stillwater Valley is nearly 1-mile wide along Reach LSR1. The valley consists of low terraces, alluvial fans, and floodplains. North of the river, alluvium has been deposited in fans (up to 50 feet deep) from upland sources. The south valley is predominantly low gravel terraces, 10 to 60 feet above the river bottom. These features generally have a surface soil layer of loam, clay loam, or silty clay loam that vary in depth.

The valley is bordered on both sides by the Tongue River Member, Fort Union geologic formation. This formation is resistant sandstones interbedded with shale, siltstone, and occasional thin coal beds characterized by steep upland benches that rise over 300 feet above the valley bottom. On the lower half of the reach, unstable landslide deposits (soil and blocks of bedrock) can be found along the valley margin above the Garrigus Ditch.

Land Use: Historic aerial photography shows that the land use in the river valley was exclusively agriculture until the 1960s. Over the last 50 years, the conversion of agricultural land to small-tract subdivision development has been substantial. Five subdivisions border 32% of the river along this 1.7-mile reach largely on the south side of the river. Reach LSR1 has one of the highest densities of subdivisions on the Stillwater River.

Channel Characteristics: The channel gradient averages 0.75%. Channel sinuosity (channel length/valley length) is relatively straight at 1:1. Little has changed over the last 65 years; however, old channel traces suggest that channel sinuosity was once higher (1.2 to 1.3). Channel features are predominantly riffles (fast, shallow, turbulent) and runs (fast, deep) with a few short pools (slow, deep). The channel bottom is layered with small cobbles and gravel.

Very little in-channel woody debris can be found due to high velocity flows that continually move it downstream.

The river banks are mostly cobbles and gravels making them inherently stable. However, where houses, roads, and gas pipelines are near the river, rock rip-rap and floodplain dikes have been commonly used to shield them from river migration and flooding.

The river channel along Reach LSR1 is relatively straight with fast-moving riffles/runs and a cobble/gravel bottom.

Riparian Characteristics: The riparian corridor is generally a narrow band of riparian vegetation along a single-threaded channel. Small riparian patches and old channel traces have low to moderate density cover. Subdivision development, over the last 50 years, has impacted the extent and condition of the native plant community. Prior to the onset of subdivision development, riparian areas heavily used by livestock have not fully recovered.

The riparian forest overstory is primarily native black cottonwood trees. Where the riparian forests have been overgrazed or landscaped, there is often little or no remaining understory vegetation. However, in well-managed riparian forests, a dense understory of thin leaf alder, juniper, chokecherry, snowberry, and black cottonwood saplings is common.

The amount of riparian forest is limited along Reach LSR1; however, there are small patches of riparian forest that have good age and species diversity.

Noxious Weeds:

- Canada thistle, leafy spurge, mullein, and houndstongue are present throughout Reach LSR1. Spotted knapweed and burdock are also present, but to a lesser extent. Birdsfoot trefoil (an old pasture legume) has become increasingly invasive.
- Small patches of yellow toadflax and oxeye daisy can be found in the Fellows Subdivision.
- Common tansy is used as an ornamental on at least one tract in the Circle T Subdivision.

Common tansy is a noxious weed used as an ornamental on a subdivision tract.

Reach Recommendations: Priority: High

Riparian Management: To maintain a healthy riparian corridor, limit clearing and mowing of riparian vegetation on small tracts. Where livestock are concentrated in small pastures along the river, grazing impacts to bank stability and native riparian vegetation can be reduced by managing livestock numbers, grazing duration, and season of use. Off-river water developments and permanent or portable fencing may be necessary to fully implement a grazing management plan. In high impact areas, re-establishing native riparian plants may become necessary.

Noxious Weed Control: Implement an aggressive program to actively control noxious weeds on both small tract subdivisions and larger agricultural operations. The Stillwater County Weed District will help landowners develop customized weed management plans. Subdivision tract owners should be targeted for an information/education campaign to help them recognize noxious weeds on their properties and develop treatment alternatives.

Site LSR-1 Stream Crossing – Albert Johnson Bridge
(Lower Stillwater River – Map #1)
This is a revised site description for the Johnson Bridge Site SW-103 included in the Upper Stillwater River Assessment Report (March 2014).

The Albert Johnson bridge was built in 1908. The 1900 Government Land Office Survey Map shows an earlier bridge located about ¼ mile upstream. The Albert Johnson Bridge is a 163-foot long Pratt through truss bridge that connects Bridge Road to the North Stillwater Road. The bridge is supported by wood abutments and two sets of in-channel, concrete-filled, steel cylinder supports. The Garrigus Ditch headgate is located immediately upstream from the north abutment.

The Albert Johnson Bridge has recently been determined to be “structurally deficient” by the Montana Department of Transportation and is scheduled to be replaced in 2020 with a 155-foot long by 20-foot wide pony truss bridge. The new bridge will span the river without mid-channel supports. The Garrigus Ditch crossing under the county road will be replaced with a concrete box culvert.

The Albert Johnson Bridge is scheduled to be replaced in 2020. The old bridge will be offered for "adoption". If there is no interest, it will likely be dismantled.

Recommendations:
None

Site LSR-2 Absaroka Fishing Access Site (FAS)
(Lower Stillwater River – Map #1)
This 1-acre Montana FWP Fishing Access Site is located on the north river bank about 250 feet downstream from the Albert Johnson Bridge (Site LSR-1). The land was purchased in 1958. The FAS is divided into two separate tracts: a boat launch/picnic area and a small parking lot. The two tracts lie within the Midnight Frolic Subdivision and are accessed off the North Stillwater Road. The FAS is primarily used as a put-in and take-out spot for recreational floaters. The gravel boat launch is bordered by small boulders projecting 15 feet into the river channel.

Absaroka Fishing Access Site is a popular launch site for recreational floaters.

Recommendations:
None

Site LSR-2A Small Tracts – Midnight Frolic Subdivision
(Lower Stillwater River – Map #1)
The Midnight Frolic Subdivision consists of 3 small tracts along the north river bank, downstream from the Albert Johnson Bridge (Site LSR-1) and across the river from the Rock-N-River Subdivision

(Site LSR-3). The subdivision tracts, separated by two Absaroka FAS tracts (Site LSR-2), are accessed via the North Stillwater Road. Subdivision tracts vary in size from 0.9 to 1.3 acres, all with houses, driveways, and landscaping. The subdivision lies within the 100-year floodplain with houses generally built less than 50 feet from the river's edge. One house was built on a mid-channel island accessed via a low-water concrete ford or a high-water cable transport across the north channel. A cobble retaining wall lines the upper end of the island.

The subdivision was developed before 1975, prior to mandatory subdivision review. Approximately 625 feet of the north bank are impacted by the subdivision. Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually small, but multiple small tracts in an older subdivision cumulatively pose a significant risk to the Stillwater River.

A house and rock retaining wall built on a mid-channel island is part of the Midnight Frolic Subdivision.

Recommendations: Priority: High

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Suggested program topics would be noxious weed control, water rights, septic field maintenance, riparian forest management, low-impact landscaping, and basic river dynamics. The program could be jointly run by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-3 Small Tracts – Rock-N-River Subdivision

(Lower Stillwater River – Map #1)

This subdivision consists of 10 small tracts located on the south bank, downstream from the Albert Johnson Bridge (Site LSR-1), and across the river from the Midnight Frolic Subdivision (Site LSR-2A) and the Absaroka Fishing Access Site (Site LSR-2). The subdivision tracts vary in size from 0.5 to 4.1 acres, nearly all are developed with houses, driveways, and landscaping. Most houses are set back 15-40 feet from the terrace edge. The conversion from agricultural land to small residential tracts occurred between 1997 and 2004, subject to subdivision review by Stillwater County.

The subdivision was built on a low terrace above the river corridor and floodplain. This has limited the necessity for river bank armoring. The riparian vegetation zone is confined to a narrow band along the toe of the terrace.

Nearly 1,100 feet of the Stillwater River are affected by this subdivision. Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually small, but multiple small tracts in a subdivision cumulatively pose a significant risk to the Stillwater River.

Rock-N-River Subdivision tracts have been developed on a low terrace above the 100-year floodplain.

Recommendations: Priority: Medium

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Suggested program topics would be noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly run by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-4 Bank Erosion – North Stillwater Road (Upper Section)

(Lower Stillwater River – Map #1)

This section of the North Stillwater Road closely follows 970 feet of the north river bank. The edge of the road berm is less than 15 feet from the river, and in some cases, much closer. The river bank is subject to periodic ice jams and annual high water. Short segments of bank have been armored with rock and/or concrete chunks (poorly sized and spaced); other segments are currently stabilized by small trees/shrubs or left bare to erosion. Given the proximity of the road to the river, protecting the road and assuring public safety is an on-going concern for the Stillwater County Road Department and local landowners.

North Stillwater Road (Upper Section) closely parallels the river where eroding banks are threatening road integrity.

Recommendations: Priority: High

1) Bank Armor/Flow Deflectors: Placing rock rip-rap on the eroding bank may be challenging as there is not sufficient room between the river and road to accommodate a 2:1 back slope. To attain a stable back slope, the rock rip-rap would have to encroach into the existing channel or the county road would need to be shifted slightly north. Another option would be a series of well-designed flow deflectors placed along the full length of the site. Flow deflectors would be the least expensive option when compared to blanket rock rip-rap or road relocation, but they do carry a slightly higher risk of failure.
2) Vegetated Bank: Some river bank segments are currently stable due to small trees and shrubs growing along the toe of the bank. Potential bank instability exists where larger trees are being undermined by high flows. When these trees eventually fall into the river, the exposed root balls and debris often make the river bank more vulnerable to erosion. Trees currently being undermined and leaning towards the river should be cut with the stump/root ball left in the bank. The cut debris should be removed from the river. In time, young sprouts will grow from the root ball that will contribute to future bank stability.
3) Stakeholder Collaboration: There appears to be confusion over who has the responsibility and authority to stabilize the river bank along the county road. Stillwater County is encouraged to collaborate with adjacent landowners, Montana Fish, Wildlife and Parks, and the Stillwater Conservation District on a road protection plan for Sites LSR-4, LSR-7, and LSR-10. The agreed-upon approach should be proactive and long-lasting.

Site LSR-5 Irrigation Headgate/Diversion – Benbow Ditch

(Lower Stillwater River – Map #1)

The Benbow Ditch headgate and diversion are located on the south bank at the upstream end of an old river channel. The headgate lies between the Rock-N-River Subdivision (Site LSR-3) and the Fellows Subdivision (Site LSR-6). The irrigation system was abandoned about 25 years ago following the conversion of irrigated hay/pasture fields to small residential tracts (Circle T Subdivision).

The irrigation system is not shown on the 1900 Government Land Office Survey Map; however, the 1946 Water Resources Survey map depicts the Benbow Ditch irrigation system with a point of diversion at its current location. “1970” inscribed on the headgate structure is likely the date when it was last replaced or repaired.

A 20-foot long concrete sill diversion extends upstream from the headgate with large rock placed off the end of the sill. Immediately downstream from the headgate, large angular rock and concrete rubble were placed along 150 feet of river bank to protect the upper ditch.

Although the headgate is no longer used, removal is not recommended. The site is currently stable with minimal impact on the river. Any disturbance resulting from structure removal may accelerate bank and channel instability.

The Benbow Ditch Headgate diverted water to irrigated lands that have since been converted to small residential tracts.

The concrete sill and rock diversion associated with the old Benbow Ditch headgate can still be seen in the river.

<u>Recommendations:</u>
None

Site LSR-6 Small Tracts – Fellows Subdivision
(Lower Stillwater River – Map #1)
The Fellows Subdivision consists of 7 small tracts that lie along the south river bank. All tracts, except one, are approximately 0.3 acre in size. The subdivision, located within the 100-year floodplain, is densely developed with houses, driveways, and landscaping. Most houses are less than 50 feet from the river channel. Hand-placed cobble dikes, 2-3 feet high, line the bank along most of the subdivision tracts. The native riparian plant community has been significantly altered due to landscaping and noxious weed infestations.

The subdivision was developed before 1975, prior to mandatory subdivision review. Approximately 650 feet of the south bank are impacted by this subdivision. Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually minor, but multiple small tracts in a relatively old subdivision cumulatively pose a significant risk to the Stillwater River.

Fellows Subdivision is an old subdivision with tracts in the 100-year floodplain.

Recommendations: Priority: High

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Suggested program topics would include noxious weed control, water rights, septic field maintenance, riparian forest management, low-impact landscaping, and basic river dynamics. The program could be jointly run by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-7 Bank Erosion – North Stillwater Road (Middle Section)

(Lower Stillwater River – Map #1)

Site LSR-7 is comparable to Site LSR-4: Bank Erosion - North Stillwater Road (Upper Section). The middle section of the North Stillwater Road closely follows 1,400 feet of the north river bank. The edge of the road berm is often less than 10 feet from the river and as close as 2 feet. The river bank is sparsely armored with poorly sized and spaced rock and/or concrete rubble. Most bank armor has scoured out and/or sloughed down the steep bank subjecting the river bank and adjacent road to active erosion. Some concrete rubble has exposed rebar, creating a safety hazard. Brush has been piled on the bank at the lower end of the site. Small trees and shrubs growing along the toe of the bank have provided some stability to the river bank.

Protecting this road is an on-going issue for the county and local landowners. Public safety is a concern for drivers given the proximity of the road to the river and for floaters because of exposed rebar in the channel.

The river bank along the North Stillwater Road is actively eroding due to periodic ice jams and early summer high flows.

The existing rock rip-rap has sloughed down into the channel making the river bank and road vulnerable to erosion.

Recommendations: Priority: High

1) Existing rock/concrete rip-rap: Carefully place angular rock of mixed sizes within the existing matrix of rock/concrete rip-rap to prevent further scouring and sloughing. Cut off the exposed rebar on concrete rubble.
2) Flow Deflectors: Placing rock rip-rap on the eroding bank may be challenging as there is not sufficient room between the river and road to accommodate a 2:1 back slope. To attain a stable back slope, the rock rip-rap would either need to encroach into the existing channel or the county road would need to be shifted slightly north. Another option would be a series of flow deflectors placed along the full length of the site. Flow deflectors would be the least expensive option when compared to blanket rock rip-rap or road relocation, but would need to be carefully designed and installed.
3) Vegetated Bank: Some of the river bank is stable due to small trees and shrubs growing along the toe of the bank. Potential bank instability exists where larger trees are being undermined by high flows. When these trees eventually fall into the river, the exposed root balls and debris make the river bank more vulnerable to erosion. Trees currently being undermined and leaning towards the river should be cut with the stump/root ball left in-place. The cut debris should be removed from the river. In time, young sprouts will grow from the root ball contributing to future bank stability.
4) Stakeholder Collaboration: There appears to be confusion over who has the responsibility and authority to stabilize the river bank along the county road. Stillwater County is encouraged to collaborate with adjacent landowners, Montana Fish, Wildlife and Parks, and the Stillwater Conservation District on a road protection plan for Sites LSR-4, LSR-7, and LSR-10. The agreed-upon approach should be proactive and long-term.

Site LSR-8 Small Tracts – Circle T Subdivision

(Lower Stillwater River – Map #1)

The Circle T Subdivision has 14 tracts that border the south side of the Stillwater River. The property was subdivided in the late 1980s. Twelve of the 14 tracts are 2 to 5 acres in size and have been developed with houses, driveways, and landscaping. The tracts are located on a low terrace above the 100-year floodplain with houses 40 to 100+ feet from the terrace edge. These tracts affect approximately 2,840 feet of river bank. The remaining 2 tracts include a large 25+ acre undeveloped tract that lies within the 100-year floodplain and a 21-acre Home Owners Association (HOA) Park

upstream from the confluence of Rosebud Creek. They encompass an additional 3,560 feet of river bank.

The Home Owners Association Park is partially mowed. Minor bank erosion is occurring on the upper end of the park where shrubs or trees are sparse. The lower end of the park has been left as riparian forest and wetlands with a series of walking trails. An old cobble dike, ~ 200-foot-long, restricts high water access to a historic flood channel. This restriction forces more high-water flow against the opposite bank along the North Stillwater Road (Site LSR-10). A small rock jetty and a short segment of old rock rip-rap on the lower end of the park have little to no effect on the river.

Very little bank armoring is associated with the subdivision except on the lowermost tract, downstream from the HOA Park. This tract is located along an outside bend on a 10-15-foot high terrace. The terrace bank, ~200 feet long, has large angular rock along the toe with smaller cobble rip-rap higher up the bank. The main house is less than 40 feet from the terrace edge. On the upstream side of the terrace armoring, active erosion is occurring that could eventually compromise the armor. On the opposite bank, rock rip-rap and diking are preventing high water from accessing the historic floodplain (lower end of Site LSR-10). By restricting floodplain access, more high energy flows are directed towards the south terrace which may be contributing to its erosion and instability.

Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually minor, but multiple small tracts cumulatively pose a significant risk to the Stillwater River.

Circle T Subdivision tracts are located on a low terrace above the river.

Establishing a riparian buffer along the upper end of the Circle T Subdivision Home Owners Assn. Park would stabilize the eroding river bank.

Recommendations: Priority: Medium

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Suggested program topics would be noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly run by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

HOA Park: A riparian buffer between the river and the upper HOA Park (~ 300 feet long by 20+ feet wide) should be established using native riparian woody plants (i.e. black cottonwood, alder, sandbar willow, chokecherry, etc.).

Breach the downstream cobble dike on the HOA Park to reconnect the river to the historic flood channel.

Site LSR-9 Small Tracts – SID Bridges Subdivision

(Lower Stillwater River – Map #1)

This subdivision consists of 7 small tracts set along the north river bank, accessed via the North Stillwater Road. The tracts vary in size from 0.2 to 0.6 acre, all densely developed with houses, driveways, and landscaping. Clearing and landscaping have significantly reduced the native riparian plant community. Several tracts have pumps in the river or shallow wells for lawn watering. Approximately 770 feet of river bank are being impacted by the subdivision. The property was subdivided before 1975, prior to mandatory subdivision review.

All tracts lie within the 100-year floodplain with houses and outbuildings generally off-set more than 100 feet from the river's edge. Cobble rip-rap and a retaining wall have been built along 180 feet of river bank on the lowermost tract. Hand-placed cobble line the river bank on the other tracts. An irrigation waste water ditch branching off the Garrigus Ditch passes through the subdivision.

Upstream from the developed tracts, a 3.8-acre tract has not been developed. A short high-water channel passes through it with a series of old cobble jetties on its north bank. This tract also lies within the 100-year floodplain.

Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually minor, but multiple small tracts in a relatively old subdivision cumulatively pose a long-term risk to the Stillwater River.

Retaining walls, bank armor, and floodplain dikes have been installed to shield subdivision tracts from river migration and flooding.

Recommendations: Priority: High

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Program topics would include noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly sponsored by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-10 Bank Erosion – North Stillwater Road (Lower Section)

(Lower Stillwater River – Map #1)

Site LSR-10 is comparable to Sites LSR-4 and LSR-7 in that the North Stillwater Road closely parallels the river. On the upper end of Site LSR-10, 475 feet of the North Stillwater Road sits vertically above the river by as much as 8 feet. The edge of the road berm is as close as 2 feet from the river channel. The river bank is intermittently armored with large concrete rubble and round cobbles, most of which have sloughed down the steep bank into the channel. A gas transmission pipeline is buried along the road ROW.

Both the county road and gas pipeline are vulnerable to future bank erosion. Protecting this road is an on-going issue for the county and local landowners. Public safety is also an issue given the proximity of the road to the river.

The lower end of Site LSR-10 is armored with 670 feet of rock rip-rap comprised of large cobbles and boulders. Some brush has also been piled between the road and the river bank. Downstream from where the county road bends east, a 3-4-foot-high cobble dike restricts over-bank flows from accessing the historic floodplain. The dike is protecting a house on the downstream floodplain; however, it may also be contributing to terrace instability on the downstream south bank (lower end of Site LSR-8).

The river bank is actively eroding along the North Stillwater Road.

Rock rip-rap and a cobble dike on the lower end of Site LSR-10 are preventing high flows from accessing the historic floodplain.

Recommendations: Priority: High

1) Existing rock/concrete rip-rap: Carefully place angular rock of mixed sizes within the existing matrix of rock/concrete rip-rap to prevent further scouring and sloughing. Maintain a minimum 2:1 back slope for stability.
2) Flow Deflectors: Placing rock rip-rap on the eroding bank may be challenging as there is not always sufficient room between the river and road to accommodate a 2:1 back slope. To attain a stable back slope, the rock rip-rap would need to encroach into the existing channel or the county road would need to be relocated slightly north. Another option would be a series of well-designed flow deflectors placed along the full length of the site. Flow deflectors would be the least expensive option when compared to blanket rock rip-rap or road relocation, but they do carry a slightly higher risk of failure. The design, spacing, and placement of flow deflectors on the outside bend of this site is especially critical.
3) Vegetated Bank: Some of the river bank is stable due to small trees and shrubs growing along the toe of the bank. Potential bank instability exists where larger trees are being undermined by high flows. When these trees eventually fall into the river, the exposed root balls and debris make the river bank more vulnerable to erosion. Trees currently being undermined and leaning towards the river should be cut with the stump/root ball left in-place. The cut debris should be

removed from the river. In time, young sprouts will grow from the root ball contributing to future bank stability.

4) Stakeholder Collaboration: There appears to be confusion over who has the responsibility and authority to stabilize the river bank along the county road. Stillwater County is encouraged to collaborate with adjacent landowners, Montana Fish, Wildlife and Parks, and the Stillwater Conservation District on a road protection plan for Sites LSR-4, LSR-7, and LSR-10. The agreed-upon approach should be proactive and long-lasting.

4.2 Reach LSR2

Site LSR-10 (near Rosebud Creek Confluence) to Site LSR-30 (Whitebird Fishing Access Site): 6.5 miles
(Lower Stillwater River – Maps #1-3)

Geology/Soils: The Stillwater Valley is over 1-mile wide on the upper end of Reach LSR2 where Beaver Creek enters from the south and Buck Creek from the north. The valley is bordered on both sides by the Lebo Member, Fort Union Formation which is a relatively soft shale and claystone interbedded with sandstone and siltstone lenses. The valley fill includes alluvial gravels from both river deposits and deposits brought in from side tributaries. The valley has a surface layer of loam and clay loam soils over 5 feet deep.

Downstream from Buck Creek, the upland geology transitions into the Tullock Member, Fort Union Formation, a more resistant ledge-forming sandstone. In response to this geologic change, the Stillwater River Valley narrows to less than 4,000 feet. Along the south margins of the river valley, alluvial gravels are deposited in fans (up to 50 feet deep) from upland sources. The river corridor and floodplain are predominantly a mix of river-deposited silt, gravel, and cobble.

The Tullock Member Formation is characterized by steep upland benches that rise over 300 feet above the valley bottom. On these high benches, scattered deposits of old alluvial gravels are up to 20 feet thick.

Land Use: Since the 1890s, the valley and river bottom have been in agricultural use. Multi-tract development has not occurred except for the Riverside Subdivision (Site LSR-14). Irrigated hay or pasture production is supported by five irrigation ditches that have been in operation for over 110 years. Demographics have changed over the last 40 years from traditional multi-generational families with large ranches to new landowners acquiring smaller ranches.

Channel Characteristics: The channel gradient transitions from 0.75% on the upper end to 0.63% on the lower end. Channel sinuosity (channel length/ valley length) remains relatively straight at 1.1, comparable to Reach LSR1. Below the Riverside Inn Bridge (Site LSR-15), the river becomes more braided with the main channel, side channels and mid-channel islands shifting back and forth over time.

The channel substrate is primarily small cobbles and gravel. Channel features are long riffles (fast and shallow) with intermittent small pools (slow and deep) found on outside bends or behind in-channel structures such as flow deflectors.

Very little in-channel woody debris is present due to high velocity flows that flush it downstream. Woody debris is commonly found on the adjacent floodplain deposited during out-of-bank flood events.

Rock rip-rap and floodplain dikes are often associated with houses and roads located too close to the river's edge. At other locations, old floodplain dikes, flow deflectors, and rock rip-rap were constructed to protect agricultural land. There are two sites where large dikes have been constructed to create wetlands.

Riparian Characteristics: The riparian corridor ranges from a narrow band of trees and shrubs to large patches of cottonwood trees. During the first half of the 20th century, the riparian forest was partially cleared to accommodate new cropland and pasture fields. Less riparian clearing has occurred in the last 70 years.

The riparian overstory is predominantly native black cottonwood trees. Where the riparian forest is being well-managed, a healthy understory of thin leaf alder, juniper, snow berry, chokecherry and black cottonwood seedlings is common. In sub-irrigated areas, reed canarygrass and meadow foxtail have crowded out nearly all other vegetation.

The riparian forest is generally in good condition with two exceptions: small pens where livestock is concentrated, and larger riparian pastures being damaged by unmanaged livestock use. Both situations hinder new shrub/tree growth and promote river bank instability.

An open black cottonwood riparian corridor without understory vegetation is not be sustainable.

Noxious Weeds:

- Canada thistle, leafy spurge, mullein, and houndstongue infestations are widespread along the river corridor and adjacent floodplain. Spotted knapweed is more common on dry gravel areas and disturbed sites. Birdsfoot trefoil (an old pasture legume), yellow toadflax, and burdock are also present, but less frequent.

Reach Recommendations: Priority: High

Riparian pasture management is essential for long-term sustainability of the riparian forest. Permanent/portable fencing and water developments may sometimes be necessary to properly manage riparian pastures. Where small holding pens are located directly on the river, relocating them outside the river corridor or permanently fencing the river bank out may be the only viable options. The Columbus NRCS Office can assist with a riparian grazing management plan that would be based upon site-specific conditions and landowner objectives.

Portable electric fencing is an inexpensive method to effectively manage livestock in the riparian corridor.

Noxious Weed Control: Whether a small subdivision tract, hay field or large riparian pasture, river corridor stewardship requires an aggressive program to control noxious weeds and invasive plants. Stillwater County Weed District personnel are available to assist landowners with the development of a site-specific weed management plan.

Site LSR-11 Corral

(Lower Stillwater River – Map #1)

The corral system is located on the north side of the North Stillwater Road. The county road lies between the corral and the river. A drain ditch diverts run-off and irrigation return flows out of the corrals, through a road culvert and directly to the river. Elevated levels of nutrients from the corrals are likely reaching the river.

Irrigation waste water and surface runoff from corrals pass through a county road culvert to the river.

<u>Recommendations:</u> Priority: High

The landowner is encouraged to have the Columbus NRCS Office complete an evaluation of the corral system to suggest options to redirect irrigation waste water before reaching the corral and to contain snowmelt and rain runoff.

Site LSR-12 Bank Stabilization – Rock Rip-Rap
(Lower Stillwater River – Map #1)
Rock rip-rap has been placed along 750 feet of the Stillwater River's north bank. The North Stillwater Road runs parallel to the river and sits vertically above the channel by as much as 15 feet. The rip-rap consists of mixed-sized angular rock that was poorly placed on a steep slope. As a result, some rock has sloughed into the channel making the bank vulnerable to erosion

On the north side of the county road, NorthWestern Energy operates a natural gas compressor station designated Absarokee Compressor Station #054-1. The station, formerly owned by the Montana Power Company has been in operation for over 65 years. Associated with the compressor station is a concrete sump embedded in the rock rip-rap that provides water to the facility. On the lower end of the site, a gas transmission pipeline crosses beneath the river. The pipeline's age, depth below the river bottom, and type of material is unknown.

Rock rip-rap placed between the river and the North Stillwater Road.

Recommendations:
None

Site LSR-13 Irrigation Headgate/Diversion – Roadhouse Ditch
(Lower Stillwater River – Map #1)
The Roadhouse Ditch headgate is located on the south river bank. The headgate has been recently replaced with a concrete structure and two slide gates, placed ~20 feet into the ditch. Remnants of the previous structure can be seen in front of the headgate. A large rock diversion extends ~ 50 feet into the channel at a 45° upstream angle towards a mid-channel gravel bar.

Extensive armor on the opposite bank (Sites LSR-12 and LSR-14) prevents the river from migrating helping maintain river alignment at the headgate.

Downstream from the headgate, ~ 1,100 feet of rock rip-rap and a ditch berm buffer the Roadhouse Ditch from the river. The rip-rap consists of large angular rock placed along the dike that is about 8 feet high. The lower 200 feet of rip-rap veers away from the ditch berm, directing flows towards the Riverside Inn Bridge (Site LSR-15). Short sections of rip-rap have sloughed down the bank; however, most of it remains intact.

History: In 1893, James Herrington and Joseph Hundley filed on 1,000 miner's inches to be diverted from the south bank of the Stillwater River about ½ mile upstream from the mouth of Beaver Creek. The system was described as a dam and ditch. The intended place of use was given as lands on the recently ceded portion of the Crow Indian Reservation. The Roadhouse Ditch Company was subsequently formed in 1912 to serve five farms. The original headgate as shown on the 1900 Government Land Office Survey Map appears to be in same general location as it is today.

The Roadhouse Ditch headgate was recently replaced with a concrete structure and slide gates.

Downstream from the Roadhouse headgate, a large dike faced with rock rip-rap prevents the river from breaching into the Roadhouse Ditch.

<u>Recommendations:</u> Priority: Low

The Roadhouse Ditch irrigation system is over 120 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

Site LSR-14 Small Tracts – Riverside Subdivision
(Lower Stillwater River – Map #1)
The Riverside Subdivision consists of 7 small tracts along the north river bank that are accessed via the North Stillwater Road. The tracts vary in size from 0.3 to 0.4 acre; all have been developed with houses, driveways, and landscaping.

Approximately 1,150 feet of river bank is affected by the subdivision. The property was subdivided before 1975, prior to mandatory subdivision review.

Most tracts lie within the 100-year floodplain with houses and outbuildings generally less than 30 feet from the river's edge. As a result, nearly every tract is lined with cobble rip-rap and dikes to protect the structures from river migration and flooding. Bank armor on the opposite side of the river (Site LSR-13) may direct higher flows and more frequent flooding along the subdivision.

Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually minor, but multiple small tracts in a relatively old subdivision cumulatively pose a significant risk to the Stillwater River.

Nearly all the Riverside Subdivision tracts have cobble rip-rap and dikes lining the river bank.

<u>Recommendations:</u> Priority: High
Information/Education: The initiation of a small tract outreach and assistance program will help landowners better understand how to minimize their impacts on the river. Program topics would include noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly sponsored by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-15 Stream Crossing – Riverside Inn Bridge
(Lower Stillwater River – Map #1)
The current Riverside Inn bridge was relocated 380 feet upstream in 2001. It is a 181-foot prestressed concrete bridge that is part of the North Stillwater Road. The bridge foundation includes concrete abutments and three sets of in-channel supports. There is ~ 400 feet of rock rip-rap along the north bank, upstream from the bridge. This rip-rap, in addition to the bank armor on the south bank, described under Site LSR-13, maintains river alignment to the bridge.

A US Geological Survey (USGS) gage station is located on the downstream side of the bridge. It is designated as "USGS 06205000 Stillwater River near Absarokee, MT." The gage station was installed after 2001 when the new bridge was built. The old gage station was located 2 miles downstream.

History: Prior to 2001, the bridge crossing was located 380 feet downstream from its current location. Old bridge abutments are still evident on both sides of the river. The Government Land Office Survey Map shows a bridge crossing at this same location as early as 1900. In the early 20th century, the Riverside Inn was built near the south bridge approach. The Beaver Creek School was located on the north side, a short distance from the river.

Riverside Inn Bridge is a prestressed concrete bridge built in 2001.

Recommendations:
None

Site LSR-16 Jeffrey's Landing Fishing Access Site (FAS)
(Lower Stillwater River – Map #2)
This 3.7-acre Montana FWP Fishing Access Site is located on the south bank downstream from the Riverside Inn Bridge (Site LSR-15). The FAS has a concrete boat ramp and a large parking area. It was opened in 2009.

The Jeffrey's Landing Fishing Access Site includes a concrete boat ramp.

Recommendations:
None

Site LSR-17 Bank Stabilization – Rock Rip-Rap & Dike
(Lower Stillwater River – Map #2)
West Bank: Old rock rip-rap and a cobble dike line ~ 700 feet of river bank east of the Scollard buildings. During the winter of 2017, ice jams caused out-of-bank flooding on the west bank.

Upstream, near the Miller Road intersection, another segment of rock rip-rap, ~ 360 feet long, buffers a ranch road from the river.
East Bank: The hay field next to the river is flood irrigated causing the river bank to become saturated. When saturated, sections of river bank actively slough. Small head cuts and scars from over-bank irrigation return flows are also evident. Despite the active sloughing, the river bank has receded very little over the last 20 years.

West Bank: Old rock rip-rap lines the river bank along a horse pasture.

East Bank: Sloughing of the bank is caused by irrigation-induced saturation.

Recommendations: Priority: Medium
East Bank: Complete an evaluation of the irrigated field to consider options for improving water efficiency and bank stability.

1) Establish a native shrub/tree buffer between the field and the river bank that is 20+ feet wide. In addition, construct rock-lined drops into the river for irrigation waste water. The use of gated pipe would improve water management under a flood irrigation system.

2) Excessive water infiltration and bank saturation would be significantly reduced by converting the existing flood irrigation system to sprinkler irrigation. The Columbus NRCS Office or local sprinkler dealer could help evaluate the feasibility and cost effectiveness of this option.

Site LSR-18 Irrigation Headgate – Nichols Ditch
(Lower Stillwater River – Map #2)
The Nichols Ditch headgate is located on a secondary channel that loops south of the Stillwater River mainstem. The headgate is an old concrete structure reinforced with steel braces. The amount of water entering the headgate is controlled using a wood slide gate and a check structure with removable boards. The structure is in good condition with slight scouring under the wall footings. The headgate is set 165 feet down-ditch from the channel. Cobble diversions are periodically used in both the mainstem and secondary channel to direct late season flow towards the headgate.

History: The irrigation system is not shown on the 1900 Government Land Office Survey Map; however, the earliest recorded priority date for irrigation water associated with the Nichols Ditch is April 1893.

Beaver Creek enters the secondary channel ~ 430 feet upstream from the Nichols Ditch. The creek originates in Carbon County and travels 14.6 miles before entering the Stillwater River. It is considered to have perennial flows although summer flows are often less than 1 cfs. The sources of water are springs and irrigation waste water. The creek channel is vertically incised due to hydrologic alterations (irrigation waste water that augments summer flows) over the last 100+ years and fewer numbers of beaver dams.

The Nichols Ditch headgate is an old concrete structure that still functions well.

<u>Recommendations:</u> Priority: Low
The Nichols Ditch irrigation system is over 100 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

Site LSR-18A Irrigation Headgate/Diversion
(Lower Stillwater River – Map #1)
This Irrigation headgate/diversion is located upstream from the Nichols Ditch on the same secondary channel. The headgate diverts water to a 20-acre field on an "island" accessed by a private bridge

(Site LSR-19). The field and irrigation system were likely developed in the late 1920s as the recorded water rights priority date is 1930.

Recommendations:
None

Site LSR-19 Stream Crossing – Private Bridge
(Lower Stillwater River – Map #2)
The bridge appears to have been built within the last 20 years. It is 80 feet long with concrete beams resting on concrete abutments and a mid-channel support. The bridge is ~ 7 feet above the channel bottom. Woody debris caught on the mid-channel support has created a sediment island on the upstream side. During high water the island deflects high energy flows towards the bridge abutments.

The mid-channel bridge support has created an upstream sediment bar.

Recommendations: Priority: Low
When the bridge is eventually replaced, the new bridge should span the channel without the need for a mid-channel support.

Site LSR-20 Bank Stabilization – Floodplain Dikes
(Lower Stillwater River – Map #2)
This site encompasses a series of bank stabilization and floodplain dikes on both sides of the Stillwater River along a 1-mile reach. The individual sites are labeled A through K on Map #2.

Site A – north river bank: ~ 600 feet of old cobble rip-rap lines the bank near a ranch road, buildings, corrals, and hay yard. The rip-rap is intact and mostly covered in vegetation. There is an old gravel/cobble dike on the lower end. The corrals on the north side of the road are ~ 45 feet from the river.

Site B – north river bank: ~ 140 feet of rip-rap armors a sharp 90° bend. The rip-rap is comprised of mixed-sized angular rock, mostly intact. Because of the sharp bend, a backwater eddy has created a gravel bar along the north bank.

Site C – north river bank: 4 flow deflectors (jetties) are spaced out along 440 feet of bank. The deflectors are constructed of large angular rock. It is unclear why flow deflectors were installed as most straight channels are inherently stable. The flow deflectors do provide fish habitat.

Site D-south river bank: The ~ 140-foot long cobble floodplain dike restricts out-of-bank floods from crossing an adjacent hay field and perhaps creating an avulsion (cutting a new channel) to the secondary channel.

Site E-south river bank: 4 large rock flow deflectors (jetties) are spaced along 440 feet of an outside bend. The deflectors extend off a floodplain dike described at Site D. The deflectors point downstream at a 45° angle. Some bank scouring has occurred on the downstream side of each deflector due to backwater eddies. They were installed prior to 1975, possibly to prevent the river from migrating into the adjacent hay field. The deflectors appear to be working as intended.

Large rock flow deflectors (jetties) are causing backwater eddies that result in bank scouring.

Site F-south river bank: ~ 700 feet of large rock rip-rap was installed prior to 1975 to protect the adjacent hay field. Bank scouring and rock sloughing have occurred.

Site G-north river bank: A series of large cobble dikes, up to 30 feet wide, were constructed near the mouth of Buck Creek. Shallow wetlands have formed behind the dikes. The 1955 USGS topographic map shows that the main river channel passed through the current location of the dikes and wetlands. Between 1955 and 1975, the river channel shifted ~400 feet southeast. This channel shift may have prompted bank protection measures on the south river bank as discussed under Sites F, H, and I.

A large floodplain dike and wetlands located near the mouth of Buck Creek.

Site H-south river bank: An old cobble dike boarders an inside bend extending off rock rip-rap described at Site F. The dike is about 1-3 feet high and 280 feet long. It may have been built to prevent out-of-bank flooding from reaching a nearby hay field.

Site I-north river bank: 4 large rock flow deflectors (jetties) were spaced along 330 feet of a 20-foot-high terrace bank. Minor scouring has occurred between the deflectors due to backwater eddies. The uppermost flow deflector was installed at the mouth of Buck Creek.

Buck Creek is about 5 miles long. The lower end is designated a perennial stream fed by springs and seasonal irrigation water from the Garrigus Ditch.

Site J-south river bank: ~ 190 feet of rock rip-rap and 500 feet of cobble rip-rap/floodplain dike (2-3 feet high) are located upstream from where the secondary channel enters the Stillwater River mainstem. Bank scouring and rock sloughing are evident on these old features. The first segment of rip-rap was probably installed to prevent the river from eroding into the adjacent hay field, but it is unknown why the cobble rip-rap/floodplain dike was built.

Site K-north river bank: ~ 570 feet of rock rip-rap is located across the river from the mouth of the secondary channel. The rip-rap includes large rock intermittently placed along the river bank on a straight reach of river. Minor bank scouring and rock sloughing have occurred.

Rock rip-rap has been intermittently placed along a naturally stable cobble bank.

Recommendations:
None

Site LSR-21 Floodplain Dike & Rock Rip-Rap
(Lower Stillwater River – Map #2)
There are 350 feet of floodplain dike and rock rip-rap located immediately upstream from a braided river channel. A 3-4 feet high cobble/gravel dike is located on the upper half of the site with rock rip-rap intermittently placed on the lower half. High water restriction to the historic floodplain and armoring of the river bank have contributed to the braided condition of the channel and the unstable river banks downstream.

Downstream from Site LSR-21, the river was once a single-threaded channel. Over the last 60 years, it has transitioned into a braided channel. The south channel has become the mainstem. It is very wide with several mid-channel gravel bars. The river has migrated ~ 80 feet into the south floodplain over the last 20 years. Foot bridge abutments are still evident on the south channel.

North Bank: An old cobble dike, 340 feet long, was constructed on an inside bend across from Site LSR-21. Further downstream on the braided section, the river has migrated ~ 70 feet north over the last 40 years, prompting the landowner to move a ranch road and armor 630 feet of a low terrace river bank with rock rip-rap.

Cobble dike piled on top of the river bank prevents high water access to the historic floodplain.

Recommendations:
None

Site LSR-22 Bank Erosion
(Lower Stillwater River – Map #2)
Erosion of the south river bank is due to heavy livestock use and an absence of riparian vegetative cover. A series of aerial photography from 1951 to 2015 show that the river corridor has steadily declined from a dense riparian forest to a thinly scattered remnant of cottonwood trees.

On the downstream bend, the channel becomes braided. Within the last 40 years, the main channel has directed more erosive flows toward the south river bank.

The river bank is actively eroding due to heavy livestock use and an absence of riparian vegetation.

Recommendations: Priority: Medium
Build a riparian fence (portable electric) along 2,300 feet of bank to allow the riparian plant community to recover. Incorporate a water gap or develop off-stream livestock water as needed. Planting young cottonwood seedlings and native shrubs would hasten recovery.

Site LSR-23 Corral

(Lower Stillwater River – Map #2)

An old corral system borders a side channel along the south river bank. It was recently replaced with a new set of corrals to address water quality concerns. The new corrals are over 200 feet from the river and outside the floodplain. Riparian fencing and a water gap were also part of the project.

Mexican Joe Creek enters the Stillwater River on the south bank near the new corrals. The creek is ~5 miles long. It is designated as a perennial stream on the lower 1.2 miles, mostly fed by springs and irrigation waste water. Both the Roadhouse Ditch and Nichols Ditch cross the creek.

History: Mexican Joe Creek was named in tribute to Jose Pablo Torjie, also known as "Mexican Joe". He was a member of a crew cutting timber for the Crow Agency in the Whitebird area. On July 2, 1875 Torjie fell from his horse during a confrontation with a group of raiding Lakota. When the shooting was over, the crew was unable to find him. A year later, his body was found beside what is now known as Mexican Joe Creek.

North bank: An old abandoned meander trace is evident on the north side of the river. High water channels also line both sides of the Stillwater River mainstem. Although this section of river has historically been very dynamic, only minor changes have occurred over the last 115 years.

Orson Coulee is ~ 5 miles long, entering the Stillwater River on the north bank. It is considered to have intermittent flows from runoff during snowmelt and high precipitation events. The Garrigus Ditch crosses the coulee near the north valley fringe. Once Orson Coulee enters the Stillwater River valley, a defined channel is hard to distinguish.

A new water gap was included with the recent corral relocation project.

The new corral system is set back from the river corridor and out of the floodplain.

Recommendations:
None

Site LSR-24 Irrigation Headgate – Whitebird Ditch
(Lower Stillwater River – Map #3)
The Whitebird Ditch headgate is on the south river bank. The headgate is an old concrete structure with a metal slide gate. It is in good condition with minor scouring under the wall footings. The structure was placed ~50 feet off the river channel. Woody debris and sediment may collect in front of the headgate and need to be periodically removed.

Rock rip-rap lines ~ 400 feet of river bank upstream from the headgate. The rip-rap consists of mixed-sized angular rock. Downstream from the headgate, a large dike buffers the river from the Whitebird Ditch. It extends over 600 feet from the headgate down to a side channel dike (Site LSR-25). Infestations of spotted knapweed and yellow toadflax are scattered along the ditch berm.

History: The Whitebird irrigation system was constructed prior to 1900. The point of diversion and ditch depicted on the 1900 Government Land Office Survey Map appear to be unchanged from its current location.

The Whitebird Ditch headgate set into the south river bank.

Recommendations: Priority: Low

The Whitebird Ditch irrigation system is nearly 120 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

Site LSR-25 High Water Channel Dike – Wetlands

(Lower Stillwater River – Map #3)

A 145-foot long by 15-foot high dike blocks a historic high-water channel on the south river bank. The old channel is 3,300 feet long with a series of 4 constructed wetlands separated by small dikes and culverts. The channel dike was built in the late 1940s or early 1950s to protect the Whitebird Ditch from being breached by the river. 1951 aerial photography shows this high-water channel with standing water and bare gravel bars, indicating that it was active during high flow events.

The first wetland/dike in the channel was built prior to 1975. The 2nd and 3rd wetlands/dikes were constructed by the Montana Department of Transportation in the spring of 1999 to mitigate wetland impacts associated with the FAA expansion of the Columbus airport and a roadway improvement project between Absarokee and Columbus. The dikes impound irrigation water from the nearby Whitebird irrigation ditch and groundwater. The wetlands created by these two dikes encompass 9.7 acres that include 5.6 acres of shallow open water (< 6 feet deep). Over the last 18 years, the open waters have gradually decreased because of emergent wetland plant encroachment. The 3rd dike also serves as a roadway for ranch operations and access to a house (Site LSR-26) north of the wetlands. There is a 4th wetland below the roadway that appears to have been artificially enhanced sometime during the 1990s.

Infestations of Canada thistle, spotted knapweed, houndstongue, leafy spurge, and mullein are common across this site.

Upstream from the high-water channel dike, an additional 600 feet of dike extends upstream to the Whitebird Ditch headgate (Site LSR-24). Downstream from the channel dike, over 1,100 feet of dike and rock rip-rap (Site LSR-26) border an outside bend. The two dikes prevent flood water from entering the old high-water channel and the possible breaching of the river mainstem into the old high-water channel.

A large dike was built across a high-water channel over 60 years ago to protect the Whitebird Ditch.

A series of four wetlands have been constructed in the old high-water channel.

Recommendations: Priority: Low

For optimal wildlife habitat, shallow open water is a critical component in wetland areas. If the shallow open water is significantly diminished by the encroachment of emergent wetland plants, the eventual removal of built-up sediment and emergent plants may be necessary to retain good habitat.

This site requires aggressive weed control measures to address noxious weed infestations throughout the area.

Site LSR-26 Bank Stabilization – Floodplain Dike & Rock Rip-Rap

(Lower Stillwater River – Map #3)

Approximately 1,100 feet of rock rip-rap have been placed along the east river bank. The upper half of this site includes a floodplain dike that begins at the high-water channel dike described in Site LSR-25. A house built on the lower end of the site is about 40 feet from the armored bank.

West Bank: The Garrigus Ditch ends on the west terrace, north of Site LSR-26. A 250-foot dike and water control gate are used to distribute the remaining ditch water on a floodplain pasture. The river mainstem passed along the dike in the early 1950s, but has since shifted nearly 250 feet east.

On the downstream bend, an eroding terrace, ~1,100 feet long by 20-25 feet high, is a significant source of sediment to the river. The sediment coming off the terrace is fine silt that is usually flushed downstream; however, large point bars have formed at the base of the terrace from coarser sediment.

Rock rip-rap lines a long section of the east river bank.

Recommendations:
None

Site LSR-27 Irrigation Headgate – Brown Ditch
(Lower Stillwater River – Map #3)
The Brown Ditch headgate sits on the north bank along a braided section of river. The headgate is a concrete structure with a metal slide gate. The gate leaks, but overall, the structure is in relatively good condition. The irrigation system is used by a single water-user. Outside the irrigation season, ditch water is used for livestock and is diverted into a series of small ponds on the lower end of Norve Coulee.

The headgate is located where a secondary channel merges with the main channel. This mergence creates a backwater effect resulting in gravel buildup at the headgate. The gravel deposit helps direct low flows to the headgate, but over time, the removal of excess gravel may become necessary to keep the headgate open.

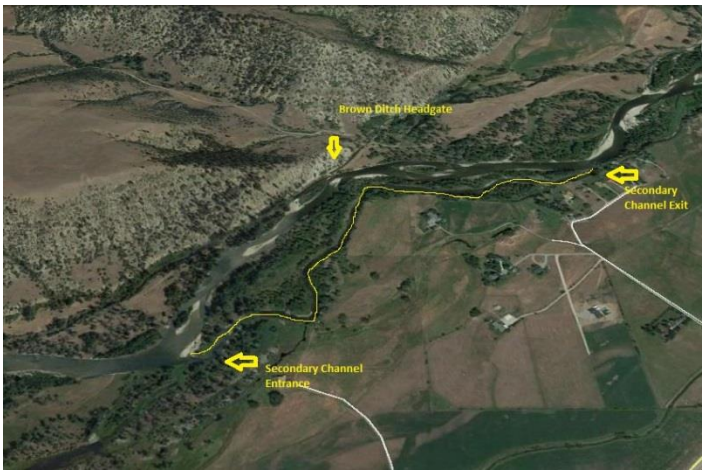
Upstream from the headgate, ~1,200 feet of rock rip-rap lines a ranch road built along the toe of the valley wall. The rip-rap is generally intact, but minor sloughing has occurred in places. At the upper end of the rip-rap, a large-rock flow deflector partially diverts low flows away from the secondary channel that conveys water to the Brown Headgate. Its original purpose may have been to reduce erosive flows along the ranch road above the headgate, although now, the road is rip-rapped making the deflector no longer needed.

From the flow deflector upstream to Site LSR-26, short segments of old rock rip-rap and dike have been intermittently placed on both sides of the river. They have become largely ineffective.

Extending downstream from the Brown Headgate is ~100 feet of rock rip-rap. A short distance further, cobble/gravel dikes were built many years ago to block off two small flood channels.

The river is very dynamic along this reach and will likely create future challenges in maintaining adequate flow to the headgate. Since the flood channel described in Site LSR-25 was blocked several decades ago, the main channel has become more braided. As late as 1975, the main river channel passed next to the headgate. Over the last 40 years, the river has become more braided with the mainstem channel shifting south.

A secondary channel along the south bank could eventually be breached become the main channel. The secondary channel currently merges with the main channel at Site LSR-28, downstream from the headgate. If the main channel does breach into this secondary channel, the river could shift even further from the Brown Headgate.



The secondary channel is shown on the south side of the river (yellow line). If breached, the main river could shift away from the Brown Ditch headgate.

Norve Coulee is an intermittent stream with its headwaters near Huntley Butte. The coulee runs about 4 miles on a southeasterly course before reaching the Stillwater River valley. The coulee enters the Brown Ditch ~ 500 feet down from the headgate. An overflow channel on the ditch passes high run-off flows back into the old coulee channel.

History: Water rights filed on the Brown Ditch date back to 1893. The irrigation system is depicted on the 1900 Government Land Office Survey Map although it doesn't clearly show the original headgate location. It was most likely at or near its current location.

The Brown Ditch Headgate is located against the north valley wall.

An old flow deflector partially diverts late summer flows away from a secondary channel that conveys water to the Brown Ditch Headgate.

Recommendations: Priority: Medium

Remove rock flow deflector at the head of the side secondary channel that diverts flow away from the Brown Ditch Headgate.

The Brown Ditch irrigation system is nearly 120 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

Site LSR-28 Small Tracts – River Meadows Subdivision

(Lower Stillwater River – Map #3)

This subdivision consists of 9 small tracts along the south river bank. The tracts vary in size from 1 to 3 acres and are located on a low terrace above the 100-year floodplain. Houses are set back over 50 feet from the river. The conversion from agricultural land to a residential subdivision occurred sometime between 1975 and 1996. It was likely reviewed and approved by county officials prior to development. Approximately 1,400 feet of river bank are affected by this subdivision.

About ¼ mile upstream from the subdivision, a secondary channel is close to being breached by the main channel. At one point, less than 70 feet separate the two channels.

Before the subdivision was developed, 1975 aerial photography shows that the main river channel ran along the south bank where the subdivision is now located. Over the last 40 years, the river has shifted slightly north leaving half of the tracts on a new secondary channel and the other half on an outside bend of the main channel. The river bank along nearly every tract has been armored with rock rip-rap. The apex of the bend is slowly migrating downstream which may cause the river to breach into another secondary channel downstream from the subdivision.

Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually small, but several small tracts together cumulatively pose a significant risk to the Stillwater River.

All River Meadows Subdivision tracts are located on a high river bank above the 100-year floodplain.

Recommendations: Priority: Medium

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Suggested program topics would be noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly run by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-29 Irrigation Headgate – Scott Ditch

(Lower Stillwater River – Map #3)

The Scott Ditch headgate is located on a secondary channel on the upstream end of the Whitebird Fishing Access Site (Site LSR-30). The headgate is a concrete structure with a metal slide gate. Over the last 65 years, the river has gradually shifted south making the secondary channel progressively larger. A cross-channel concrete check structure was part of the headgate system when the secondary channel was smaller. The check structure has since been replaced with a 40-foot long rock diversion angled 45° upstream from the headgate.

A Parshall flume was placed in the ditch near the Whitebird Fishing Access Site parking area. It is a metal structure with a 4-foot throat that is functional and in good condition.

Upstream from the headgate, a narrow 25-foot riparian buffer separates a heavily-used corral from the river.

History: Water rights filed on the Scott Ditch date back to 1898. The irrigation system is also shown on the 1900 Government Land Office Survey Map. Over 20 years ago, the headgate was relocated to its current site. Its original location was ~600 feet downstream on what is now the Whitebird Fishing Access Site (Site LSR-30). Large rocks remain on the river bank where the headgate once sat.

The Scott Ditch headgate is located near the mouth of a secondary channel upstream from the Whitebird Fishing Access Site.

Recommendations: Priority: Low

Scott Ditch: The Scott Ditch irrigation system is 120 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

Corrals: Upstream corral system: Request the Columbus NRCS technicians to evaluate the existing corral layout to determine if nutrient-rich runoff reaches the river; and, if so, what alternatives may be considered to mitigate the problem. Alternatives may include a riparian buffer and dike containment system.

4.3 Reach LSR3

Site LSR-30 (Whitebird Fishing Access Site) to Site LSR-44 (Countryman Creek Road Bridge): 4.5 miles
(Lower Stillwater River – Maps #4 & 5)

Geology/Soils: The Stillwater Valley averages 3,500 feet wide along this reach, bordered on both sides by the Hell Creek Formation. This geologic formation is resistant bedrock consisting of interbedded, ledge-forming sandstone and mudstone. The valley fill includes alluvial gravels from both river deposits and upland sediments transported in from tributaries. Sediment deposition entering the Stillwater River from east valley tributaries (i.e. Whitebird Creek, Joe Hill Creek, and Shane Creek) has forced the river against the west valley wall.

Soils include gravelly loams of mixed depths along the river corridor with deep clay loams more common on the east side of the valley.

The Hell Creek Formation is characterized by upland hills and benches that rise over 350 feet above the valley bottom. On these high benches, scattered deposits of alluvial gravels are up to 20 feet thick.

Land Use: Since the 1890s, the valley and river bottom have been primarily under agricultural use. Three irrigation systems were built in the 1890s and early 1900s, not long after the Crow Nation ceded their lands south of the Yellowstone River. Since the 1960s, three small-tract subdivisions have been developed. Two subdivisions are pre-1975 with most of the houses and landscaping within the 100-year floodplain. Nearly 40% of the river along this reach has small tract impacts that include septic drain fields, riparian clearing, bank armoring, floodplain diking, and invasive weed infestations.

Channel Characteristics: The average channel gradient is 0.62%, essentially the same as Reach LSR2. Channel sinuosity (channel length/valley length) remains relatively straight at 1.05, slightly less than Reach LSR2. The river meanders very little due to alluvial deposition from the east tributaries forcing the river against the west valley wall. Sinuosity is further restricted by side and flood channel dikes constructed over the last 100 years.

The channel substrate is primarily small cobbles and gravel. Channel features are long riffles (fast and shallow) with intermittent pools (slow and deep) on outside bends and behind in-channel infrastructure such as flow deflectors.

Large amounts of woody debris enter the river throughout the year, but little remains in the active channel because of high velocity flows that flush it downstream. However, woody debris from out-of-bank flood events are common on the adjacent floodplain.

Rock rip-rap and dikes have been widely used where houses and roads are located too close to the river channel and on the 100-year floodplain. Large dikes and rock rip-rap are also associated with two bridges in this reach intended to maintain river channel alignment.

Old cobble floodplain dikes are common along Reach LSR3. These dikes block historic flood channels intended to protect agricultural infrastructure, roads and houses built on the floodplain.

Riparian Characteristics: The width of the riparian corridor varies from 300 feet to over 1,000 feet with an average of 800 feet. The extent of riparian forest has changed little over the last 65 years; however, forest density has decreased. In the early 20th century, when hay and pasture fields were initially developed, a substantial amount of riparian forest was cleared.

The riparian overstory is predominantly black cottonwood trees with understory vegetation that includes thin leaf alder, snowberry, juniper, chokecherry and young black cottonwood trees. The regeneration of shrubs and trees is crucial for long-term riparian forest sustainability. Currently, the riparian forest is in good condition with two exceptions: small pens where livestock are concentrated and large riparian pastures continuously grazed each summer.

Black cottonwood trees sprouting along the river's edge provide age diversity essential to long term riparian forest sustainability.

Noxious Weeds:

- Canada thistle, leafy spurge, spotted knapweed, and houndstongue infestations are common along the river corridor. Birdsfoot trefoil (an old pasture legume), yellow toadflax, and mullein are also present, but less common.

Reach Recommendations: Priority: High

Riparian pasture management is essential for long-term sustainability of the riparian forest. Permanent/portable fencing and water developments may sometimes be necessary to properly manage riparian pastures. Where small holding pens are located directly on the river, relocating them outside the river corridor or permanently fencing the river bank out may be the only viable

options. The Columbus NRCS Office can assist with a riparian grazing management plan that would be based upon site-specific conditions and landowner objectives.

Noxious Weed Control: Whether a small subdivision tract, hay field or large riparian pasture, river corridor stewardship requires an aggressive program to control noxious weeds and invasive plants. Stillwater County Weed District personnel are available to assist landowners with the development of a site-specific weed management plan.

Site LSR-30 Whitebird Fishing Access Site (FAS)
(Lower Stillwater River – Map #3)
This 5.9-acre Montana FWP Fishing Access Site is located on the south bank. The land was purchased in 1966. The FAS has a concrete boat ramp that is partially washed out. Additionally, it is a poor launch site, especially during low water, due to a large gravel bar that has formed next to the ramp.

Whitebird Creek: Whitebird Creek is a perennial stream, 14.5 miles long, that enters the Stillwater River Valley from the south. Its headwaters are in Carbon County. Old channel traces indicate that the mouth of Whitebird Creek was once located at or near Site LSR-30. The creek now enters the Stillwater River further downstream.

A large gravel bar has formed along the Whitebird FAS making it difficult for floaters to use the ramp.

Recommendations:
None

Site LSR-31 High Water Channel Dikes
(Lower Stillwater River – Map #4)
Across from the Whitebird FAS, is a series of old floodplain and high-water channel dikes along ½ mile of the west bank. They vary in size from small "bulldozer" dikes pushed up from nearby riverbed materials to an 8-foot-high by 15-foot-wide dike. The dikes were built to prevent the river from recapturing old channels and isolating small riparian pastures.

The largest dike, nearly 1,100 feet long, borders 10-15 acres of floodplain pasture. The upper half of the dike is faced with rock rip-rap while the lower half is unprotected. Some rock rip-rap is sloughing off the upper dike and active scouring is occurring along the toe of the lower dike. A series of small

wetlands, fed by groundwater, are located behind the dike. Spotted knapweed plants have spread along the dike berm.

A large floodplain dike blocks a historic flood channel.

Recommendations: Priority: Low

Insert a culvert with slide gate through the large dike to provide high-water flow to the floodplain wetlands behind the dike. This would significantly enhance the wetland's wildlife habitat value while controlling the volume of flood water that enters the old channel.

Site LSR-32 Swinging Bridge Fishing Access Site (FAS)

(Lower Stillwater River – Map #4)

This 6-acre Montana FWP Fishing Access Site is located on the east river bank. The land was purchased in 1959. The FAS has 5 campsites without a designated boat ramp. The FAS name originated from a footbridge that once crossed the river at this location.

The FAS lies on a braided reach of river where a high-water channel bisects the FAS property. Another high-water channel, once the river's mainstem less than 10 years ago, passes along the upstream side of the FAS. The river mainstem recently shifted west leaving this channel dry except during early summer high flows. On the downstream end of the FAS, a secondary channel is kept open by the Shane Ditch water users to maintain adequate flow to the Shane Ditch Headgate (Site LSR-34).

West Bank: Across from the Swinging Bridge FAS on the west bank, a series of large rock flow deflectors have been intermittently spaced along the toe of an 8-10-foot-high terrace. It is not clear why the deflectors were installed, possibly to protect a hay field and ranch road on the terrace. The bank is eroding between the deflectors due to their inadequate spacing. Bank saturation during the irrigation season exacerbates the problem. Exposed bedrock along the bank provides both natural flow deflection and bank armoring.

On the north end of Swinging Bridge FAS, a secondary channel is kept open to maintain flow to the Shane Ditch headgate.

A series of flow deflectors line the west river bank across from the Swinging Bridge FAS.

<u>Recommendations:</u>
None

Site LSR-33 Stream Crossing – Private Bridges
(Lower Stillwater River – Map #4)
There are two bridges at this site. The larger bridge that crosses the mainstem is ~ 120 feet long with steel beams placed on plank-faced, concrete-filled steel cylinder abutments and a mid-channel concrete-filled steel cylinder bridge support. The south abutment encroaches into the channel about 10 feet.

The smaller bridge crosses a secondary channel southeast of the mainstem bridge. This bridge is 55 feet long with steel beams supported on concrete-filled steel cylinder abutments faced with flat rock. The bridge is too narrow for the channel creating a squeeze-point. The backwater effect from this restriction has resulted in a sediment "island" on the upstream side of the bridge. This "island" nearly doubles the width of the channel, directing high flows towards the nearby channel banks and bridge abutments.

The bridges were built sometime between 1951 and 1975 on a braided and dynamic reach of river. The 1951 aerial photography shows this section of river having multiple channels that were in a

constant state of flux. A large dike, 730 feet long X 6-8 feet high, was built upstream of the main bridge confining the river to two channels. Additional dikes have been built downstream from the two bridges.

Upstream from the main bridge, a bedrock shelf serves as a natural vertical grade control. The 3-4 foot drop off this shelf presents a hazard to recreational floaters. A warning sign has been posted upstream from the drop.

A private bridge with a mid-channel support spans the Stillwater River mainstem.

A large sediment "island" on the upstream side of the secondary channel bridge.

Recommendations: Priority: Low

When it becomes necessary to replace the secondary channel bridge, it should be designed to better accommodate high flows and bedload.

Site LSR-34 Irrigation Headgate – Shane Ditch

(Lower Stillwater River – Map #4)

The Shane Ditch headgate is located on a secondary channel, southeast of the main channel. The headgate is a concrete structure with two steel slide gates. A 3-foot high X 45-foot long concrete sill across the channel elevates water to the headgate inlet. The headgate structure is in fair condition; however, a wing wall has separated from the headgate.

The headgate sits on a secondary channel that splits off the main river channel about 3,300 feet upstream on the north boundary of the Swinging Bridge FAS (Site LSR-32). The water users occasionally dredge gravel from the channel entrance to maintain flow to their headgate. When necessary, concrete blocks are used to divert late season flows down the channel. As late as 1975, the secondary channel was the river mainstem passing by the headgate. The mainstem has since shifted northwest away from the headgate.

Rock riprap has been placed on ~ 800 feet of river bank downstream from the headgate. The rip-rap is large angular rock installed over 40 years ago when the main river channel was against this bank. Bedrock has been exposed in the channel bottom.

The Shane Ditch is about 13 miles long. The ditch is siphoned under both Joe Hill Creek and Shane Creek. The canal delivers irrigation water to fields along the lower Stillwater River and into the Yellowstone River valley.

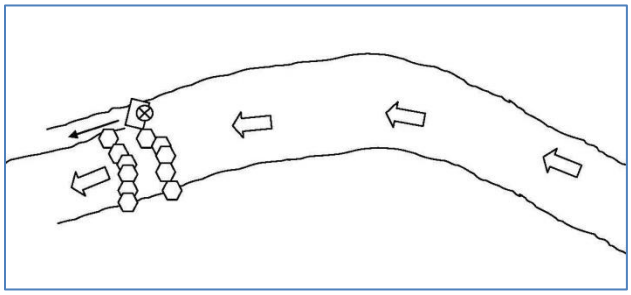
History: The Shane Ditch irrigation system was constructed about 1898 by Thomas Shane. Mr. Shane married a Crow woman named Sarah, settling on the Stillwater River while it was still the Crow Indian Reservation. Prior to 1918, the Shane Ditch Company supplied water to Columbus by means of a siphon across the Yellowstone River. The siphon washed out during the June 1918 flood and was never reconstructed.

Shane Ditch headgate and cross-channel check structure are located on a secondary channel.

A secondary channel on the north side of the Swinging Bridge FAS conveys water to the Shane Ditch headgate. The Shane Ditch water users occasionally use concrete blocks to divert late summer low flows into the channel.

Recommendations: Priority: Medium

1) Check Structure: Replace the cross-channel check structure with a series of 2-3 rock lifts at the headgate. This lift design would provide better long-term stability and accommodate fish passage.



Conceptual drawing of large rock lifts that would replace the concrete sill.

2) Shane Ditch Evaluation: The Shane Ditch irrigation system is nearly 120 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

Site LSR-35 Bank Erosion – Irrigation Saturation

(Lower Stillwater River – Map #4)

Downstream from the bridge described in Site LSR-33, intermittent sections of river bank are actively sloughing along ½ mile of the north bank. This instability is primarily caused by irrigation-induced bank saturation. In some areas, water flows directly out of the bank toe. Additionally, there are several gullies along the edge of the hay field caused by over-the-bank irrigation tailwater. Some gullies have begun to heal on their own; others have been partially filled with concrete slabs and/or cobbles.

The Brown Ditch ends at a coulee on the lower end of this site.

Concrete slabs dumped in an irrigation wash-out intended to prevent further erosion.

Recommendations: Priority: Medium

1) Consult with the Columbus NRCS Office on an irrigation water management plan for the irrigated hay field. The plan would provide guidelines on irrigation set times and frequency to minimize surface and subsurface water loss. Irrigation tailwater control would also need to be a part of the plan.
2) Another option is to convert to hand sprinklers, wheel lines or possibly a small pivot. This would require an initial investment, but improved water efficiency, lower labor costs, and increased crop yields would off-set expenses. The Columbus NRCS Office or a local irrigation company could help determine the feasibility and cost/benefits for such a conversion.

Site LSR-36 Small Tracts – Sutherland Subdivision

(Lower Stillwater River – Map #4)

The Sutherland Subdivision includes 13 small tracts that lie along the south river bank. The tracts vary in size from 0.2 to 3.6 acres and nearly all have been developed with houses, driveways, and landscaping. All, but three, lie partially or totally within the 100-year floodplain. To mitigate the flooding, some tract owners have built houses on stilts and/or armored the bank with cobble dikes. Houses are generally off-set more than 60 feet from the river's edge.

Approximately 2,000 feet of river bank are impacted by this subdivision. The property was subdivided before 1975, prior to mandatory subdivision review. Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually small, but small tracts in a relatively old subdivision cumulatively pose a significant risk to the Stillwater River.

The Sutherland Subdivision tracts lie within the 100-year floodplain making them vulnerable to flooding.

Recommendations: Priority: High

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Suggested program topics would include noxious weed control, water rights, septic field maintenance, riparian forest management, low-impact landscaping, and basic river dynamics. The program could be jointly run by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-37 Bank Stabilization

(Lower Stillwater River – Map #4)

Angular rock rip-rap lines about 500 feet of the east river bank. The rip-rap protects a road and house built less than 50 feet from the river's edge. The rip-rap appears to be less than 20 years old.

Across the river from Site LSR-37, an exposed bedrock shelf crosses a secondary channel with a 2-3-foot drop.

Exposed bedrock shelf traverses a secondary channel.

Recommendations:

None

Site LSR-38 Joe Hill Creek Confluence

Joe Hill Creek is approximately 13 miles long, entering the Stillwater River valley from the south. The Montana Department of Environmental Quality (MDEQ) has recently compiled biological and physical data on Joe Hill Creek related to Montana's water quality standards. Their summary concludes that the upper portions of Joe Hill Creek do not support a healthy fish population due to intermittent flows. The lower section in the Stillwater River valley has perennial flows that should be able to support a fish population. Brown trout are reported to use the last 1/4 mile of Joe Hill Creek.

The lower end of Joe Hill Creek has an over-widened, shallow channel with a silt bottom and narrow riparian zone. Macroinvertebrate samples suggest that Joe Hill Creek is moderately impaired and partially supports aquatic life. A chlorophyll (algae) sample taken at the lower end of the creek also exceeded guidelines for Aquatic Life/Fisheries and Contact Recreation beneficial uses. Dewatering from irrigation and sediment/nutrient inputs from adjacent cropland are reasons given for the listed impairments.

At the Joe Hill Creek confluence with the Stillwater River, a hay field was converted to a private residence about 12 years ago. This conversion included riparian clearing and landscaping to the edge of the creek. The confluence is on an outside bend along a braided section of the Stillwater River. Active terrace erosion is evident on both sides of the Joe Hill Creek confluence. Brush and lawn clippings have been piled on the eroding bank intended to curtail the erosion.

Joe Hill Creek enters the Stillwater River from the south.

<u>Recommendations:</u> Priority: Medium

The Stillwater Valley Watershed Group could contact landowners and irrigation users along Joe Hill Creek to gage their interest in participating in a comprehensive stream assessment to outline options and priorities for addressing the listed impairments.

Site LSR-39 Small Tracts – Dolan Subdivision

(Lower Stillwater River – Map #4)

This subdivision includes 18 small tracts along the east side of the river. The tracts vary in size from 0.7 to 2.7 acres. Most have been developed with houses, driveways, riparian forest clearing, and landscaping.

Approximately 3,900 feet of river bank are impacted by the subdivision. The property was subdivided before 1975, prior to mandatory subdivision review.

Most of the tracts lie within the 100-year floodplain with houses and outbuildings as close as 15 feet from the river's edge. Over 50% of the river bank along the subdivision has been armored with rock rip-rap and/or diked to mitigate flooding.

Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually small, but small tracts in a relatively old subdivision cumulatively pose a significant risk to the Stillwater River.

Most development in the Dolan Subdivision lies within the 100-year floodplain and close to the river's edge.

Recommendations: Priority: High

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Program topics would include noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly sponsored by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-40 Irrigation Headgate

(Lower Stillwater River – Map #5)

This irrigation headgate is located on the west river bank, upstream from a high-water channel. The headgate is a concrete structure with a slide gate and large rock diversion that extends upstream ~40 feet. The headgate structure is in fair condition, although wing wall footing are becoming scoured. The irrigation ditch follows the toe of a large bluff, past the Fireman's Point FAS (Site LSR-42), and into the Yellowstone River valley. An in-ditch water control structure is located 750 feet down from the headgate. The irrigation system has not had much use in recent years. It would be difficult to get sufficient water into the headgate during late summer months and the ditch is choked with vegetation.

Large angular rock rip-rap has been placed on 450 feet of river bank downstream from the headgate between the ditch and river. The lack of size diversity in the rock has resulted in scouring and sloughing of rip-rap down the bank. Bedrock has been exposed in the river bank above the headgate.

History: This irrigation system was constructed prior to 1902. The Government Land Office Survey Map shows that the headgate may have been located several hundred feet downstream from its current location.

The irrigation headgate has a short rock diversion extending into the river channel.

Recommendations:
None

Site LSR-41 Small Tracts – Shane Creek Ranch Subdivision
(Lower Stillwater River – Map #5)
The Shane Creek Ranch Subdivision includes 9 tracts along the east side of the river. The tracts vary in size from 12 to 20 acres. About half of the tracts have houses, driveways, and landscaping, all outside the 100-year floodplain. The riparian corridor and floodplain have had minor disturbance from the subdivision development. The subdivision borders approximately 4,000 feet of river bank.

Shane Creek passes through the subdivision, entering the Stillwater River from the southeast. It is a perennial stream over 13 miles long with its headwaters in Carbon County. Upstream and downstream from the mouth of Shane Creek, 950 feet of rock rip-rap line the Stillwater River.

History: Shane Creek was named for the Thomas and Sarah Shane family who lived near its confluence with the Stillwater River in the mid to late 1800s. Sarah Shane was an enrolled member of the Crow Tribe. When the reservation boundary moved, the Shane Ranch possibly invoked a provision in the Dawes Act that allowed allotments outside the reservation boundary. Heirs of Sarah Shane sold 40 acres of the ranch to the Columbus Volunteer Fire Department in 1919. Today, it is known as Fireman's Point.

Individual subdivision tract impacts to channel stability, in-stream flow, and water quality are usually minor, but multiple small tracts cumulatively pose a significant risk to the Stillwater River.

Most of the development in the Shane Creek Ranch Subdivision has taken place outside the 100-year floodplain.

Recommendations: Priority: Medium

Information/Education: The initiation of a small tract outreach and assistance program would help landowners better understand how to minimize their impacts on the river. Program topics would include noxious weed control, water rights, septic field maintenance, riparian vegetation management, low-impact landscaping, and basic river dynamics. The program could be jointly sponsored by the Stillwater Valley Watershed Council and the Stillwater Conservation District.

Site LSR-42 Fireman's Point Fishing Access Site (FAS)

(Lower Stillwater River – Map #5)

This 162-acre Montana FWP Fishing Access Site is located on the west river bank above the Countryman Creek Road Bridge (Site LSR-44). Land for the FAS was purchased in 1968. The FAS does not have a boat ramp; although, a slide launch for rafts has recently been added. The FAS is a day use only site.

A 6-foot high dike buffers the FAS from the river. The old dike is covered with trees and shrubs with minor scouring along the dike toe. The dike was originally built to maintain river alignment under the Countryman Creek Road Bridge.

Slide launch for rafts was recently added to the Fireman's Point Fishing Access Site.

Recommendations:

None

Site LSR-43 Irrigation Headgate – White Ditch

(Lower Stillwater River – Map #5)

The White Ditch headgate is located on a secondary channel east of the main channel and ~50 feet upstream from the county bridge (Site LSR-44). The headgate is a concrete structure with a Waterman slide gate. A recently constructed cross-channel concrete sill, 2-3 feet high x 60 feet long, raises water up to the headgate inlet. An additional 2 feet of lift can be achieved using jack legs and boards on top of the sill. This has created a large backwater pool behind the cross-channel structure. Downstream from the headgate, another cross-channel concrete sill, ~2-foot high, serves as a grade control structure associated with the bridge. The total lift from the channel bottom at the bridge to the headgate inlet is nearly 6 feet. The headgate structure is in poor condition with wing walls partially scoured and crumbling.

The entrance to the secondary channel that delivers water to the headgate is ~1,400 feet upstream. A rock chute constructed at the channel entrance provides partial control of flows entering the channel. The rock chute ties into bank rip-rap along the Shane Creek Ranch Subdivision (Site LSR-41). The rip-rap prevents the river from flanking the rock chute and capturing the secondary channel. Over the last 65 years, the secondary channel has become progressively larger.

History: The White Ditch irrigation system is shown on the 1901 Government Land Office Survey Map with the original headgate at or near its current location. The ditch conveys water to fields along the lower Stillwater River and into the Yellowstone River valley.

The White Ditch headgate and cross-channel check structure are located on a secondary channel.

The rock chute at the entrance of the secondary channel limits flow to the White Ditch headgate.

Recommendations: Priority: Low

1) Headgate: The headgate structure needs to be replaced in the immediate future.
2) Rock Ramp: Place a rock ramp between the top of the concrete headgate sill and the bridge grade control sill. Remove jack legs and boards after each irrigation season. This lift design would provide long-term stability and accommodate fish passage.
3) White Ditch Evaluation: The White Ditch irrigation system is nearly 120 years old. A comprehensive system-wide evaluation of water conveyance efficiency, infrastructure condition and functionality, fish entrainment, and noxious weed mapping would serve as the basis for a long-term capital improvement plan that would provide prioritization and scheduling of system improvements.

4.4 Reach LSR4

Site LSR-44 (Countryman Creek Road Bridge) to the Yellowstone River Confluence: 1.3 miles
(Lower Stillwater River – Map #5)

Geology/Soils: Reach LSR4 is the lower end of the Stillwater River as it enters the Yellowstone River valley. The geology includes a large alluvial fan of gravels, cobbles, silt, and sand that have been worked and reworked over the centuries by the Stillwater and Yellowstone Rivers. Most floodplain soils near the Stillwater/Yellowstone confluence have 1-3 feet of loam/gravelly loam overlaying gravel and cobbles.

Land Use: The river corridor and adjacent floodplain have been in agricultural use since the 1890s. Small hay fields and an extensive riparian forest dominate the east side. The west side was platted into 20+ acres tracts, but never developed; it continues to be in pasture and hay production.

Channel Characteristics: The average channel gradient for this reach is 0.38%, nearly 40% less than upstream from Fireman's Point. Channel sinuosity (channel length/valley length) increases to 1.3 and is extremely dynamic. Islands form, river banks may erode several hundred feet, and new side channels develop all within a single flood. Old channel traces show that the Stillwater River confluence has historically shifted back and forth over a 2-mile swath. Since 1996, the river confluence has shifted nearly 800 feet.

Due to a low channel gradient and the backwater effect from the Yellowstone River, the Stillwater River channel is wider and more depositional as it nears the confluence. This reach is subject to periodic ice jams during mid to late winter months often resulting in out-of-bank flows and bank scouring.

The channel features include long riffles (fast and shallow) with short pools (slow and deep) on some outside bends. The channel substrate is predominately gravel. Large woody debris is common along the river bank and on most gravel bars.

Floodplain dikes and rock rip-rap can be found along the upper section of Reach LSR4; however, the lower mile is free of bank armor or floodplain restrictions. Across from the Stillwater/Yellowstone confluence, along the north bank of the Yellowstone River, the BNSF railroad right-of-way has been heavily armored. This unyielding feature contributes to the ever-shifting river banks and island formation at the Stillwater/Yellowstone confluence.

The river channel near the Stillwater/Yellowstone confluence is wide and shallow with large gravel bars.

Riparian Characteristics: The riparian forest is up to ½ mile wide on the east side of the river. In the early 20th Century, small patches of riparian forest were cleared to accommodate hay and pasture fields. The amount of riparian forest has increased slightly over the last 65 years. The overstory is primarily black cottonwood trees with an understory of thin leaf alder, snowberry, willows, water birch, chokecherry and young black cottonwood trees.

Noxious Weeds:

- Canada thistle, leafy spurge, and houndstongue infestations are common along the river corridor. Spotted knapweed is often found on irrigation ditch banks and disturbed areas. Russian olive trees along the Yellowstone River are beginning to move up the Stillwater River corridor.

Russian olive trees are common along the Yellowstone River. These invasive plants are beginning to move up the Stillwater River. It is highly recommended that they be eradicated while it is still economically feasible to do so.

Reach Recommendations: Priority: High

Riparian pasture management is essential for long-term sustainability of the riparian forest. Permanent/portable fencing and water developments are sometimes necessary to properly manage riparian pastures. The Columbus NRCS Office can assist with a riparian grazing management plan that is based upon site-specific conditions and landowner objectives.

Noxious Weed Control: Proper river corridor management requires an aggressive program to actively control noxious weeds. The Stillwater County Weed District can assist landowners develop a site-specific weed management plan.

A cooperative effort between the Stillwater River Valley Council, the Stillwater County Weed District, and affected landowners should be initiated to eradicate the Russian olive infestation at the confluence and along the entire length of Reach LSR4.

Site LSR-44 Stream Crossing – Countryman Creek Road Bridge

(Lower Stillwater River – Map #5)

The Countryman Creek Road Bridge on the mainstem channel was built in 1988. It is a 192-foot steel beam/concrete deck bridge sitting on concrete abutments and two mid-channel supports. Debris build-up on the mid-channel supports has created a 350-foot long gravel bar on the downstream side of the bridge. Upstream from the bridge, along the west bank, an old dike borders the Firemen's

Point FAS that maintains river alignment with the bridge. Rock rip-rap on the west bank extends ~130 feet downstream from the bridge to an irrigation headgate (Site LSR-45).
East of the mainstem bridge, a smaller bridge spans a secondary channel. It is located ~50 feet downstream from the White Ditch Headgate (Site LSR-43). The bridge was replaced in 2006 with pre-stressed concrete beams supported on concrete abutments. It is 70 feet long with no mid-channel supports. Rock rip-rap lines both sides of the channel, upstream and downstream from the bridge. A 2-foot-high concrete grade-control sill crosses the channel beneath the bridge.

History: The 1901 Government Land Office Survey Map shows the current bridge crossing as a ford crossing. Another ford crossing was located downstream 1.2 miles at the Stillwater/Yellowstone confluence.

Countryman Creek Road Bridge has mid-channel supports that catch woody debris. A large gravel bar has formed on the downstream side of the bridge.

The bridge across the secondary channel has a cross-channel grade control sill beneath it.

<u>Recommendations:</u>
None

Site LSR-45 Irrigation Headgate
(Lower Stillwater River – Map #5)
The irrigation headgate is located 130 feet downstream from the Countryman Creek Road Bridge (Site LSR-44) on the west bank. It is an old concrete structure with a metal slide gate that is in poor condition. The landowner says the headgate is still used; although, it appears to be limited.

History: This irrigation system is not depicted on the 1901 Government Land Office Survey Map; however, the 1946 Water Resources Survey does show the irrigation system at its current location.

The headgate is in poor condition and should be replaced in the near future.

