County	Stillwater	**Upstream River Mile**	417.3
Classification	PCA: Partially confined anabranching	**Downstream River Mile**	413.7
General Location	Columbus	**Length**	3.60 mi (5.79 km)

Narrative Summary

Reach A13 is 3.6 miles long and is located at Columbus. The reach is a Partially Confined Anabranching (PCA) reach type, indicating some valley wall influence and relatively extensive forested islands. Reach A13 marks an abrupt widening in the river valley as the erosion resistant sandstone cliffs of the Hell Creek Formation transition downstream into the more erodible Bearpaw Shale. The reach is urbanized with most development concentrated on the north side of the river. Migration rates since 1950 have been moderate in this reach largely due to extensive bank armoring.

Similar to other reaches in Region A, the overall footprint of the river channel has increased in size since 1950. In 1950, the channel footprint was 258 acres but by 2001 it had expanded to 327 acres. This was accompanied by a net loss of about 40 acres of riparian area to channel during that same timeframe.

About 28 percent of the banks in Reach A13 are armored, with the majority of that armor being rock riprap. Reach A13 has almost 3,000 feet of concrete riprap, reflecting an abrupt increase in the use of concrete as armor relative to upstream. The concrete is on the north bank of the river just upstream of the Columbus Bridge. Between 2001 and 2011, there was a gain of about 2,800 feet of rock riprap in the reach; most of this was on the north side of the river adjacent to town.

Land use in Reach A13 is predominantly agricultural, although there are over 600 acres of exurban/exurban development within the mapping footprint. Approximately one half of the agricultural land is in flood irrigation (600 acres). No other types of irrigation were mapped in the reach. A total of 133 acres of developed land are in the Channel Migration Zone, and about half of that is in urban/exurban development. About 13 percent of the CMZ is isolated by physical features, most of which is armor protecting the railroad in Columbus.

About 18 percent of the historic 100-year floodplain has become isolated from the river due primarily to the downstream shadow caused by the Columbus Bridge embankment on the north side of the river.

There is one pipeline crossing in Reach A13, a natural gas crossing called the Lake Basin-Absarokee Line owned by NW energy. The pipeline crosses the river at RM 417.

One ice jam has been recorded in this reach. On February 6, 1996, an ice jam break-up was reported to cause local flooding.

There are corrals that are part of an animal handling facility in the reach, north of the river at RM 414.

Riparian mapping in Reach A13 shows a reduction of about 50 acres of closed timber in the reach since 1950.

Reach A13 has approximately 5 acres of mapped Russian olive, which is spread out both within the riparian corridor and through the town of Columbus. There are also over 100 acres of mapped wetland in the each, most of which is emergent marshes and wet meadows.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been moderate in this reach. The mean annual flood is estimated to have dropped from 14,400 cfs to 13,600 cfs, a drop of about 6 percent. 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 2,270 cfs to 1,760 cfs with human development, a reduction of 22 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 A13 include:
- A jump in the use of concrete armor relative to upstream
- Armoring associated with urbanization
- Urban/Exurban development in CMZ

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach A13 include:
- CMZ management at Columbus due to high level of encroachment
- Nutrient management at corrals at RM 414
- Bank Stabilization Recommended Practices due to extent of armoring in reach (28 percent)
- Russian olive removal (5 acres)
- Pipeline management (natural gas) for main river crossing at RM 417
- Wetland restoration/management due to extent of mapped wetland (110 acres)

Yellowstone River Reach Narratives — Reach A13

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)	31,000	29,800	-3.9%
100 Year (cfs)	56,600	55,900	-1.2%

"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
258.2	280.0	301.0	326.6	68.4

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	7,874	20.7%	2,783
Concrete Riprap	2,837	7.5%	0
Flow Deflectors	0	0.0%	0
Total	**10,711**	**28.2%**	**2,783**

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	65.5	62.6
Acres/Year	2.5	2.5
Acres/Year/Valley Mile	0.8	0.8

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

-38.55 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	11.1	13%
100 Year	71.7	18%

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
100.8	13%

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)	1,778.1	1,332.0
Ag. Infrastructure (Ac)	43.8	79.2
Exurban (Ac)	13.1	245.8
Urban (Ac)	270.5	384.9
Transportation (Ac)	68.1	66.5

