County	Yellowstone	**Upstream River Mile**	357.9
Classification	PCS: Partially confined straight	**Downstream River Mile**	354
General Location	Upstream of Huntley	**Length**	3.90 mi (6.28 km)

Narrative Summary

Reach B4 is 3.9 miles long and located upstream of Huntley. It is classified as a Partially Confined Straight (PCS) reach type because within this area the river flows straight along the south valley wall with minimal meandering. The reach is characterized by the most extensive bank armoring of any reach on the river.

In total there are about 29,000 feet of bank protection in Reach B4, such that 74 percent of the bankline is armored. Most of the armor is rock riprap, although there are over 8,000 feet of concrete riprap mapped in the reach, as well as over 9,000 feet of floodplain dikes. Between 2001 and 2011, 500 feet of concrete riprap and 1,050 feet of flow deflectors were eroded out in the reach. The failed flow deflectors and concrete riprap have been largely replaced by rock riprap, although at the upstream end of the reach at RM 357.8, about 300 feet of flanked flow deflectors are in the river about 75 feet off of the left (north) bank.

The predominant land use in the reach is agriculture, with about 1,200 acres of land in flood irrigation in 2011. A total of 204 acres of developed land uses have encroached into the Channel Migration Zone (CMZ), including 193 acres of flood irrigation and 11 acres of transportation corridor. In order to protect these land uses, bank armor installations have isolated about one half of the river's CMZ.

Huntley Diversion Dam is located at RM 355.8. The structure diverts flow into the Huntley Main Canal, which follows the southern margin of the Yellowstone River floodplain. The diversion capacity of Huntley Dam is 600 cfs, and the project has the capacity to provide irrigation water to 30,000 acres of farm land. The crest length of the structure is 325 feet, and its structural height is 10.5 feet (http://www.usbr.gov/dataweb/dams/yellowstone_river_diversion.htm). The Huntley diversion structure was originally constructed as a temporary earthfill dam in 1931. In 1934, the temporary structure was modified to a concrete weir. In 1959, the dam underwent considerable rehabilitation due to undermining caused by settling and cracking of the concrete structure. As part of repairs required after recent flooding on the river, a fish passage channel was constructed around the north end of the dam. The structure is located at a point of split flow on the river, and blocks only the main channel. However, 2001 color infrared air photos of the site show that at low flows, the unblocked secondary channels are essentially dry and therefore incapable of passing fish.

Land has been developed in commonly flooded areas. About 280 acres of flood irrigated land is within the 5-year floodplain area.

There are corrals that are part of an animal handling facility adjacent to the north bank of the river at RM 355.

About 2.3 acres of Russian olive have been mapped in Reach B4.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been substantial in this reach. The mean annual flood is estimated to have dropped from 24,000 cfs to 19,900 cfs, a drop of about 17 percent. The 2-year flood, which strongly influences overall channel form, has dropped from 44,700 cfs to 40,300 cfs, which is a reduction of 10 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 2,940 cfs to 2,010 cfs with human development, a reduction of 32 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 3,846 cfs under unregulated conditions to 2,227 cfs under regulated conditions at the Billings gage, a reduction of 42 percent.

CEA-Related observations in Reach B4 include:
- Flanking of flow deflectors
- Repair of damaged flow deflectors with riprap

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach B4 include:
- Flanked flow deflector removal at RM 357.8
- Nutrient management at corrals associated with animal handling facility at RM 355.
- Fish passage at Huntley Diversion Dam
- Watercraft passage at Huntley Diversion Dam
- Irrigation Diversion structure management at Huntley Diversion Dam

Yellowstone River Reach Narratives — Reach B4

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)	44,700	40,300	-9.8%
100 Year (cfs)	79,400	76,800	-3.3%

"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
322.4	315.6	315.7	360.6	38.2

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	20,729	52.1%	1,205
Concrete Riprap	8,331	20.9%	-502
Flow Deflectors	258	0.6%	-1,056
Total	**29,318**	**73.7%**	**-353**

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	72.7	60.4
Acres/Year	2.8	2.4
Acres/Year/Valley Mile	0.8	0.7

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

-14.25 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	131.5	14%
100 Year	28.9	2%

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
484.3	44%

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)	2,775.5	2,552.4
Ag. Infrastructure (Ac)	75.7	167.6
Exurban (Ac)	0.0	40.9
Urban (Ac)	0.0	0.0
Transportation (Ac)	21.8	59.4

	1950	2011
Flood (Ac)	727.6	1,161.5
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.
11.4	0.0	11.4	3.0%

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	17.0	4.6
Emergent	34.3	9.2
Scrub/Shrub	8.1	2.2

Total Wetland Acres: **59.5**

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	%
2.3	1.1%

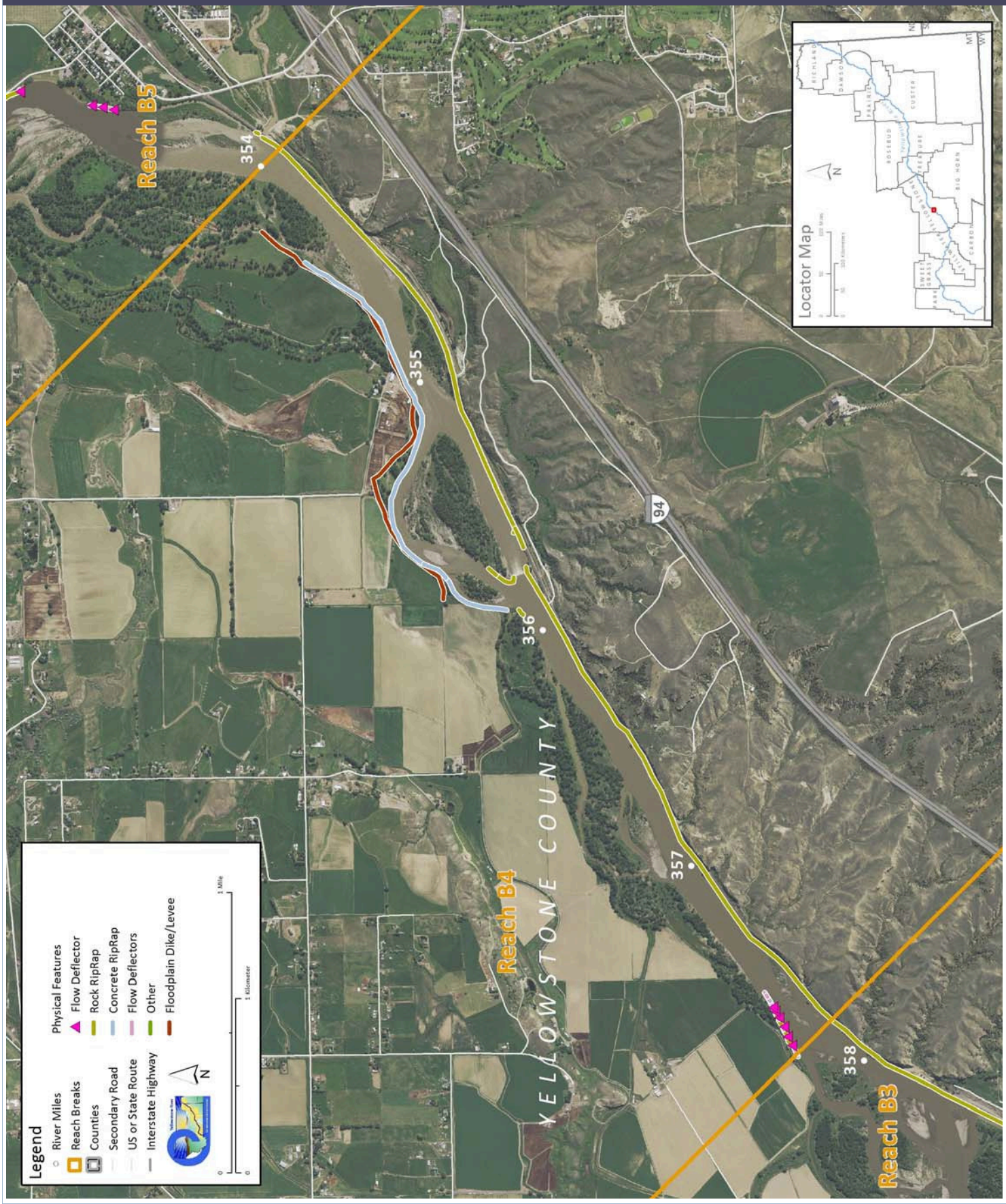
Russian olive is considered an invasive species and its presence in the corridor is fairly recent. Its spread can be used as a general indicator of invasive plants within the corridor.

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

1950	1976	2001	Change 1950-2011
0.5	0.0	0.0	-0.5

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

PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP