

County	Treasure	Upstream River Mile	286.8
Classification	UA: Unconfined anabranching	Downstream River Mile	282
General Location	To Yellowstone Diversion	Length	4.80 mi (7.72 km)
General Comments	Just downstream of Myers Bridge, Reach C3 provides an example of the extent of Channel Migration Zone isolation that can occur in the vicinity of transportation and irrigation infrastructure.		

Narrative Summary

Reach C3 is located in Treasure County, between Myers Bridge and the Yellowstone Ditch Diversion, at the head of the Mission Valley. The reach is a 4.4 mile long Unconfined Anabranching reach type, extending from RM 282.0 to RM 286.4. In this area the alluvial valley bottom is approximately 2.5 miles wide, and this broad valley configuration is due to the presence of relatively erodible Cretaceous-age Bearpaw Shale in the valley walls and valley floor on the west limb of the Porcupine Dome. The Bearpaw Shale consists of dark gray shale that is approximately 800 feet thick. The unit is commonly exposed in the valley walls where the Yellowstone valley bottom is anomalously wide, such as in the Mission and Hammond Valleys, indicating that it is erodible in comparison to the resistant sandstones that typically form the valley margin. Upstream of Myers Bridge, the river has undercut its right bank where Bearpaw Shale underlies Hell Creek sandstone. The rail line follows the river's edge on the sandstone, and land sliding on the shale horizon has resulted in extensive bank armoring to protect the rail line (Womack, 2001).

This reach was used by Koch (1977) to exemplify an especially dynamic river segment where the channel crosses the valley from one valley wall to another. Koch (1977) and Womack (2001) noted that in these areas, the Yellowstone River exhibits a particularly rich and diverse riparian zone.

There are over two miles of bank armor in the reach, all of which is rock riprap. A total of 25 percent of the bank is armored. In addition, approximately 31,000 linear feet of transportation encroachments and floodplain dikes were mapped in the reach. These floodplain features include floodplain dikes at Myers Bridge and the Yellowstone Ditch Diversion, and a long segment of railroad grade that is on a high terrace margin adjacent to an anabranching channel thread. Several of the floodplain dikes are protected by riprap. Land use is dominated by agriculture, with 33 acres of pivot irrigation development since 1950. Physical features such as bank armor, dikes, and levees have isolated 19 percent of the Channel Migration Zone in Reach C3.

The Yellowstone Ditch Diversion Dam is located at the lower end of Reach C3 at River Mile 282. The structure was built in 1909.

Even though Reach C3 has extensive armoring and diking throughout the reach, it has maintained substantial side channel connectivity.

Over 300 acres of 100-year floodplain has been isolated by human development, and all of that isolation is due to agricultural development on the north side of the river. The isolation reflects 12 percent of the total 100-year floodplain. The 5-year floodplain is even more affected; 65 percent of the historic 5-year floodplain is no longer inundated at that frequency. The loss of 5-year floodplain shows the strong imprint of flow alterations below the mouth of the Bighorn River and consequent development of those areas that are less frequently inundated; about 700 acres of currently irrigated areas are in the historic 5-year floodplain footprint.

Reach C3 shows a net encroachment of 192 acres of woody vegetation into the active channel corridor, suggesting that hydrologic alterations may have driven some channel narrowing since 1950. This is also supported by the loss of 121 acres of bankfull area between 1950 and 2001. This reflects encroachment of vegetation into the channel that has experienced a 20 percent reduction in channel forming (2-year) flow. There are about 21 acres of Russian olive in the reach. The reach supports about 30 acres of wetland per valley mile, which is a relatively dense wetland concentration for the corridor.

Reach C3 was sampled as part of the fisheries study. A total of 32 fish species were sampled in the reach and one of those species was Sauger, which has been identified by the Montana Natural Heritage Program as a Species of Concern (SOC).

Reach C3 was sampled as part of the avian study. A total of 39 bird species were identified in the reach. The average species richness in Reach C3 was 8.1, which indicates the average number of species observed during site visits to the reach in cottonwood habitats. The average species richness for sites evaluated is 8. Three bird species identified by the Montana Natural Heritage Program as Potential Species of Concern (PSOC) were also found, the Chimney Swift, the Ovenbird and the Plumbeous Vireo. One species identified as a Species of Concern (SOC) was documented, the Red-headed Woodpecker. In contrast to most other reaches, Reach C3 has seen an increase in the forested area that is at low risk of cowbird parasitism since 1950. At that time, there were 65 acres per valley mile of such forest, and that number increased to 82 acres per valley mile by 2001.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been major in this reach. The 2-year flood, which strongly influences overall channel form, has dropped by 23 percent. Low flows have also been impacted; severe low flows described as 7Q10 (the lowest average 7-day flow anticipated every ten years) for summer months has dropped from an estimated 4,610 cfs to 2,950 cfs with human development, a reduction of 36 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 6,150 cfs under unregulated conditions to 3,320 cfs under regulated conditions at Reach C10 downstream where the analysis begins, a reduction of 46 percent.