	1950	2011
Flood (Ac)	686.0	599.0
Sprinkler (Ac)	0.0	0.0
Pivot (Ac)	0.0	0.0

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.
18.9	36.7	55.6	14.0%

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	18.1	5.7
Emergent	75.8	23.8
Scrub/Shrub	16.2	5.1

Total Wetland Acres: **110.1**

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	%
5.0	1.1%

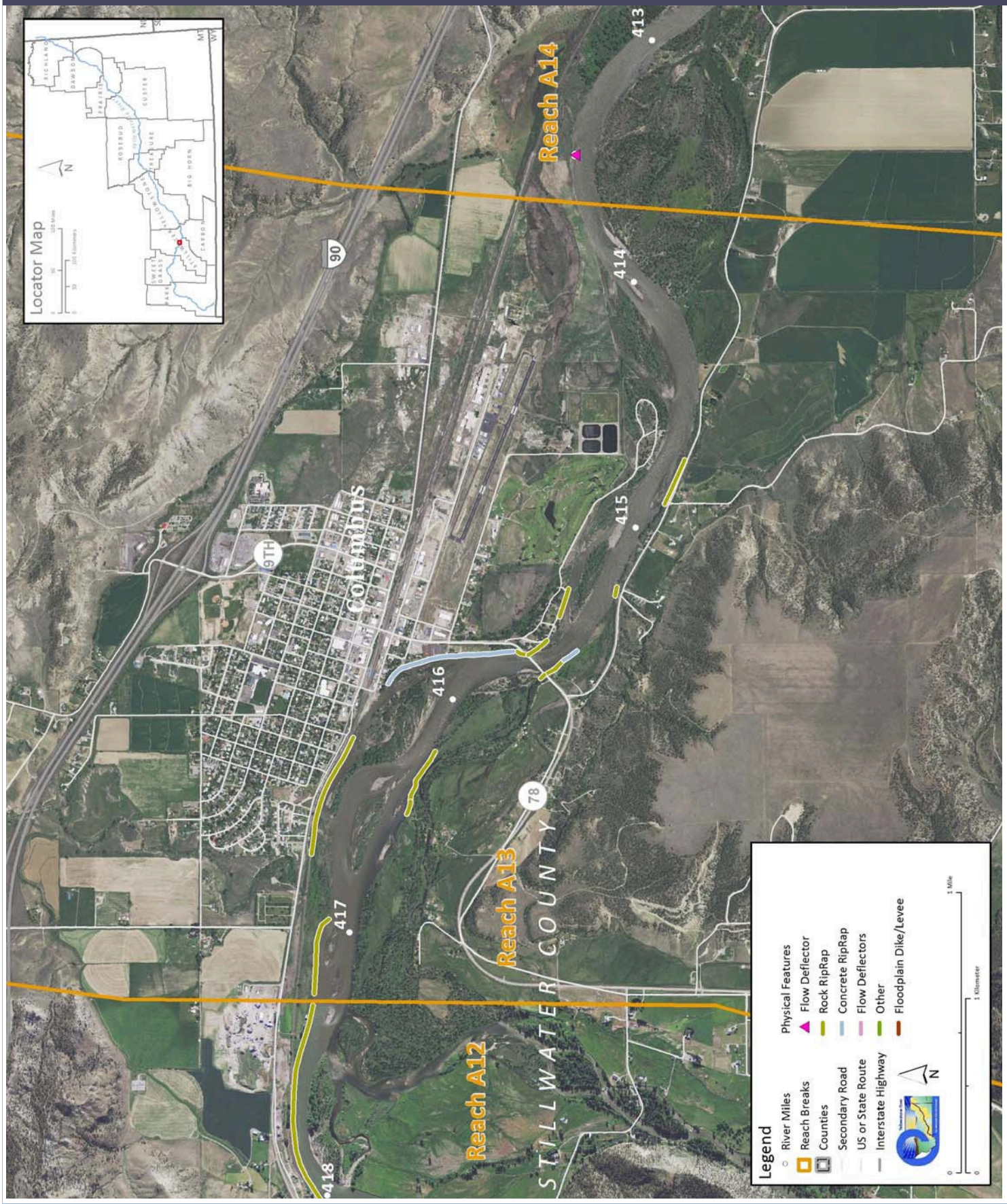
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

Riparian Forest at low risk of Cowbird Parasitism (Ac/Valley Mile)

1950	1976	2001	Change 1950-2011
0.0	0.0	0.0	0.0

Cowbirds are associated with agricultural and residential development, displacing native bird species by parasitizing their nests.

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP