

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)

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

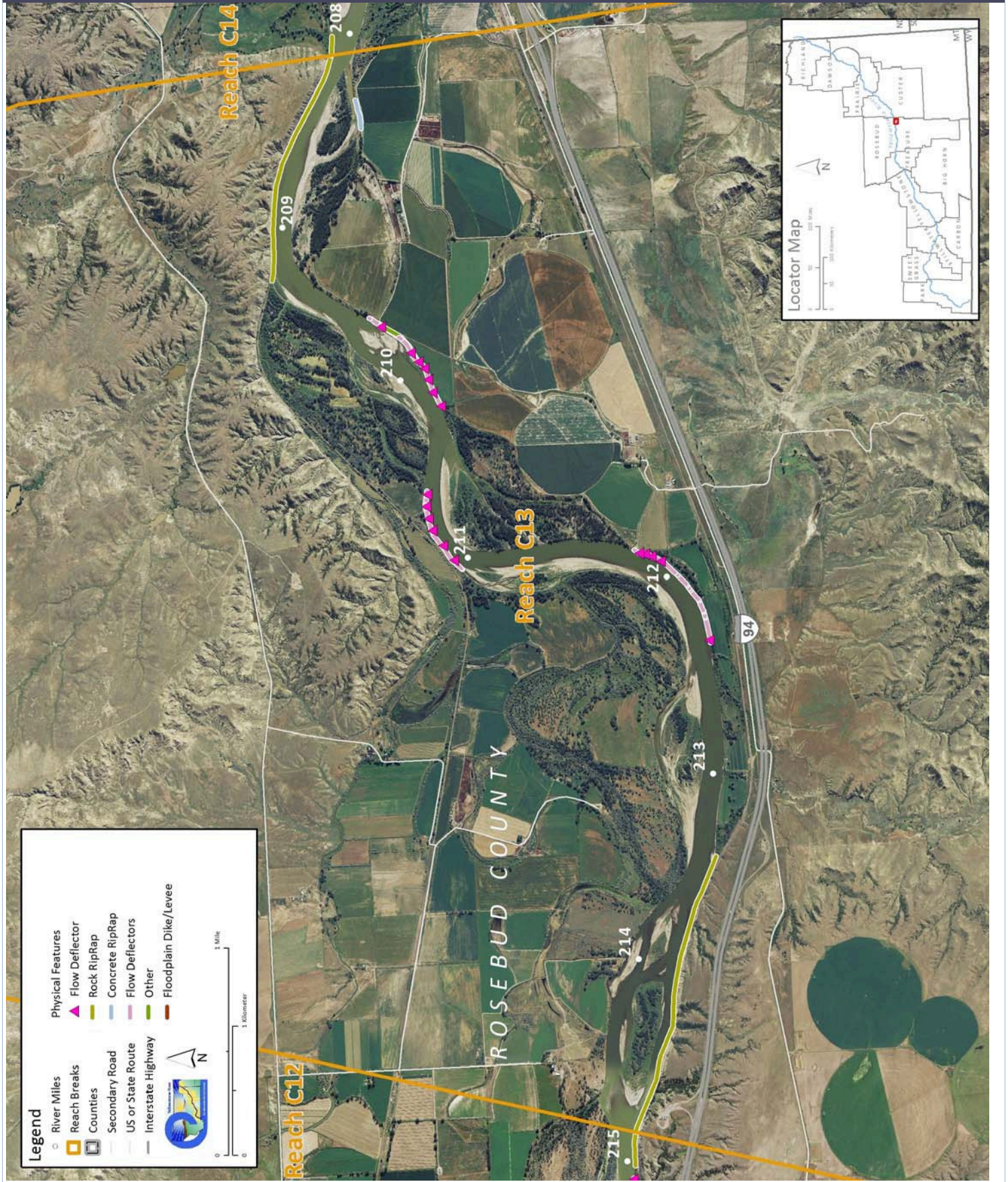
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach C13 include:

- 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)

The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated from a large dataset that is presented in more detail in the full reach narrative report.

Discharge	Undev.	Developed	% Change	"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.		
2 Year (cfs)	61,900	47,300	-23.6%			
100 Year (cfs)	120,000	98,800	-17.7%			
Bankfull Channel Area (Ac)	1950	1976	1995	2001	1950-2001	Bankfull channel area is the total footprint of the river inundated at approx. the 2-year flood.
	783.2	689.3	711.3	707.5	-75.7	
Physical Features	2011 Length (ft)	% of Bankline	2001-2011 Change	There are additional types of bank armor such as car bodies and steel retaining walls, but they are relatively minor.		
Rock Riprap	13,403	18.8%	0			
Concrete Riprap	744	1.0%	0			
Flow Deflectors	4,567	6.4%	-3,969			
Total	18,714	26.3%	-3,969			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	0	4,575				
Floodplain Turnover	1950 - 1976	1976 - 2001	1950-2001 In-channel riparian encroachment (negative number indicates retreat)		The rate of floodplain turnover reflects how many acres of land are eroded by the river. Turnover is associated with the creation of riparian habitat.	
Total Acres	129.8	103.2	117.07 acres			
Acres/Year	5.0	4.1				
Acres/Year/Valley Mile	0.8	0.7				
Open Bar Area	Point Bars	Bank Attached	Mid-Channel	Total	The type and extent of open sand and gravel bars reflect in-stream habitat conditions that can be important to fish, amphibians, and ground-nesting birds such as least terns.	
Change in Area '50 - '01 (Ac)	18.4	23.4	-51	-9.1		
Floodplain Isolation	Acres	% of FP	Floodplain isolation refers to area that historically was flooded, but has become isolated do to flow alterations or physical features such as levees.			
5 Year	920.7	45%				
100 Year	640.6	20%				
Restricted Migration Area	Acres	% of CMZ	Channel Migration Zone restrictions refer to the area and percent of the CMZ that has been isolated by features such as bank armor, dikes, levees, and transportation embankments.			
	222.1	11%				
Land Use	1950	2011	1950	2011	Changes in land use reflect the development of the river corridor through time. The irrigated agricultural are is a sub-set of the mapped agricultural land.	
Agricultural Land (Ac)	6,899.7	6,620.2	Flood (Ac)	3,571.5	2,411.6	
Ag. Infrastructure (Ac)	60.1	132.9	Sprinkler (Ac)	0.0	0.1	
Exurban (Ac)	0.0	23.8	Pivot (Ac)	0.0	327.6	
Urban (Ac)	0.0	0.0				
Transportation (Ac)	104.8	242.3				
1950s Riparian Vegetation Converted to a Developed Land Use (ac)	To Irrigated	To Other Use	Total Rip. Converted	% of 1950s Rip.	Changes in the extents of riparian vegetation are influenced by land use changes within the corridor.	
	133.3	0.0	133.3	11.0%		
National Wetlands Inventory	Acres	Acres per Valley Mi	Total Wetland Acres	Wetlands units summarized from National Wetlands Inventory Mapping include Riverine (typically open water sloughs), Emergent (marshes and wet meadows) and Shrub-Scrub (open bar areas with colonizing woody vegetation).		
Riverine	21.1	3.5	209.6			
Emergent	134.3	22.5				
Scrub/Shrub	54.1	9.1				
Russian Olive (2001) (Appx. 100-yr Floodplain)	Acres	%	Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.			
	215.8	3.8%				
Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)	1950	1976	2001	Change 1950-2011	Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.	
	62.3	30.2	26.6	-35.7		

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP