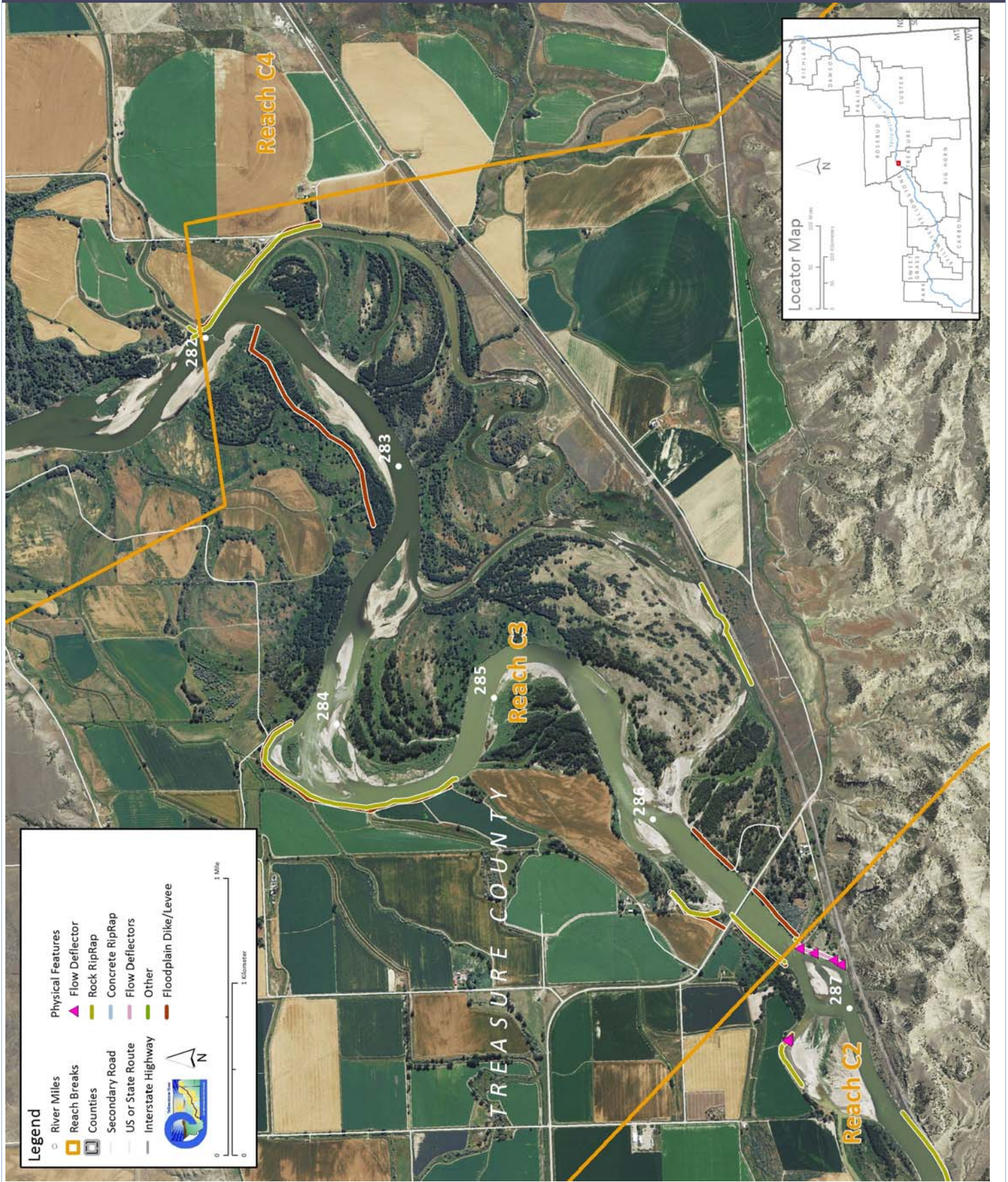
CEA-Related observations in Reach C3 include:

- Influence of flow alterations on floodplain inundation and riparian extent
- Increase in area at low risk of cowbird parasitism with riparian encroachment

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach C3 include:

- Fish passage at Yellowstone Ditch Diversion RM 282
- Watercraft passage at Yellowstone Ditch Diversion at RM 282
- Irrigation diversion infrastructure management at Yellowstone Ditch Diversion at RM 282
- Russian olive removal

PHYSICAL FEATURES MAP (2011)



HYDROLOGIC SUMMARY

Hydrologic data available for the Reach Narratives include data from representative gaging stations, modeling from the COE from the Big Horn river upstream, and modeling by the USGS for the Big Horn River to the Missouri River confluence. Gaging stations that best represent the watershed area within any reach are used to describe the flood history within the reach. Hydrology modeling results generated for all reaches provides unregulated and regulated flow values. Seasonal and annual flow duration data generated by the USGS are available for reaches C10 through D13.

Gage Representation (Gage-Based): Miles City

Flood History

Year	Date	Flow on Date	Return Interval	Gage No	Downstream Gage	Upstream Gage
1974	Jun 22	75,400	10-25 yr	6309000	6309000	6214500
1997	Jun 15	83,300	10-25 yr	Miles City	Miles City	Billings
1943	Jun 26	83,700	10-25 yr	1929-2015	1929-2015	1929-2015
2011	May 24	85,400	10-25 yr	Distance To (miles)	98.0	77.6
1944	Jun 19	96,300	50-100 yr			
1978	May 22	102,000	50-100 yr			

Discharge

	1.01 Yr	2 Yr	5 Yr	10 Yr	50 Yr	100 Yr	500 Yr	7Q10 Summer	95% Sum. Duration
Unregulated		60,900	76,600	87,000	110,000	119,000	142,000	4,610	3,846
Regulated		47,100	61,300	70,700	91,200	100,000	121,000	2,950	2,227
% Change		-22.66%	-19.97%	-18.74%	-17.09%	-15.97%	-14.79%	-36.01%	-42.10%

AERIAL PHOTOGRAPHY

A variety of aerial photographic sources provide the basis for much of the Cumulative Effects Assessment analysis. The table below lists the air photos compiled for the reach and the associated discharge at the most representative USGS gaging station.

	Source	Acquisition Date	Type	Scale	Gage	Discharge
1950	USGS-EROS	26-Aug-49	B/W	1:14,800	6309000	3620
1976	USCOE	29-Sep-76	B/W	1:24,000	6309000	9520
1995	USGS DOQQ	8/8/96 - 7/14/96	B/W		6295000	25300
2001	NRCS	August 2-8, 2001	CIR	1:24,000	6295000	3500
2005	NAIP	07/13/2005	color	1-meter pixels	6309000	17700
2007	Woolpert	10/15/2007 - 11/2/0007	Color		6309000	6490
2009	NAIP	7/30/2009	Color	1-meter pixels	6309000	13800
2011	USCOE	October 2012	color	1-ft pixel	6309000	8100
2011	NAIP	7/20/2011	Color	1-meter pixels	6309000	46100
2013	NAIP	07/13/2013	color	1-meter pixels	6309000	

PHYSICAL FEATURES

Several efforts to capture the types and extents of physical features in the corridor have been generated by the CEA study. The 2001 Physical Features Inventory was performed through helicopter/video Rapid Aerial Assessment by the NRCS (NRCS, 2001) and did not include Park County. This inventory includes point and linear features that represent bank armor, irrigation structures, transportation encroachments, and areas of accelerated erosion. Bank armor mapped in the 2001 inventory only reflects features on the active channel margin, and thus excludes off-channel features on historic side channels. Some floodplain restriction features such as dikes and levees in the 2001 Physical Features Inventory may extend well beyond the active channel. In 2013, the 2001 inventory was revised to include Park County. At that time, some attribute inconsistencies in the original data were addressed. This dataset was then updated to reflect conditions in the 2011 NAIP imagery.

For Stillwater, Yellowstone and Dawson Counties, a Physical Features Timeline was generated that includes additional mapping based on aerial photography and assigns approximate dates of feature construction based on observed presence/absence in historic imagery between the 1950s and 2005 (DTM and AGI, 2008). The Physical Features Timeline contains features that were not mapped in the 2001 inventory (e.g. bank armor abandoned in floodplain areas by 2001). As such the total bank armor extent in the 2005 data is commonly greater than that identified in 2001 or 2013.

Note: As the goal for each physical features mapping effort were different, with differing mapping extents, there will be discrepancies between total feature lengths (e.g. length of rock riprap) in each data set.

2001 and 2011 Physical Features Bankline Inventories

Feature Class	Feature Type	2001 Length (ft)	% of Bankline	2011 Length (ft)	% of Bankline	2001-2011 Change
Stream Stabilization						
	Rock RipRap	12,557	25.2%	12,618	25.4%	62
	Feature Type Totals	12,557	25.2%	12,618	25.4%	62
Floodplain Control						
	Transportation Encroachment	13,219	26.6%	13,219	26.6%	0
	Floodplain Dike/Levee	17,438	35.1%	17,438	35.1%	0
	Feature Type Totals	30,657	61.6%	30,657	61.6%	0
	Reach Totals	43,214	86.9%	43,276	87.0%	62

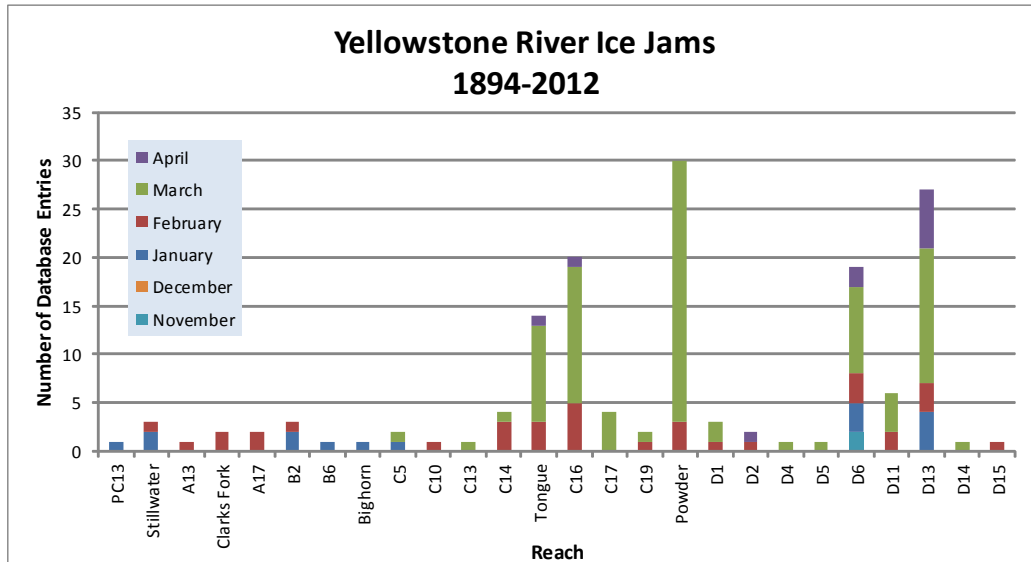
Intent of Bank Protection: 2001

The 2001 bank protection features were assessed for the 'intent' of what they protect.

Feature Type	Irrigated	Non-Irrig.	Ag. Infrastr.	Road	Interstate	Railroad	Urban	Exurban
Rock RipRap	7,856	0	492	2,165	0	2,158	0	0
Totals	7,856	0	492	2,165	0	2,158	0	0

ICE JAMS

Ice jam data were obtained from the National Ice Jam Database maintained by the Ice Engineering Group at Army Corps of Engineers Cold Regions Research and Engineering Laboratory (<https://rsgis.crrel.usace.army.mil/icejam/>). From this database, Yellowstone River ice jams are summarized by reach in the Yellowstone River Historic Events Timeline (DTM and AGI, 2008b). The basic information for each ice jam is presented as a list of events. The graph represents the number of database entries for a reach. Note that a single jam event may have multiple entries.



GEOMORPHIC

The geomorphology data presented below consist of measured changes in Braiding Parameter since 1950 and blocked side channels. Braiding parameter is a measure of the total length of side channels relative to that of the main channel. The braiding parameter is calculated as the sum of anabranching and primary channel lengths divided by the primary channel length. Secondary channels within the bankfull margins are a function of flow stage and hence were not included in the braiding parameter calculation. If a reach has a braiding parameter of 3, then the total bankfull channel length is three times that of the main channel. The mean braiding parameter measured for all 88 reaches is 1.8.

Blocked side channels that were either plugged with a small dike or cutoff by larger features such as a levee or road prism were identified for the pre and post-1950s eras.

Additional geomorphic parameters are discussed in more detail in the study report and appendices.

Braiding (Bankfull)

	Primary Chan. Length (ft)	Anab. Ch. Length (ft)	Bankfull Braiding Parameter		% Change in Braiding
1950	27,296	37,678	2.38	1950 to 1976:	-2.87%
1976	29,355	38,514	2.31	1976 to 1995:	16.55%
1995	24,717	41,887	2.69	1995 to 2001:	-2.69%
2001	24,872	40,347	2.62	1950 to 2001:	10.16%
Change 1950 - 2001	-2,424	2,669	0.24		

Length of Side Channels Blocked

Pre-1950s (ft)	0
Post-1950s (ft)	0

HYDRAULICS

Available hydraulic information includes county-based HEC-RAS modeling efforts by the Army Corps of Engineers with the exclusion of Park County. Floodplain modeling was performed for four conditions representing a developed and undeveloped floodplain, and unregulated and regulated flows for the 1.5, 2, 5, 10, 20, 50, 100, 200, and 500-year events. Park County has limited FEMA hydraulic modeling and was not included in the analysis.

The results of HEC-RAS modeling for the 5 and 100-year flood events were assessed to compare the extents of inundated area for the pristine (undeveloped floodplain, unregulated flows) and developed (developed floodplain, regulated flows) conditions. The data sets provided for each flow condition were unioned in the GIS to identify areas where the inundated extent differed. These areas of human-caused floodplain isolation due to either flow alterations or physical features such as levees. For the 100-year flood event, isolated areas greater than 5 acres were attributed with the interpreted reason for isolation (railroad, levee, etc.). The resulting values are presented as acres and percent of the pristine floodplain that has been isolated. The pristine floodplain is defined as the total floodplain footprint minus the area of the mapped 2001 bankfull channel (mapped islands were included in the floodplain area).

Floodplain Isolation

	100-Year		5-Year	
	Isolated Acres	% of Floodplain	Isolated Acres	% of Floodplain
Non-Structural (hydrology, geomorphic, etc.)	0	0.0%		
Agriculture (generally relates to field boundaries)	0	0.0%		
Agriculture (isolated by canal or large ditch)	45	1.6%		
Levee/Riprap (protecting agricultural lands)	188	6.9%		
Levee/Riprap (protecting urban, industrial, etc.)	0	0.0%		
Railroad	0	0.0%		
Abandoned Railroad	0	0.0%		
Transportation (Interstate and other roads)	81	3.0%		
Total Not Isolated (Ac)	2409		1245	
Total Floodplain Area (Ac)	2723		2442	
Total Isolated (Ac)	314	11.5%	1197	65.1%

The 5-year floodplain is a good allegory for the extent of the riparian zone. Thus, irrigated areas within the 5-year floodplain tend to represent riparian zones that have been converted to agriculture and may result in additional bank protection to protect the agricultural production and irrigation infrastructure.

	Flood	Sprinkler	Pivot	Total
Irrigated Acres within the 5 Year Flooplain:	113	0	0	113

CHANNEL MIGRATION ZONE

A series of Channel Migration Maps were developed for the Yellowstone River from Gardiner to its mouth in McKenzie County, North Dakota (Thatcher, Swindell, and Boyd, 2009). These maps and their accompanying report can be accessed from the YRCDC Website. The channel migration zone (CMZ) developed for the Yellowstone River is defined as a composite area made up of the existing channel, the historic channel since 1950 (Historic Migration Zone, or HMZ), and an Erosion Buffer that encompasses areas prone to channel erosion over the next 100 years. Areas within this CMZ that have been isolated by constructed features such as armor or floodplain dikes are attributed as “Restricted Migration Areas” (RMA). Beyond the CMZ boundaries, outlying areas that pose risks of channel avulsion are identified as “Avulsion Potential Zones”.

Mean 50-Yr Migration Distance (ft)	Erosion Buffer (ft)	Total CMZ Acreage	Restricted CMZ Acreage	% Restricted Migration Area	Total AHZ Acreage	Restricted AHZ Acreage	% Restricted Avulsion Area
512	1,024	2,249	476	21%	283	0	0%

2011 Restricted Migration Area Summary

Note that these data reflect the observed conditions in the 2011 aerial photography (NAIP for Park and Sweet Grass Counties, COE for the rest of the river).

Reason for Restriction	Land Use Protected	RMA Acres	Percent of CMZ
RipRap			
	Railroad	27	1.1%
	Public Road	69	2.7%
	Irrigated	205	8.1%
Flow Deflectors			
	Non-Irrigated	0	0.0%
Dike/Levee			
	Public Road	69	2.7%
	Non-Irrigated	106	4.2%
	Totals	476	18.8%

Land Uses within the CMZ (Acres)

Flood Irrigation	Sprinkler Irrigation	Pivot Irrigation	Urban/ExUrban	Transportation
393.6	0.0	17.9	1.4	9.2

LAND USE

Land uses were mapped from aerial photography Gardiner to the confluence of the Missouri River in North Dakota for four time periods: 1950s, 1976, 2001, and 2011. Mapping was performed at approximately 1:6,000 to ensure consistent mapping across all data sets. Typically, if a feature could not be easily mapped at the target mapping scale, it was not separated out from the adjacent land use.

A four-tiered system was used to allow analysis at a variety of levels. Tier 1 breaks land use into Agricultural and Non-Agricultural uses. Tier two subdivided uses into productive Agricultural Land and Infrastructure for the Agricultural land, and Urban, Exurban and Transportation categories for the Non-Agricultural land. Tier three further breaks down land uses into more refined categories such as Irrigated or Non-Irrigated and Residential, Commercial, or Industrial. Finally, Tier 4 focuses primarily on the productive agricultural lands, identifying the type of irrigation (Pivot, Sprinkler or Flood).

Land Use Timeline - Tiers 2 and 3

Feature Class	Feature Type	Acres				% of Reach Area			
		1950	1976	2001	2011	1950	1976	2001	2011
Agricultural Infrastructure									
	Canal	8	8	8	8	0.2%	0.2%	0.2%	0.2%
	Agricultural Roads	0	11	11	11	0.0%	0.2%	0.2%	0.2%
	Other Infrastructure	33	74	89	89	0.7%	1.6%	1.9%	1.9%
	Totals	41	93	108	108	0.9%	2.0%	2.3%	2.3%
Agricultural Land									
	Non-Irrigated	1,394	1,406	1,409	1,367	29.2%	29.5%	29.6%	28.7%
	Irrigated	1,882	1,817	1,821	1,811	39.5%	38.1%	38.2%	38.0%
	Totals	3,276	3,223	3,229	3,177	68.7%	67.6%	67.8%	66.7%
Channel									
	Channel	1,410	1,402	1,381	1,425	29.6%	29.4%	29.0%	29.9%
	Totals	1,410	1,402	1,381	1,425	29.6%	29.4%	29.0%	29.9%
ExUrban									
	ExUrban Other	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	ExUrban Undeveloped	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	ExUrban Industrial	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	ExUrban Commercial	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	ExUrban Residential	0	0	0	8	0.0%	0.0%	0.0%	0.2%
	Totals	0	0	0	8	0.0%	0.0%	0.0%	0.2%
Transportation									
	Public Road	22	31	31	31	0.5%	0.7%	0.6%	0.6%
	Interstate	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Railroad	17	17	17	17	0.4%	0.4%	0.4%	0.4%
	Totals	39	48	48	48	0.8%	1.0%	1.0%	1.0%
Urban									
	Urban Other	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Urban Residential	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Urban Commercial	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Urban Undeveloped	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Urban Industrial	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Totals	0	0	0	0	0.0%	0.0%	0.0%	0.0%

Land Use Timeline - Tiers 3 and 4

Feature Class	Feature Type	Acres				% of Reach Area				Change Between Years (% of Agricultural Land)			
		1950	1976	2001	2011	1950	1976	2001	2011	'50-76	'76-01	'01-11	'50-11
Irrigated													
	Sprinkler	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Pivot	0	0	0	33	0.0%	0.0%	0.0%	1.0%	0.0%	0.0%	1.0%	1.0%
	Flood	1,882	1,817	1,821	1,778	57.4%	56.4%	56.4%	55.9%	-1.1%	0.0%	-0.4%	-1.5%
	Totals	1,882	1,817	1,821	1,811	57.4%	56.4%	56.4%	57.0%	-1.1%	0.0%	0.6%	-0.5%

Non-Irrigated

Multi-Use	1,244	1,356	1,378	1,336	38.0%	42.1%	42.7%	42.0%	4.1%	0.6%	-0.6%	4.1%
Hay/Pasture	150	50	31	31	4.6%	1.5%	1.0%	1.0%	-3.1%	-0.6%	0.0%	-3.6%
Totals	1,394	1,406	1,409	1,367	42.6%	43.6%	43.6%	43.0%	1.1%	0.0%	-0.6%	0.5%

RIPARIAN

Riparian mapping data are derived from the Yellowstone River Riparian Vegetation Mapping study (DTM/AGI 2008). This study coarsely mapped the riparian vegetation communities using 1950's, 1976-1977, and 2001 aerial imagery in a GIS environment. The polygons are digitized at a scale of approximately 1:7,500, with a minimum mapping unit of approximately 10 acres. The goal of the delineation was to capture areas of similar vegetation structure as they appeared on the aerial imagery, while maintaining a consistent scale.

The "Riparian Turnover" values quantify the total area within the active channel area that converted from either woody vegetation to open bar or water, or from open bar or water to woody vegetation. A comparison of these values allows some consideration of overall riparian encroachment into the river corridor from 1950 to 2001.

Riparian Mapping

Statistic	Shrub (Acres)			Closed Timber (Acres)			Open Timber (Acres)		
	1950	1976	2001	1950	1976	2001	1950	1976	2001
Min	0.4	0.4	0.7	0.1	1.5	1.0	10.8	1.6	1.9
Max	47.8	107.1	75.5	272.5	79.0	154.8	63.2	141.9	102.6
Average	7.9	14.6	14.6	32.5	19.3	33.7	25.0	36.8	29.0
Sum	213.3	365.7	320.6	747.4	521.5	674.1	99.8	368.0	347.6

Riparian Turnover

Conversion of riparian areas to channel, or from channel to riparian between the 1950's and 2001 data set.

Riparian to Channel (acres) 122.1

Channel to Riparian (acres) 314.2

Riparian Encroachment (acres) 192.1

Riparian Recruitment

Creation of riparian areas between 1950s and 2001.	1950s Channel Mapped as 2011 Riparian (Ac)	318.6
	1950s Floodplain Mapped as 2011 Channel (Ac)	79.4
	Total Recruitment (1950s to 2011)(Ac)	398.0

WETLANDS

Wetland areas were mapped to National Wetland Inventory standards by the Montana Natural Heritage Program. Palustrine wetlands within the mapped 100-year inundation boundary were extracted and summarized into four categories: Riverine (Unconsolidated Bottom - UB, Aquatic Bed - AB, and Unconsolidated Shore - US), Emergent - EM, Scrub-Shrub - SS, and Forested - FO.

	Riverine	Emergent	Scrub/Shrub	Forested	Total
Mapped Acres	6.4	90.6	23.2	0.0	120.2
Acres/Valley Mile	2.0	28.7	7.4	0.0	

RUSSIAN OLIVE

Russian olive is considered an invasive species and its presence in the Yellowstone River corridor is fairly recent. As such, its spread can be used as a general indicator of invasive plants within the corridor. It has the added benefit of being easily identified in multi-spectral aerial photography, making it possible to inventory large areas using remote techniques.

In 2011, Natural Resources Conservation Service (NRCS) in Bozeman, MT conducted an inventory of Russian olive locations in the Yellowstone River watershed. This study utilized the Feature Analyst extension within ArcGIS to interpret multi-spectral 2008 NAIP imagery for the presence of Russian olive. The resulting analysis was converted from raster format to a polygon ESRI shape file for distribution and further analysis within a GIS environment.

This work scope was tasked with integrating the resulting Russian olive inventory into the Yellowstone River Conservation Districts Council (YRDC) Cumulative Effects Assessment (CEA) GIS and associated reach-based database. Additionally, analysis of Russian olive within the corridor was conducted to characterize its distribution in throughout the corridor and its association with other corridor data sets.

	Floodplain Area (Ac)	% of Floodplain	Other Area (Ac)	Inside RMA (Ac)	Inside '50s Channel (Ac)	Inside 50s Island (Ac)
Russian Olive in Reach	21.17	0.60%	5.66	4.51	2.15	1.40

FISHERIES SUMMARY

Fisheries data available for the Reach Narratives include low-flow and high-flow habitat mapping of 2001 conditions for 406 miles of river, extending from the mouth upstream to a point approximately 8 miles upstream of Park City. Habitat mapping was performed remotely on the 2001 CIR aerial photography utilizing habitat classifications developed by Montana Fish, Wildlife, and Parks (DTM 2009). Historic habitat mapping using the 1950's imagery is limited to Reach B1 (high-flow) and D9 (low and high-flow).

Fisheries field sampling data have been provided by Ann Marie Reinhold (MSU). In this study, the Yellowstone River from Park City to Sidney was divided into five segments. Within each segment, fish were sampled in reaches modified by riprap ("treatment reaches") and relatively unmodified reaches ("control reaches"). Fish sampling was conducted during summer and autumn of 2009, 2010, and 2011. Boat electrofishing, trammel nets, mini-fyke nets and bag seines were used to collect data from river bends.

Fish presence data is only presented for those reaches that were sampled.

The Low Flow Habitat Mapping followed schema developed by Montana Fish Wildlife and Parks to identify key habitat units for certain aquatic species.

Fish Species Observed in Reach/Region

Species of Concern

Reach	Region	Reach	Region	Reach	Region	Reach	Region
<input type="checkbox"/>	<input checked="" type="checkbox"/> Bigmouth buffalo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Flathead chub	<input type="checkbox"/>	<input type="checkbox"/> Northern redbelly dace	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Stonecat
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Black bullhead	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Freshwater drum	<input type="checkbox"/>	<input type="checkbox"/> Pallid sturgeon	<input type="checkbox"/>	<input type="checkbox"/> Sturgeon chub
<input type="checkbox"/>	<input checked="" type="checkbox"/> Black crappie	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Goldeye	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Pumpkinseed	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Sucker species
<input type="checkbox"/>	<input checked="" type="checkbox"/> Blue sucker	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Green sunfish	<input type="checkbox"/>	<input type="checkbox"/> Rainbow trout	<input type="checkbox"/>	<input type="checkbox"/> Sunfish species
<input type="checkbox"/>	<input checked="" type="checkbox"/> Bluegill	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Lake chub	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> River carpsucker	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Walleye
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Brook stickleback	<input type="checkbox"/>	<input checked="" type="checkbox"/> Largemouth bass	<input type="checkbox"/>	<input checked="" type="checkbox"/> Rock bass	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Western silvery minnow
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Brown trout	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Longnose dace	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Sand shiner	<input type="checkbox"/>	<input type="checkbox"/> White bass
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Burbot	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Longnose sucker	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Sauger	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> White crappie
<input type="checkbox"/>	<input type="checkbox"/> Catfish species	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Minnow species	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Shorthead redhorse	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> White sucker
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Channel catfish	<input type="checkbox"/>	<input type="checkbox"/> Mottled sculpin	<input type="checkbox"/>	<input type="checkbox"/> Shortnose gar	<input type="checkbox"/>	<input type="checkbox"/> Yellow bullhead
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Common carp	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Mountain sucker	<input type="checkbox"/>	<input checked="" type="checkbox"/> Shovelnose sturgeon	<input type="checkbox"/>	<input type="checkbox"/> Yellow perch
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Creek chub	<input type="checkbox"/>	<input checked="" type="checkbox"/> Mountain whitefish	<input type="checkbox"/>	<input type="checkbox"/> Sicklefin chub		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Emerald shiner	<input type="checkbox"/>	<input checked="" type="checkbox"/> Northern pike	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Smallmouth bass		
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fathead minnow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Northern plains killifish	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Smallmouth buffalo		

Low Flow Fisheries Habitat Mapping

2001 (Acres)

Habitat	Bankfull	Low Flow	% of Low Flow
Scour Pool	123.5	81.6	5.9%
Rip Rap Bottom	69.2	52.3	3.8%
Secondary Channel	21.1	22.0	1.6%
Secondary Channel (Seasonal)	216.1	147.4	10.7%
Channel Crossover	146.7	81.1	5.9%
Point Bar		45.0	3.3%
Side Bar		96.8	7.0%
Mid-channel Bar		30.5	2.2%
Island	777.7	777.7	56.3%
Dry Channel		23.2	1.7%
Dam Influenced	26.5	23.2	1.7%

AVIAN

Birds were sampled in 2006 and 2007 by Danielle Jones of Montana State University. Point count methods were used at 304 randomly chosen sites in 21 braided or anabranching reaches. Each site was visited multiple times within a season, and sites were visited in both years. Birds were sampled in grassland, shrubland, and cottonwood forest habitats. Additional bird data was collected by Amy Cilimburg of Montana Audubon in summer 2012. High priority areas for data collection were identified with the assistance of the YRDC Technical Advisory Committee. The Audubon methodology recorded data for a wider variety of bird species relative to the MSU study, including raptors and waterfowl.

Bird Species Observed in Reach/Region		Species of Concern	Potential Species of Concern
Reach	Region	Reach	Region
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> American Robin	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Killdeer
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> American Crow	<input type="checkbox"/>	<input checked="" type="checkbox"/> Lark Bunting
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> American Goldfinch	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Lark Sparrow
<input type="checkbox"/>	<input checked="" type="checkbox"/> American Kestrel	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Lazuli Bunting
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> American Redstart	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Least Flycatcher
<input type="checkbox"/>	<input checked="" type="checkbox"/> Bald Eagle	<input type="checkbox"/>	<input checked="" type="checkbox"/> Mallard
<input type="checkbox"/>	<input type="checkbox"/> Baltimore Oriole	<input type="checkbox"/>	<input type="checkbox"/> Mountain Bluebird
<input type="checkbox"/>	<input checked="" type="checkbox"/> Barn Swallow	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Mourning Dove
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Belted Kingfisher	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Northern Flicker
<input type="checkbox"/>	<input checked="" type="checkbox"/> Black-billed Cuckoo	<input type="checkbox"/>	<input checked="" type="checkbox"/> Orchard Oriole
<input type="checkbox"/>	<input checked="" type="checkbox"/> Black-billed Magpie	<input type="checkbox"/>	<input type="checkbox"/> Osprey
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Black-capped Chickadee	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Ovenbird
<input type="checkbox"/>	<input checked="" type="checkbox"/> Black-and-white Warbler	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Plumbeous Vireo
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Black-headed Grosbeak	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-headed Woodpecker
<input type="checkbox"/>	<input checked="" type="checkbox"/> Blue Jay	<input type="checkbox"/>	<input type="checkbox"/> Red-naped Sapsucker
<input type="checkbox"/>	<input checked="" type="checkbox"/> Bobolink	<input type="checkbox"/>	<input type="checkbox"/> Red Crossbill
<input type="checkbox"/>	<input checked="" type="checkbox"/> Brewer's Blackbird	<input type="checkbox"/>	<input checked="" type="checkbox"/> Ring-necked Pheasant
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Brown-headed Cowbird	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-tailed hawk
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Brown Creeper	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Brown Thrasher	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Rock Dove
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Bullock's Oriole	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-winged Blackbird
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Canada Goose	<input type="checkbox"/>	<input checked="" type="checkbox"/> Red-eyed Vireo
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cedar Waxwing	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Chimney Swift	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Chipping Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Clay-collared Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cliff Swallow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Common Grackle	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Common Merganser	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Common Nighthawk	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Common Raven	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Common Yellowthroat	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Cooper's Hawk	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Dickcissel	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Downy Woodpecker	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Eastern Bluebird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Eastern Kingbird	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Eurasian Collared-dove	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> European Starling	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Field Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Franklin's Gull	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Grasshopper Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Gray Catbird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Great Blue Heron	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Great Horned Owl	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Hairy Woodpecker	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> House Finch	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> House Wren	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Killdeer	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Lark Bunting	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Lark Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Lazuli Bunting	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Least Flycatcher	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Mallard	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Mountain Bluebird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Mourning Dove	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Northern Flicker	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Orchard Oriole	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Osprey	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Ovenbird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Plumbeous Vireo	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-headed Woodpecker	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Red-naped Sapsucker	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Red Crossbill	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Ring-necked Pheasant	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-tailed hawk	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Rock Dove	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-winged Blackbird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Red-eyed Vireo	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Red-breasted Grosbeak	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Say's Phoebe	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Savannah Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Song Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Spotted Sandpiper	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Spotted Towhee	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Sharp-shinned Hawk	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Swainson's Thrush	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Sandhill Crane	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Tree Swallow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Turkey Vulture	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/> Upland Sandpiper	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Vesper Sparrow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Violet-green Swallow	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Warbling Vireo	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Western Kingbird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Western Meadowlark	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Western Wood-pewee	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> White-breasted Nuthatch	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> White-throated Swift	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Wild Turkey	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Wood Duck	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Yellow-bellied Sapsucker	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Yellow-billed Cuckoo	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Yellow-breasted Chat	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/> Yellow-headed Blackbird	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Yellow Warbler	<input type="checkbox"/>	<input type="checkbox"/>

CULTURAL INVENTORY SUMMARY

The Yellowstone River Cultural Inventory - 2006 documents the variety and intensity of different perspectives and values held by people who share the Yellowstone River. Between May and November of 2006, a total of 313 individuals participated in the study. They represented agricultural, civic, recreational, or residential interest groups. Also, individuals from the Crow and the Northern Cheyenne tribes were included.

There are three particular goals associated with the investigation. The first goal is to document how the people of the Yellowstone River describe the physical character of the river and how they think the physical processes, such as floods and erosion, should be managed. Within this goal, efforts have been made to document participants' views regarding the many different bank stabilization techniques employed by landowners. The second goal is to document the degree to which the riparian zone associated with the river is recognized and valued by the participants. The third goal is to document concerns regarding the management of the river's resources. Special attention is given to the ways in which residents from diverse geographical settings and diverse interest groups view river management and uses. The results illustrate the commonalities of thought and the complexities of concerns expressed by those who share the resources of the Yellowstone River.

Summary of Cultural Views in Region C

In the study segment, Powder River to Big Horn River, three conversations emerged across the four interest groups. The first conversation focuses on the "familiar way of life." The conversation exposes a local identity that is tied to agriculture and to traditional forms of recreation, such as hunting and fishing. When asked if the familiar management practices are sufficient in terms of sharing the river's resources, some locals express concerns. The second conversation explicitly acknowledges that the demand for recreational access to the river's resources is in its infancy in terms of representing a problem. The third conversation focuses on controlling the river with rip-rap and dikes.