

<b>County</b>	Park	<b>Upstream River Mile</b>	505
<b>Classification</b>	PCA: Partially confined anabranching	<b>Downstream River Mile</b>	501.7
<b>General Location</b>	Through Interstate bridge crossing to Livingston	<b>Length</b>	3.30 mi (5.31 km)

## Narrative Summary

Reach PC14 is a 3.3 mile long river segment that extends from the mouth of Allenspur Canyon to Sacajawea Park in Livingston. The reach is heavily developed, with almost 600 acres of urban/exurban development in the land use mapping corridor, and another 45 acres developed on 9th Street Island and Siebeck Island. There are over three miles of bank armor in the reach, with about 17,000 feet of rock riprap and 1,600 feet of flow deflectors. This armor covers about 54 percent of the streambanks. Between 2001 and 2011, almost 400 feet of rock riprap located at the head of Siebeck Island was destroyed. There are also over three miles of floodplain dikes mapped in this reach. The physical features protect development on the west floodplain and on Siebeck Island, which is a ~100 acre island just upstream of the Interstate Bridge. Physical features have isolated 39 percent of the natural channel migration zone in Reach PC14.

There have been extensive blockages of side channels in Reach PC14. Prior to 1950, about 8,600 feet of side channels were blocked by dikes, and since 1950 dikes have been built to block another mile of side channel.

About 100 acres of wetlands have been mapped in Reach PC14. About 20 of those wetland acres are on Siebeck Island.

This area of the upper Yellowstone River has seen three severe floods in the last 20 years. The 1996 and 1997 floods were very damaging, early-June events that peaked at 37,100 and 38,000 cfs, respectively. At the time, these were considered to be sequential 100-year floods. Then in late June of 2011, the river peaked at 40,600 cfs, which is currently the flood of record at Livingston. This flood exceeded a 100-year event, with both the 1996/1997 events considered to have exceeded a 75-year flood.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been relatively small in this reach. The biggest influence has been on low flows: severe low flows described as 7Q10 (the lowest average 7-day flow anticipated every ten years) for summer months has dropped from an estimated 1,570 cfs to 1,510 cfs with human development, a reduction of 3.8 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 1,760 cfs under unregulated conditions to 1,680 cfs under regulated conditions at the Livingston gage, a reduction of 4.6 percent.

CEA-Related observations in Reach PC14 include:

- Physical features blocking over 13,000 feet of side channels.
- Riprap failure at head of Siebeck Island
- Extensive CMZ Restriction with floodplain development.

