County	Rosebud	**Upstream River Mile**	214.8
Classification	PCM/I: Partially confined meandering/islands	**Downstream River Mile**	208.1
General Location	Hathaway	**Length**	6.70 mi (10.78 km)
General Comments	Valley bottom crossover		

Narrative Summary

Reach C13 is 6.7 miles long and extends from RM 215 to RM 208 in Rosebud County. The reach classified as Partially Confined Meandering with Islands (PCM/I), indicating some influence of the valley wall, a main meandering channel thread, and numerous meander cutoffs that have generated large islands. Within this reach the river crosses the valley bottom from the southern bluff line in the upper portion of the reach to the northern bluff line downstream. The length of river between bluff lines is about three miles. Reach C13 locally exhibits very rapid meander migration; at RM 211 for example, the river has migrated 960 feet to the northwest over the last 50 years. At this location the river is now within 65 feet of the abandoned Milwaukee rail line which forms a defacto flood control levee on the north side of the river.

As of 2011 there were about three miles of riprap and flow deflectors protecting 26 percent of the total bankline in Reach C13, including 13,400 feet of rock riprap, 750 feet of concrete riprap, and 4,600 feet of flow deflectors. Most of the rock riprap is protecting the rail line on the south bluff line and the abandoned rail line on the north bluff line. Another 1,350 feet of bankline is protected by old car bodies at RM 201R. All of the flow deflectors, concrete riprap, and car bodies are protecting irrigated fields. Between 2001 and 2011, about 4,000 feet of flow deflectors that were mapped at RM 212.3R were evidently destroyed. It is difficult to tell from the imagery alone whether all of these flow deflectors were flanked, however at RM 212.0, flow deflectors are sitting in the river about 60 feet off of the bank.

Since 1950, a side channel that is about 4,600 feet long was blocked at RM 211.5R. This channel cuts through the core of a large meander, and appears to be naturally reactivating as the bendway translates down the river valley.

Similar to other reaches downstream of the Bighorn River confluence, the river channel has become smaller in Reach C13 since 1950. In 1950, the bankfull footprint was about 76 acres larger than it was in 2001, and riparian mapping shows about 120 acres of riparian encroachment into old channel areas. Floodplain turnover rates are also slightly lower; from 1950-1975 the average annual rate of floodplain turnover was 5.0 acres per year, and since 1975 it has been 4.1 acres per year.

Over 600 acres of the 100-year floodplain has become isolated from the river due to flow alterations, agricultural development, and the abandoned railroad grade. In total, 20 percent of the entire historic 100-year floodplain has become isolated. Isolation of the 5-year floodplain has been even more substantial; 921 acres or 45 percent of the 5-year floodplain has become isolated at that frequency event. Much of this isolated 5-year floodplain is on flood irrigated fields both north and south of the river.

One ice jam was reported in the reach as a break-up event that occurred on March 15, 2011. No damages were reported.

A total of 221 acres of land that would normally be in the river's natural Channel Migration Zone (CMZ) have become restricted by physical features, which represents about 11 percent of the total CMZ area.

Land uses in Reach C13 are predominantly agricultural, with some conversion from flood irrigation to pivot since 1950. As of 2011 there were about 330 acres under pivot irrigation in the reach. Irrigation development largely occurred prior to 1950, but additional development since then has included riparian clearing; between 1950 and 2011 about 133 acres of riparian area was cleared for irrigation, which is 11 percent of the total 1950s riparian area.

There are 216 acres of mapped Russian olive in the reach, which is notably concentrated in abandoned side channels. Reach C13 also has fairly extensive mapped wetlands; there are over 32 mapped wetland acres per valley mile in the reach, most of which is emergent marsh and wet meadows in floodplain swales.

Reach C13 was sampled as part of the fisheries study. A total of 27 species were sampled in the reach, including Sauger and Blue Sucker, both of which have been identified as Species of Concern by the Montana Natural Heritage Program.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been major in this reach. The 100-year flood has dropped by 18 percent and the 2-year flood, which strongly influences overall channel form, has dropped by 24 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 4,840 cfs to 3,070 cfs with human development, a reduction of 37 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 6,320 cfs under unregulated conditions to 3,380 cfs under regulated conditions, a reduction of 47 percent.

Fall and winter base flows have increased in Reach C13 by about 60 percent.

CEA-Related observations in Reach C13 include:
•Floodplain isolation by the abandoned Milwaukee rail line on the north bank.
•Blocking of side channels
•Post-1950s riparian clearing for irrigation development

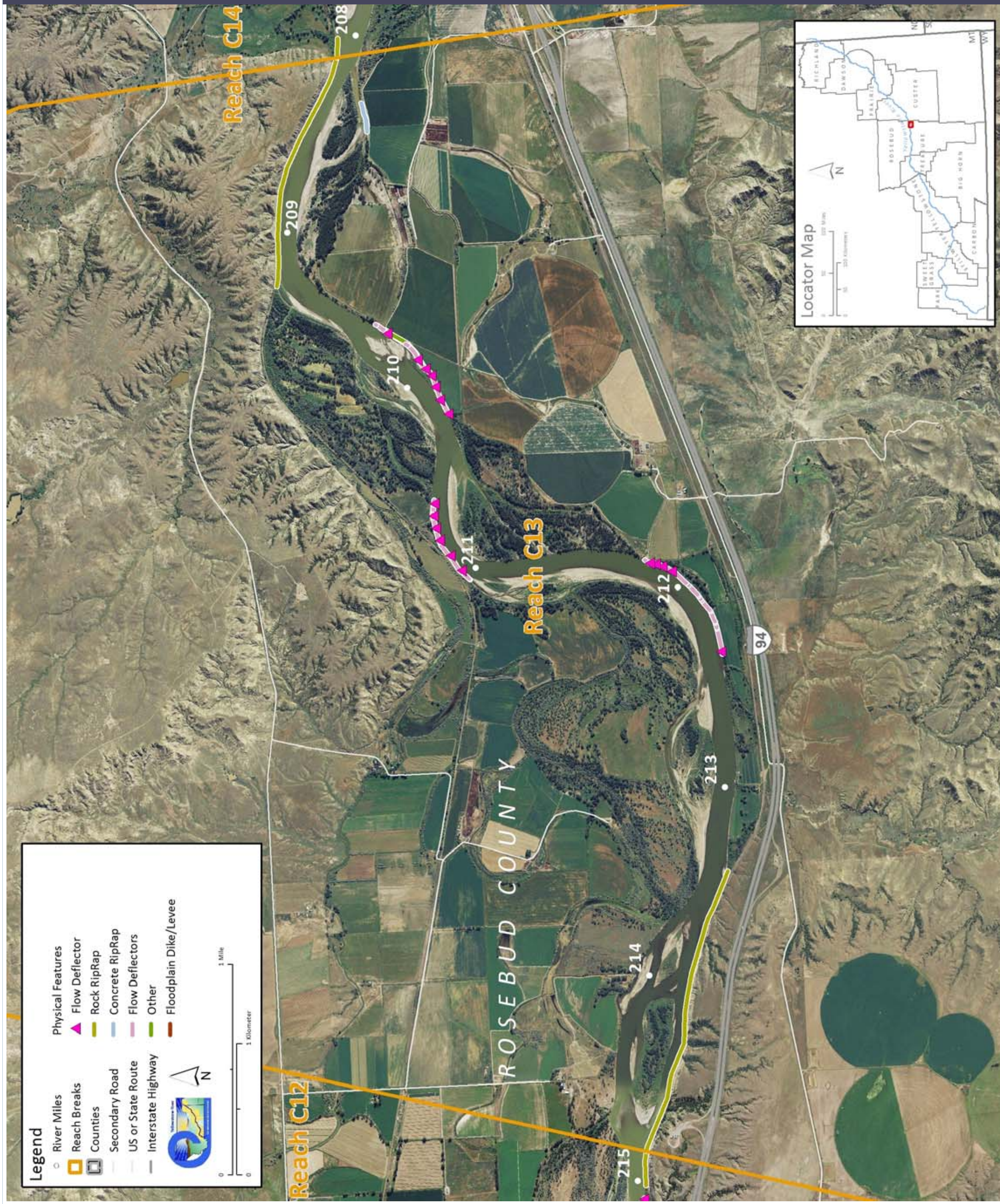
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach C13 include:

•Removal of flanked barb at RM 212.

•Side channel reactivation at RM 211.6 R.

•CMZ Management due to extent of CMZ restriction (11 percent)

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
1974	Jun 22	75,400	10-25 yr
1997	Jun 15	83,300	10-25 yr
1943	Jun 26	83,700	10-25 yr
2011	May 24	85,400	10-25 yr
1944	Jun 19	96,300	50-100 yr
1978	May 22	102,000	50-100 yr

	Downstream Gage	Upstream Gage
Gage No	6309000	6214500
Location	Miles City	Billings
Period of Record	1929-2015	1929-2015
Distance To (miles)	24.1	149.6

Discharge

	1.01 Yr	2 Yr	5 Yr	10 Yr	50 Yr	100 Yr	500 Yr	7Q10 Summer	95% Sum. Duration
Unregulated		61,900	77,800	88,100	110,000	120,000	142,000	4,840	6,320
Regulated		47,300	61,700	70,900	90,600	98,800	118,000	3,070	3,380
% Change		-23.59%	-20.69%	-19.52%	-17.64%	-17.67%	-16.90%	-36.57%	-46.52%

Flow Duration

Streamflow, in ft3/s, which was equaled or exceeded for indicated percent of time

Note that these statistics are only available from Reach C10 downstream. See the USGS report for detailed information.

Season		5%	50%	95%
Spring	Unregulated	60,600	22,700	6,070
	Regulated	46,900	13,700	4,420
	% Change	**-23%**	**-40%**	**-27%**
Summer	Unregulated	42,700	13,400	6,320
	Regulated	32,500	8,320	3,380
	% Change	**-24%**	**-38%**	**-47%**
Fall	Unregulated	9,130	5,540	2,300
	Regulated	10,500	6,890	3,640
	% Change	**15%**	**24%**	**58%**
Winter	Unregulated	11,700	4,940	2,020
	Regulated	12,300	6,030	3,260
	% Change	**5%**	**22%**	**61%**
Annual	Unregulated	45,400	7,920	2,790
	Regulated	34,100	7,380	3,630
	% Change	**-25%**	**-7%**	**30%**

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	8/7/96 - 7/12/96	B/W		6295000	27600
2001	NRCS	August 2-8, 2001	CIR	1:24,000	6295000	3500
2005	NAIP	07/08/2005	color	1-meter pixels	6309000	18800
2007	Woolpert	10/15/2007 - 11/2/0007	Color			
2009	NAIP	7/17/2009	Color	1-meter pixels	6309000	23300
2009	NAIP	7/15/2009	Color	1-meter pixels	6309000	26400
2011	USCOE	October 2012	color	1-ft pixel	6309000	8100
2011	NAIP	7/15/2011	Color	1-meter pixels	6309000	58000
2013	NAIP	07/20/2013	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 descrepancies 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	13,404	18.8%	13,404	18.8%	0
	Flow Deflectors	1,753	2.5%	1,327	1.9%	-426
	Concrete RipRap	744	1.0%	744	1.0%	0
	Car Bodies	1,354	1.9%	1,354	1.9%	0
	Between Flow Deflectors	6,783	9.5%	3,240	4.6%	-3,543
	Feature Type Totals	**24,038**	**33.8%**	**20,069**	**28.2%**	**-3,969**
	Reach Totals	**24,038**	**33.8%**	**20,069**	**28.2%**	**-3,969**

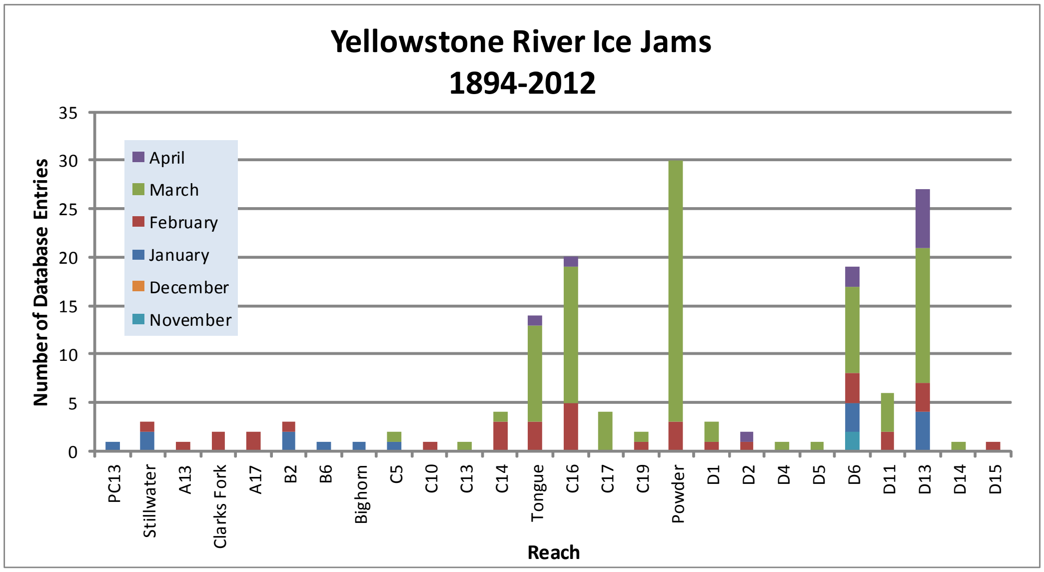
Intent of Bank Protection: 2001

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
Car Bodies	1,355	0	0	0	0	0	0	0
Concrete RipRap	745	0	0	0	0	0	0	0
Flow Deflectors/Between FDs	7,111	0	0	0	0	1,312	0	0
Rock RipRap	0	0	0	0	0	8,226	0	0
Totals	**9,210**	**0**	**0**	**0**	**0**	**9,538**	**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.



Jam Date	Jam Type	River Mile	Damages
3/15/2011	Break-up		

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	35,504	14,748	1.42	1950 to 1976:	19.54%
1976	35,672	24,681	1.69	1976 to 1995:	0.71%
1995	35,586	25,047	1.70	1995 to 2001:	-4.39%
2001	35,591	22,387	1.63	1950 to 2001:	15.09%
Change 1950 - 2001	**88**	**7,639**	**0.21**		

Length of Side Channels Blocked

Pre-1950s (ft)	0
Post-1950s (ft)	4,575

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 area 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.)	142	4.5%		
Agriculture (generally relates to field boundaries)	378	11.9%		
Agriculture (isloated by canal or large ditch)	0	0.0%		
Levee/Riprap (protecting agricultural lands)	0	0.0%		
Levee/Riprap (protecting urban, industrial, etc.)	0	0.0%		
Railroad	0	0.0%		
Abandoned Railroad	120	3.8%		
Transportation (Interstate and other roads)	0	0.0%		
Total Not Isolated (Ac)	2550		1821	
Total Floodplain Area (Ac)	3191		2742	
Total Isolated (Ac)	**641**	**20.1%**	**921**	**45.3%**

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 agrigulture 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:	185	0	0	**185**

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
396	793	1,941	222	11%	115	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/Flow Deflectors			
	Irrigated	67	3.2%
RipRap			
	Non-Irrigated	0	0.0%
	Irrigated	20	1.0%
Flow Deflectors			
	Railroad	59	2.9%
	Irrigated	76	3.7%
	Totals	**222**	**10.8%**

Land Uses within the CMZ (Acres)

Flood Irrigation	Sprinkler Irrigation	Pivot Irrigation	Urban/ ExUrban	Trans- portation
378.1	0.0	0.0	0.0	7.9

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

		Acres				% of Reach Area			
Feature Class	Feature Type	1950	1976	2001	2011	1950	1976	2001	2011
Agricultural Infrastructure									
	Canal	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Agricultural Roads	0	0	0	0	0.0%	0.0%	0.0%	0.0%
	Other Infrastructure	60	141	144	133	0.8%	1.8%	1.8%	1.7%
	Totals	**60**	**141**	**144**	**133**	**0.8%**	**1.8%**	**1.8%**	**1.7%**
Agricultural Land									
	Non-Irrigated	3,328	3,486	3,865	3,881	42.0%	43.9%	48.7%	48.9%
	Irrigated	3,571	3,114	2,750	2,739	45.0%	39.3%	34.7%	34.5%
	Totals	**6,900**	**6,600**	**6,615**	**6,620**	**87.0%**	**83.2%**	**83.4%**	**83.5%**
Channel									
	Channel	868	892	907	913	10.9%	11.2%	11.4%	11.5%
	Totals	**868**	**892**	**907**	**913**	**10.9%**	**11.2%**	**11.4%**	**11.5%**
ExUrban									
	ExUrban Other	0	24	24	24	0.0%	0.3%	0.3%	0.3%
	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	0	0.0%	0.0%	0.0%	0.0%
	Totals	**0**	**24**	**24**	**24**	**0.0%**	**0.3%**	**0.3%**	**0.3%**
Transportation									
	Public Road	39	48	48	48	0.5%	0.6%	0.6%	0.6%
	Interstate	0	160	160	160	0.0%	2.0%	2.0%	2.0%
	Railroad	65	67	34	34	0.8%	0.8%	0.4%	0.4%
	Totals	**105**	**275**	**242**	**242**	**1.3%**	**3.5%**	**3.1%**	**3.1%**
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

		Acres				% of Reach Area				Change Between Years (% of Agricultural Land)			
Feature Class	Feature Type	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	328	328	0.0%	0.0%	5.0%	4.9%	0.0%	5.0%	0.0%	4.9%
	Flood	3,571	3,114	2,423	2,412	51.8%	47.2%	36.6%	36.4%	-4.6%	-10.6%	-0.2%	-15.3%
	Totals	**3,571**	**3,114**	**2,750**	**2,739**	**51.8%**	**47.2%**	**41.6%**	**41.4%**	**-4.6%**	**-5.6%**	**-0.2%**	**-10.4%**

Non-Irrigated													
	Multi-Use	3,183	3,413	3,319	3,700	46.1%	51.7%	50.2%	55.9%	5.6%	-1.5%	5.7%	9.7%
	Hay/Pasture	145	73	546	181	2.1%	1.1%	8.3%	2.7%	-1.0%	7.2%	-5.5%	0.6%
	Totals	**3,328**	**3,486**	**3,865**	**3,881**	**48.2%**	**52.8%**	**58.4%**	**58.6%**	**4.6%**	**5.6%**	**0.2%**	**10.4%**

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

	Shrub (Acres)			Closed Timber (Acres)			Open Timber (Acres)		
Statistic	1950	1976	2001	1950	1976	2001	1950	1976	2001
Min	0.2	0.7	1.3	0.3	1.0	1.0	6.1	0.1	3.0
Max	87.6	77.2	32.2	376.6	197.6	155.3	90.7	74.5	98.6
Average	12.8	13.6	10.3	60.4	34.6	34.0	30.9	19.1	27.8
Sum	295.3	326.1	153.8	844.9	760.8	781.6	154.7	152.5	194.5

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)	121.3
Channel to Riparian (acres)	238.3
Riparian Encroachment (acres)	**117.1**

Riparian Recruitment

Creation of riparian areas between 1950s and 2001.

1950s Channel Mapped as 2011 Riparian (Ac)	243.1
1950s Floodplain Mapped as 2011 Channel (Ac)	77.9
Total Recruitment (1950s to 2011)(Ac)	**321.0**

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	21.1	134.3	54.1	0.0	**209.6**
Acres/Valley Mile	3.5	22.5	9.1	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 (YRCDC) 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	215.78	3.79%	10.28	9.98	29.74	7.23

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

Low Flow Fisheries Habitat Mapping

2001 (Acres)

Habitat	Bankfull	Low Flow	% of Low Flow
Scour Pool	88.5	66.4	7.3%
Rip Rap Bottom	200.9	152.6	16.8%
Rip Rap Margin	124.6	93.0	10.2%
Secondary Channel		8.8	1.0%
Secondary Channel (Seasonal)	143.5	115.7	12.8%
Channel Crossover	149.9	91.9	10.1%
Point Bar		41.8	4.6%
Side Bar		33.6	3.7%
Mid-channel Bar		16.0	1.8%
Island	199.8	199.8	22.0%
Dry Channel		87.5	9.6%

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 YRCDC Technical Advisory Committee. The Audubon methodology recorded data for a wider variety of bird species relative to the MSU study, including raptors and waterfowl.

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.