County	Park	**Upstream River Mile**	493.6
Classification	UA: Unconfined anabranching	**Downstream River Mile**	488.3
General Location	To below Mission Creek	**Length**	5.30 mi (8.53 km)

Narrative Summary

Reach PC18 is located in Park County, downstream of Livingston at Mission Creek. It is 5.3 miles long, extending from RM 488.2 to RM 493.5. Reach PC 18 is an Unconfined Anabranching (UA) reach type. In the uppermost portion of the Reach (RM 492.5-493.5), the river flows along bluffs of the Fort Union Formation, which is made up of massive cliff-forming sedimentary rocks. The south side of the river consists primarily of young river deposits that form the modern valley bottom and low terraces. Sheep Mountain Fishing Access Site is located at RM 491.5. Just upstream of the fishing access site, the Middle Windsor Ditch diverts water off of a side channel.

In 2001, there was 9,650 feet of rock riprap in the reach and by 2011 that had expanded to 11,486 feet. Similarly, the extent of flow deflectors expanded from 1,710 feet to 3,370 feet from 2001 to 2011. Approximately 27 percent of the total bankline was armored in 2011. There is also one floodplain dike on the south floodplain near RM 492 that is about 3,400 feet long.

Over two miles of side channel have been blocked by dikes in Reach PC18. All of these lost side channels are located in the lower end of the reach below the mouth of Mission Creek. On the order of 3,370 feet were blocked prior to 1950, and about 8,000 feet since then.

Land uses in Reach PC18 are almost entirely agricultural, with historic flood irrigation converting to sprinkler and pivot, and some exurban development since 1950. There are still 302 acres of ground under flood irrigation in the reach. The major land use in the reach, however, is non-irrigated agriculture. There is one series of corrals associated with an animal holding facility that is within 200 feet of an abandoned channel at RM 490.3. Exurban Residential land use has expanded from zero acres in the1950s to 155 acres in 2011.

About 580 acres of wetlands have been mapped in Reach PC18, most of which are emergent marshes and wet meadows. Most of these wetlands are on the south side of the river in non-irrigated hay pastures or multi-use riparian bottoms.

Reach PC18 has 17 acres of Russian olive, which is the most of in any reach in Park County. This Russian olive is concentrated in one area on the south floodplain at RM 492.8; this area also has extensive mapped emergent wetlands.

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 1,720 cfs to 1,560 cfs with human development, a reduction of 9.3 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 PC18 include:
- Blocked side channels that are thousands of feet long.
- Concentrated Russian olive infestation within mapped emergent wetland.

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach PC18 include:
- Side channel restoration at RM 490R
- CMZ Management due to current restriction of 14 percent of the Channel Migration Zone
- Russian olive removal
- Nutrient management at corrals that are part of an animal handling facility at RM 490.3L
- Bank Stabilization Recommended due to the extent of armoring in the reach (27 percent armored banks)
- Irrigation diversion structure management at Middle Windsor Ditch diversion

Yellowstone River Reach Narratives — Reach PC18

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
2 Year (cfs)	22,400	22,000	-1.8%
100 Year (cfs)	41,800	41,600	-0.5%

"Undeveloped" flows represent conditions prior to significant human development, whereas "developed" flows reflect the current condition of both consumptive and non-consumptive water use.

Bankfull Channel Area (Ac)

1950	1976	1995	2001	1950-2001
327.7			399.4	71.7

Bankful channel area is the total footprint of the river inundated at approx. the 2-year flood.

Physical Features

	2011 Length (ft)	% of Bankline	2001-2011 Change
Rock RipRap	11,486	20.6%	1,836
Concrete Riprap	0	0.0%	0
Flow Deflectors	3,462	6.2%	1,748
Total	**14,948**	**26.8%**	**3,584**

There are additional types of bank armor such as car bodies and steel retaining walls, but they are relatively minor.

Length of Side Channels Blocked (ft)

Pre-1950s	Post-1950s
3,369	7,999

Numerous side channels have been blocked by small dikes.

Floodplain Turnover

	1950 - 1976	1976 - 2001	1950-2001 In-channel riparian encroachment (negative number indicates retreat)
Total Acres			
Acres/Year			
Acres/Year/Valley Mile			acres

The rate of floodplain turnover reflects how many acres of land are eroded by the river. Tunover is associated with the creation of riparian habitat.

Open Bar Area

	Point Bars	Bank Attached	Mid-Channel	Total
Change in Area '50 - '01 (Ac)				

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.

Floodplain Isolation

	Acres	% of FP
5 Year		
100 Year		

Floodplain isolation refers to area that historically was flooded, but has become isolated do to flow alterations or physical features such as levees.

Restricted Migration Area

Acres	% of CMZ
184.6	14%

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.