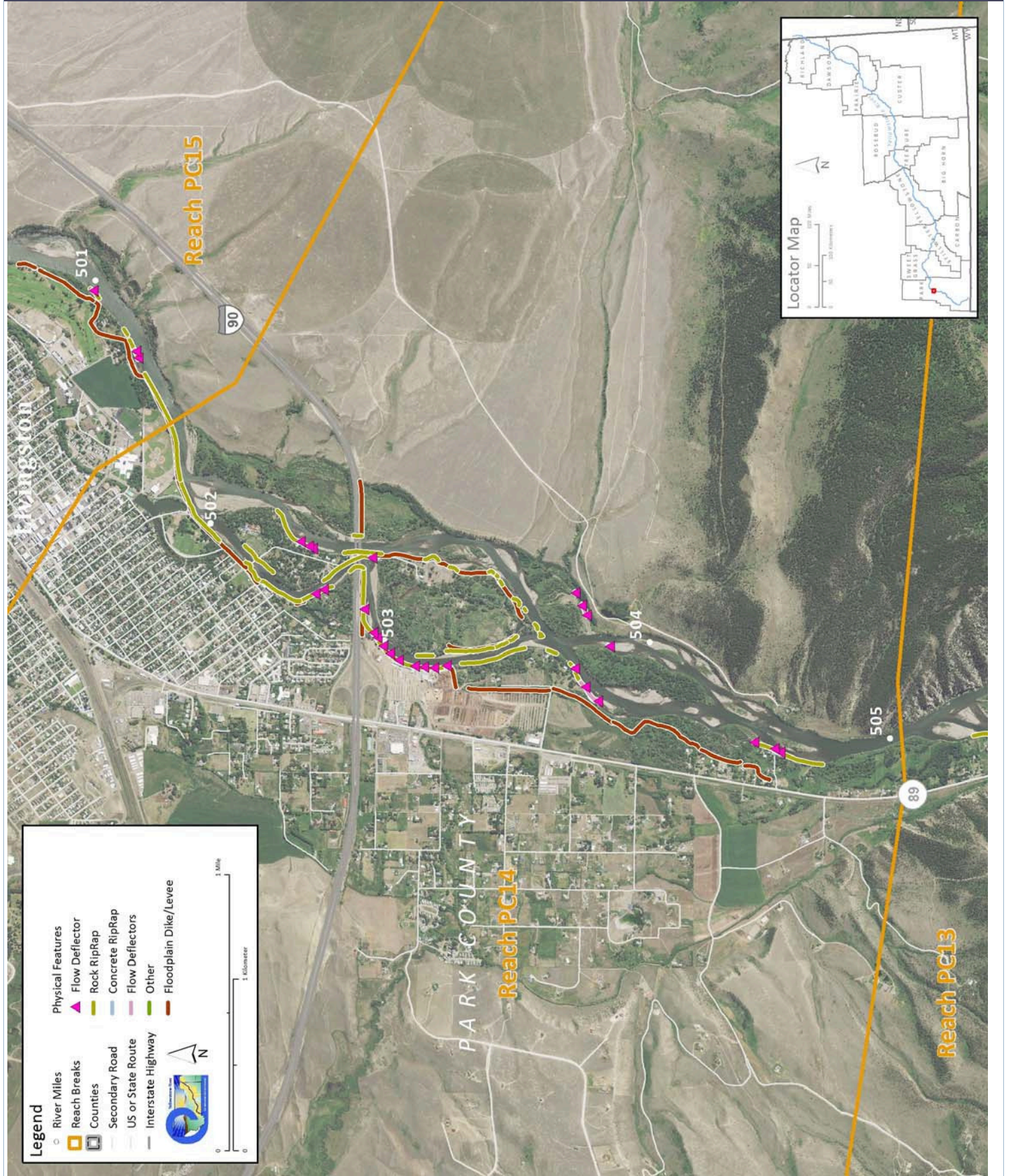
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach PC14 include:

- Side channel restoration at RM 504.6L
- Bank armor removal at head of Siebeck Island at RM 503.8
- CMZ management due to 38 percent restriction of Channel Migration Zone
- Russian olive removal
- Bank Stabilization Recommended Practices due to extensive armoring in reach (51 percent of bankline)

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.

<b>Discharge</b>	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)	20,300	20,200	-0.5%			
100 Year (cfs)	38,200	38,100	-0.3%			
<b>Bankfull Channel Area (Ac)</b>	1950	1976	1995	2001	1950-2001	Bankful channel area is the total footprint of the river inundated at approx. the 2-year flood.
	216.2			240.0	23.8	
<b>Physical Features</b>	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	16,931	46.4%	-389			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	1,581	4.3%	-8			
<b>Total</b>	<b>18,512</b>	<b>50.7%</b>	<b>-398</b>			
<b>Length of Side Channels Blocked (ft)</b>	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	8,601	5,546				
<b>Floodplain Turnover</b>	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			acres			
Acres/Year						
Acres/Year/Valley Mile						
<b>Open Bar Area</b>	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)						
<b>Floodplain Isolation</b>	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						
100 Year						
<b>Restricted Migration Area</b>	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.			
	268.2	38%				
<b>Land Use</b>	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)	811.2	444.1	Flood (Ac)	149.7	0.8	
Ag. Infrastructure (Ac)	2.1	1.4	Sprinkler (Ac)	0.0	32.9	
Exurban (Ac)	37.5	266.5	Pivot (Ac)	0.0	0.0	
Urban (Ac)	277.1	328.2				
Transportation (Ac)	18.4	74.7				
<b>1950s Riparian Vegetation Converted to a Developed Land Use (ac)</b>	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.	
<b>National Wetlands Inventory</b>	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	15.3	5.1	93.0			
Emergent	26.4	8.8				
Scrub/Shrub	51.2	17.1				
<b>Russian Olive (2001) (Appx. 100-yr Floodplain)</b>	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.			
	4.7	0.9%				
<b>Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)</b>	1950	1976	2001	Change 1950-2011	Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.	

## PHYSICAL FEATURES MAP (2011)



## CHANNEL MIGRATION ZONE MAP

