County	Park	**Upstream River Mile**	481
Classification	PCA: Partially confined anabranching	**Downstream River Mile**	478.8
General Location	To Springdale	**Length**	2.20 mi (3.54 km)

Narrative Summary

Reach PC21 is the downstream-most reach in Park County, emerging from a narrow canyon just above Springdale. The reach is 2.2 miles long, and is classified as Partially Confined Anabranching, reflecting some influence of the valley wall on channel form coupled by islands and side channels. At the upstream end of the reach, the Hunters Hot Springs Canal Diversion diverts water along the left bank of the river where it flows along the valley wall. This canal carries water about 11 miles down the river valley.

Reach PC21 is fairly heavily armored, with over a mile of bank armor in the reach, and most of that is rock riprap. Most of the armor is on the right bank against the railroad line, but there is also armor protecting the Hunters Hot Springs Canal Diversion as well as hayfields along the left bank. In the lower end of the reach the left bank is a high terrace that has bedrock exposed at its toe.

The primary land use in Reach PC21 is non-irrigated agriculture, although there are 266 acres of ground under pivot irrigation. All of the pivot irrigation is well out of the Channel Migration Zone (CMZ). The Springdale Bridge Fishing Access Site is located in at the downstream end of the reach at Springdale Bridge. The bridge narrows the CMZ width from about 2,500 feet upstream to 1,000 feet downstream of the structure. Just upstream of the bridge, there are remnants of an older bridge, including a large pier in the river. Bedrock is exposed in the riverbed just upstream of the bridge.

About 90 acres of wetlands have been mapped in Reach PC21 and about 18 of those acres consist of emergent wetlands in low historic floodplain area that has been isolated from the river by the railroad and interstate. Although the Russian olive mapping shows 0.2 acres of RO in the reach, some of that had been eroded out by the river by fall 2011.

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 1,730 cfs to 1,570 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 PC21 include:
- Corridor confinement by transportation infrastructure.
- Emergent wetlands located in isolated floodplain area.
- Narrowing of CMZ by Springdale Bridge.

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach PC21 include:
- CMZ Management due to current restriction of 19 percent of the Channel Migration Zone
- Bank Stabilization Recommended Practices due to 27 percent of banks being armored in reach
- Irrigation diversion structure management at Hunters Hot Springs Canal diversion.

Yellowstone River Reach Narratives — Reach PC21

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
136.7	13.1		148.9	12.2

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	6,270	26.2%	169
Concrete Riprap	0	0.0%	0
Flow Deflectors	123	0.5%	62
Total	**6,393**	**26.7%**	**232**

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
0	0

Numerous side channels have been blocked by small dikes.

Floodplain Turnover

	1950 - 1976	1976 - 2001
Total Acres		
Acres/Year		
Acres/Year/Valley Mile		

1950-2001 In-channel riparian encroachment (negative number indicates retreat)

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
64.9	19%

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)	918.3	832.0
Ag. Infrastructure (Ac)	18.2	73.8
Exurban (Ac)	12.5	21.3
Urban (Ac)	0.0	0.0
Transportation (Ac)	38.1	58.3

	1950	2011
Flood (Ac)	148.2	69.8
Sprinkler (Ac)	0.0	9.3
Pivot (Ac)	0.0	256.5

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	1.9	1.0
Emergent	61.8	31.4
Scrub/Shrub	25.6	13.0

Total Wetland Acres: **89.3**

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	%
0.2	0.2%

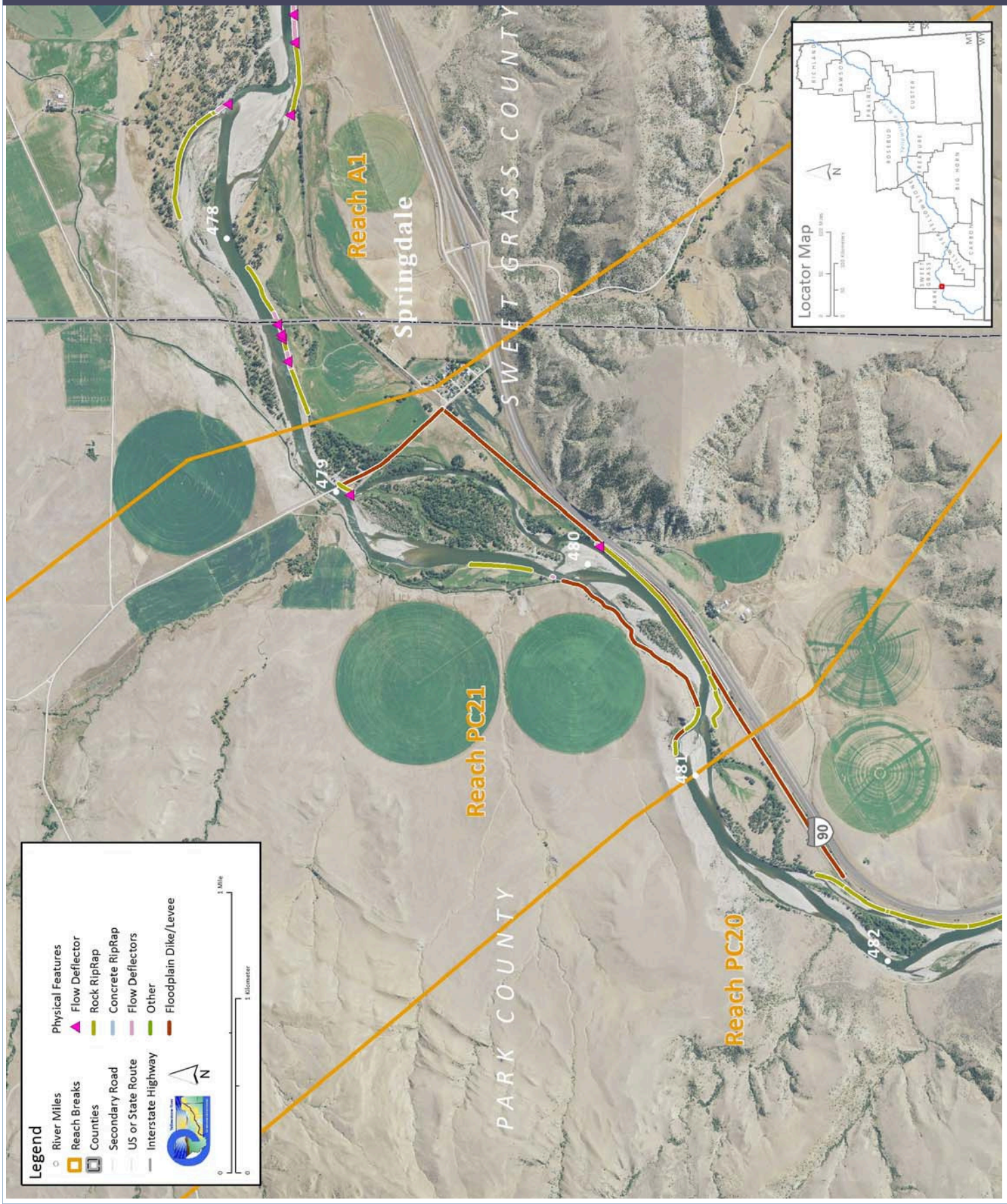
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

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