Recommendations: Priority: Low
The irrigation headgate should be replaced and the entire irrigation system evaluated to determine infrastructure improvements and water efficiency opportunities.

Site LSR-46 Bank Stabilization – Rock Rip-Rap
(Lower Stillwater River – Map #5)
Approximately 500 feet of rock rip-rap line the east bank of a secondary channel. The 40+ year old rip-rap is primarily made up of large angular rock. Rock has sloughed down the bank in several places.

The 1951 aerial photography shows the main river channel passed alongside this bank over 65 years ago. Since then, the river has become more braided with the main channel shifting more to the west. About 500 feet upstream, the main channel could eventually breach into the secondary channel which would result in increased erosive flows along this bank.

Old rock rip-rap lines the east bank of the secondary channel.

Recommendations:
None

Site LSR-47 Bank Stabilization & High-Water Channel Dike
(Lower Stillwater River – Map #5)
Rock rip-rap and a large floodplain dike were built along a sharp river bend sometime after 1975. Rock rip-rap lines ~ 400 feet of the upper half of the bend. A large floodplain dike faced with rock rip-rap is on the lower half of the bend. The dike is about 8 feet high on its upper end and decreases to 3-4 feet high on the lower end. The dike prevents high flows from accessing a complex of historic flood channels and adjacent floodplain. The lower end of the dike is actively eroding where 100 feet of rock rip-rap has sloughed off the bank into the river channel.

A large dike faced with rock rip-rap prevents high-water from accessing historic flood channels.

Recommendations:
None

5. General Recommendations

Bank Stabilization: The lower Stillwater River is a naturally meandering river with eroding banks and shifting channels. Eroding river banks are a natural function of the river that don't always need to be "repaired." Bank stabilization measures may become necessary when buildings or structures are placed too close to the river. The majority of bank stabilization on the lower Stillwater River is associated with small tract development.

Installing bank armor is expensive and often detrimental to nearby properties and the long-term health of the river. Bank stabilization should only be considered when existing infrastructure (i.e. buildings, bridges, roads, etc.) is threatened. For future developments, the prudent selection of suitable building sites set back from the river would eliminate the need for most bank armoring and diking.

The following are bank stabilization measures used in the Stillwater River Watershed:

- *Rock Rip-Rap:* If bank stabilization is unavoidable, the design should call for well-placed, mixed size, angular rock rip-rap on a 2:1 slope. The use of concrete rubble or other materials is discouraged.
- *Flow Deflectors:* Traditional rock jetties generally do not work. They often create more bank instability than they prevent. Flow deflectors (i.e. bendway weirs) are a better alternative, although they need to be carefully designed to assure proper spacing, length, upstream angle, etc. to fit the site.
- *Bioengineering (root wads, willow lifts, sod mats, etc.):* These techniques have not been used on the lower Stillwater River. The Stillwater River high energy flows and large sediment load make bioengineering a high-risk option. On tributary streams, however, bioengineered bank stabilization may be a cost-effective alternative.

Noxious Weed Control: Noxious weeds found along the lower Stillwater River corridor pose a significant economic and ecological impact to the riparian and wetland plant communities. The Stillwater Valley Watershed Group has been actively engaged with landowners to aggressively control noxious weeds. This successful program should be expanded to include landowners, regardless of property size, on the lower Stillwater River and tributaries. Russian olive tree eradication should be added to the program before it becomes a major problem.

Riparian Forest Management: A riparian forest that has a diversity (age and species) of native shrubs and trees is crucial to the long-term stability of the Stillwater River. Livestock use and small tract development have had the most impact on the riparian forest.

A grazing management plan can mitigate livestock impacts to the river corridor. A site-specific grazing plan that is closely followed can easily meet landowner objectives while maintaining a healthy and sustainable riparian plant community. To effectively implement a riparian grazing plan, off-stream water developments, cross fencing, and/or a rest-rotation grazing schedule may be necessary.

Subdivisions/Small Tracts: The lower Stillwater River has several subdivisions with small tracts that vary in size from less than 1 acre to over 20 acres. Many of these tracts have houses in the 100-year floodplain and/or near the river's edge. These developments include bank stabilization (rock rip-rap,

jetties, retaining walls, dikes, etc.), in-river pumps for lawn watering, septic systems, riparian clearing, and noxious weed infestations. Individual small tract impacts to rivers are often minimal, but cumulatively they pose a serious threat to the long-term health of the Stillwater River.

Develop and implement an outreach and assistance program to help small tract landowners better understand how to minimize their impacts on the river. This program, sponsored by the Stillwater Valley Watershed Group and Stillwater Conservation District would offer on-site visits by a qualified technician to discuss noxious weed control, water rights, septic field maintenance, native riparian forest management, livestock grazing, and basic river dynamics.

Irrigation: There are several irrigation systems on the lower Stillwater River that are over 120 years old. The infrastructure (i.e. headgates, diversions, siphons, conveyance ditches, ditch turnouts, etc.) associated with these systems vary in age and condition. A comprehensive evaluation of the larger irrigation systems is recommended. The system evaluation would include infrastructure condition/functionality and ditch efficiency measurements to identify high water loss sections.

Each flood irrigation system should have a measuring device (i.e. Parshall flume) installed in a stable section of ditch, close to the headgate, to record and manage the amount of water diverted from the river.

Flood irrigation on fields next to the river have caused some bank saturation and bank instability. Over the last 25 years, sprinkle irrigation has become increasingly popular following innovate advances in sprinkler technology. Converting some fields along the Stillwater River from flood irrigation to sprinkler irrigation may be cost-effective and provide stability to the river. Sprinkler irrigation systems typically use less than half the water required for flood irrigation. They generally require less labor and increase crop yields by as much as 40 percent. There is an initial equipment/installation investment, plus the on-going expense of energy to run the system, but over time, the economic benefits often outweigh the conversion costs.

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Appendix A: Lower Stillwater River - Recommended Restoration Priority

Site	River Mile	Bank	Latitude	Longitude	Site Description	Recommended Restoration Priority
LSR-1	13.8	-	45.52849	-109.46949	Stream Crossing – Johnson Bridge	None
LSR-2	13.7	L	45.52860	-109.468497	Absaroka Fishing Access Site (FAS)	None
LSR-2A	13.7	L	45.52845	-109.466940	Small Tracts – Midnight Frolic Subdivision	High
LSR-3	13.7	R	45.52774	-109.466637	Small Tracts – Rock-N-River Subdivision	Medium
LSR-4	13.5	L	45.53034	-109.465127	Bank Erosion – North Stillwater Road (Upper Section)	High
LSR-5	13.5	R	45.529734	-109.465342	Irrigation Headgate/Diversion – Benbow Ditch	None
LSR-6	13.4	R	45.530515	-109.462172	Small Tracts – Fellows Subdivision	High
LSR-7	13.0	L	45.533421	-109.455693	Bank Erosion – North Stillwater Road (Middle Section)	High
LSR-8	12.7	R	45.533879	-109.449483	Small Tracts – Circle T Subdivision	Medium
LSR-9	12.4	L	45.535628	-109.445615	Small Tracts – Sid Bridges Subdivision	High
LSR-10	12.3	L	45.536124	-109.442322	Bank Erosion – North Stillwater Road (Lower Section)	High
LSR-11	11.9	L	45.536152	-109.435324	Corral	High
LSR-12	11.7	L	45.536678	-109.430692	Bank Stabilization – Rock Rip-Rap	None
LSR-13	11.5	R	45.535662	-109.427714	Irrigation Headgate/Diversion – Roadhouse Ditch	Low
LSR-14	11.4	L	45.536330	-109.426084	Small Tracts – Riverside Subdivision	High
LSR-15	11.2	-	45.537050	-109.422414	Stream Crossing – Riverside Inn Bridge	None
LSR-16	11.1	R	45.53780	-109.418907	Jeffrey's Landing Fishing Access Site (FAS)	None
LSR-17	10.7	L	45.541429	-109.413035	Bank Stabilization: Rock Rip-Rap & Dike	Medium

Appendix A: Lower Stillwater River - Recommended Restoration Priority

Site	River Mile	Bank	Latitude	Longitude	Site Description	Recommended Restoration Priority
LSR-18	10.2	R	45.544809	-109.405703	Irrigation Headgate – Nichols Ditch	Low
LRS-18A	10.1	R	45.544063	-109.408126	Irrigation Headgate/Diversion	None
LSR-19	10.0	R	45.545025	-109.402352	Stream Crossing – Private Bridge	Low
LSR-20	10.0	R/L	45.547488	-109.403826	Bank Stabilization – Floodplain Dikes	None
LSR-21	9.4	R	45.549617	-109.393907	Floodplain Dike & Rock Rip-Rap	None
LSR-22	9.0	R	45.551791	-109.386668	Bank Erosion	Medium
LSR-23	8.4	R	45.554344	-109.374932	Corral	None
LSR-24	8	R	45.556880	-109.369024	Irrigation Headgate – Whitebird Ditch	Low
LSR-25	7.9	R	45.557466	-109.366593	High Water Channel Dike – Wetlands	Low
LSR-26	7.8	R	45.559079	-109.365649	Bank Stabilization – Floodplain Dike & Rock Rip-Rap	None
LSR-27	6.8	L	45.568373	-109.353558	Irrigation Headgate – Brown Ditch	Medium
LSR-28	6.4	R	45.568430	-109.345347	Small Tracts – River Meadows Subdivision	Medium
LSR-29	5.9	R	45.573031	-109.338338	Irrigation Headgate – Scott Ditch	Low
LSR-30	5.8	R	45.575480	-109.337179	Whitebird Fishing Access Site (FAS)	None
LSR-31	5.5	L	45.579019	-109.326669	High Water Channel Dikes	Low
LSR-32	5.1	R	45.584659	-109.332394	Swinging Bridge Fishing Access Site (FAS)	None
LSR-33	4.7	-	45.588324	-109.325370	Stream Crossing – Private Bridges	Low
LSR-34	4.5	R	45.588519	-109.321001	Irrigation Headgate – Shane Ditch	Medium

Appendix A: Lower Stillwater River - Recommended Restoration Priority

Site	Mile	Bank	Latitude	Longitude	Site Description	Recommended Restoration Priority
LSR-35	4.2	L	49.593047	-109.32037	Bank Erosion – Irrigation Saturation	Medium
LSR-36	4.1	R	45.593360	-109.318685	Small Tracts – Sutherland Subdivision	High
LSR-37	3.8	R	45.596084	-109.313169	Bank Stabilization	None
LSR-38	3.1	R	45.601521	-109.301256	Joe Hill Creek Confluence	Medium
LSR-39	2.5	R	45.609451	-109.298665	Small Tracts – Dolan Subdivision	High
LSR-40	1.8	L	45.617729	-109.292531	Irrigation Headgate	None
LSR-41	1.7	R	45.61945	-109.289868	Small Tracts – Shane Creek Ranch Subdivision	Medium
LSR-42	1.4	L	45.623085	-109.289679	Fireman's Point Fishing Access Site (FAS)	None
LSR-43	1.3	R	45.623426	-109.286151	Irrigation Headgate – White Ditch	Low
LSR-44	1.3	-	45.623508	109.288755	Stream Crossing – Countryman Creek Road Bridge	None
LSR-45	1.3	L	45.623941	-109.288633	Irrigation Structure	Low
LSR-46	1.1	R	45.625851	-109.283906	Bank Stabilization – Rock Rip-Rap	None
LSR-47	1.0	L	45.627967	-109.286073	Bank Stabilization & High-Water Channel Dike	None
Reach LSR-1	13.8-12.3	-	-	-	Sites LSR-1 to LSR-10	High
Reach LSR-2	12.3- 5.8	-	-	-	Sites LSR-10 to LSR-30	High
Reach LSR-3	5.8-1.3	-	-	-	Sites LSR-30 to LSR-44	High
Reach LSR-4	1.3-0				Sites LSR-44 to the Yellowstone River	High