Land Use

	1950	2011
Agricultural Land (Ac)	3,092.7	2,728.1
Ag. Infrastructure (Ac)	86.3	170.6
Exurban (Ac)	0.0	155.3
Urban (Ac)	0.0	0.0
Transportation (Ac)	83.6	155.2

	1950	2011
Flood (Ac)	1,364.7	302.5
Sprinkler (Ac)	0.0	128.4
Pivot (Ac)	0.0	412.2

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.

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.

National Wetlands Inventory

	Acres	Acres per Valley Mi
Riverine	6.5	1.4
Emergent	504.8	105.6
Scrub/Shrub	68.1	14.3

Total Wetland Acres: **579.4**

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).

Russian Olive (2001) (Appx. 100-yr Floodplain)

Acres	%
16.7	0.8%

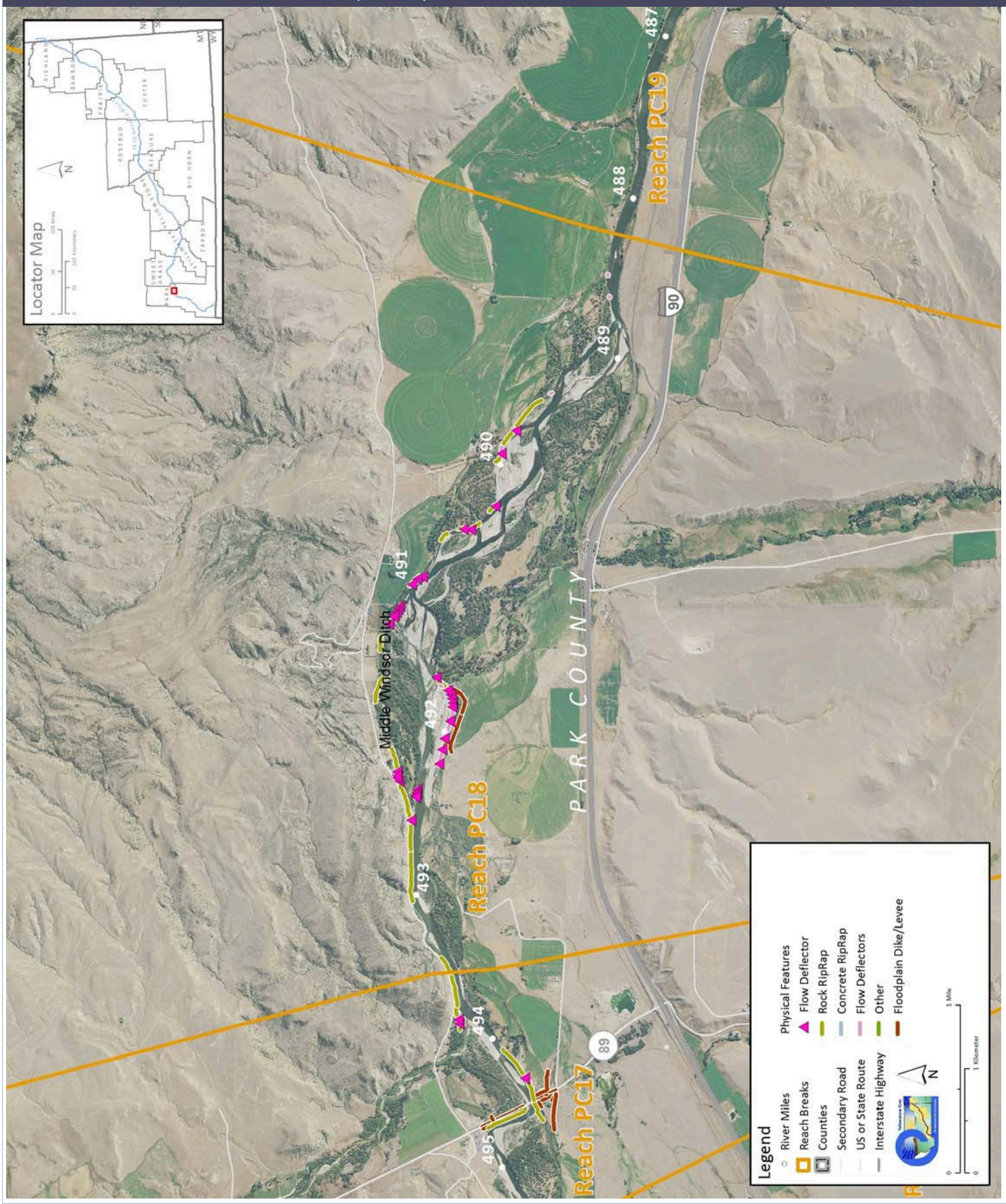
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

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.

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP