

County	Richland	Upstream River Mile	56.3
Classification	PCA: Partially confined anabranching	Downstream River Mile	49.9
General Location	Savage; Elk Island	Length	6.40 mi (10.30 km)

Narrative Summary

Reach D11 is 10.3 miles long, located near Savage and Elk Island. It is a Partially Confined Anabranching reach type (PCA) indicating distinct side channels around vegetated islands with some valley wall influences. The valley wall is comprised of Tertiary-age Fort Union Formation, and a distinct terrace surface borders the active stream corridor. Fort Union Formation rocks are exposed on a right bank bluff on the downstream end of the reach.

There is no mapped bank armor in Reach D11. Prior to 1950, however, about three miles of side channel had been blocked, mostly around Elk Island.

The most striking change in Reach D11 since 1950 is the encroachment of riparian vegetation onto old sand bars. Between 1950 and 2001, the size of the channel has dropped by 313 acres, and there has been 294 acres of riparian encroachment into old channel areas. Much of this encroachment converted open sand bars into forested islands. There has been a loss of over 100 acres of sand bar since 1950. This change has resulted in a conversion of almost 7 miles low flow channels around gravel bars to anabranching side channels around islands.

Reach D11 has had six ice jams-related floods reported since 1943. They all occurred in February or March, and several of them reported flood damages.

Approximately 36 percent of the historic 5-year floodplain has become isolated, largely due to flow alterations.

Land use in the reach is dominated by flood irrigation.

There are about 32 acres of Russian olive mapped in the reach.

Reach D11 was sampled as part of the avian study. A total of 61 bird species were identified in the reach, indicating high bird species richness. Five bird species identified by the Montana Natural Heritage Program as Potential Species of Concern (PSOC) were found, the Black and white Warbler, Chimney Swift, Dickcissel, Ovenbird, and Plumbeous Vireo. The Red-headed woodpecker was also observed, which has been identified as a Species of Concern (SOC). Reach D11 has seen an increase in the amount of forest area considered at low risk of cowbird parasitism. In 1950, there were 216.4 acres per valley mile of such forest, and by 2001, that number had increased to 247.2 acres per valley mile.

A hydrologic evaluation of flow depletions indicates that flow alterations over the last century have been major in this reach. The 2-year flood, which strongly influences overall channel form, has dropped by 22 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 4,370 cfs to 2,220 cfs with human development, a reduction of 50 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 6,540 cfs under unregulated conditions to 2,750 cfs under regulated conditions, a reduction of 59 percent. Fall and winter low flows are about 3,500 cfs; these discharges are about 60 percent to 80 percent higher than they were prior to development.

CEA-Related observations in Reach D11 include:

- Reduction in 5-year floodplain footprint with flow alterations
- Increased fall and winter low flows with development
- Reduced summer low flows with development
- Reduced channel forming discharge causing channel contraction
- Extensive riparian encroachment with flow alterations
- Conversion of open sand bars to forested islands

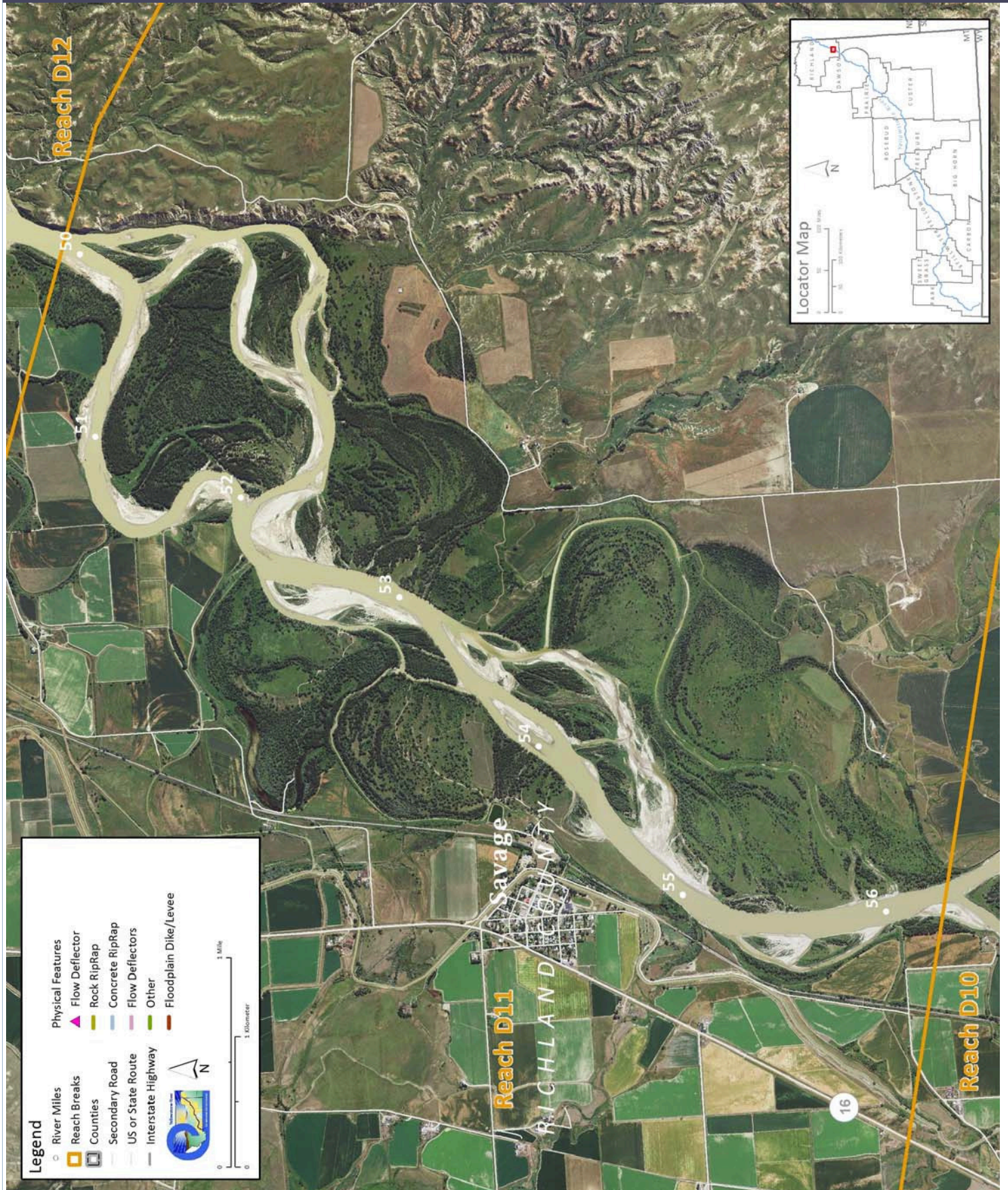
Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach D11 include:

- Side channel reactivation RM 53L
- Russian olive removal

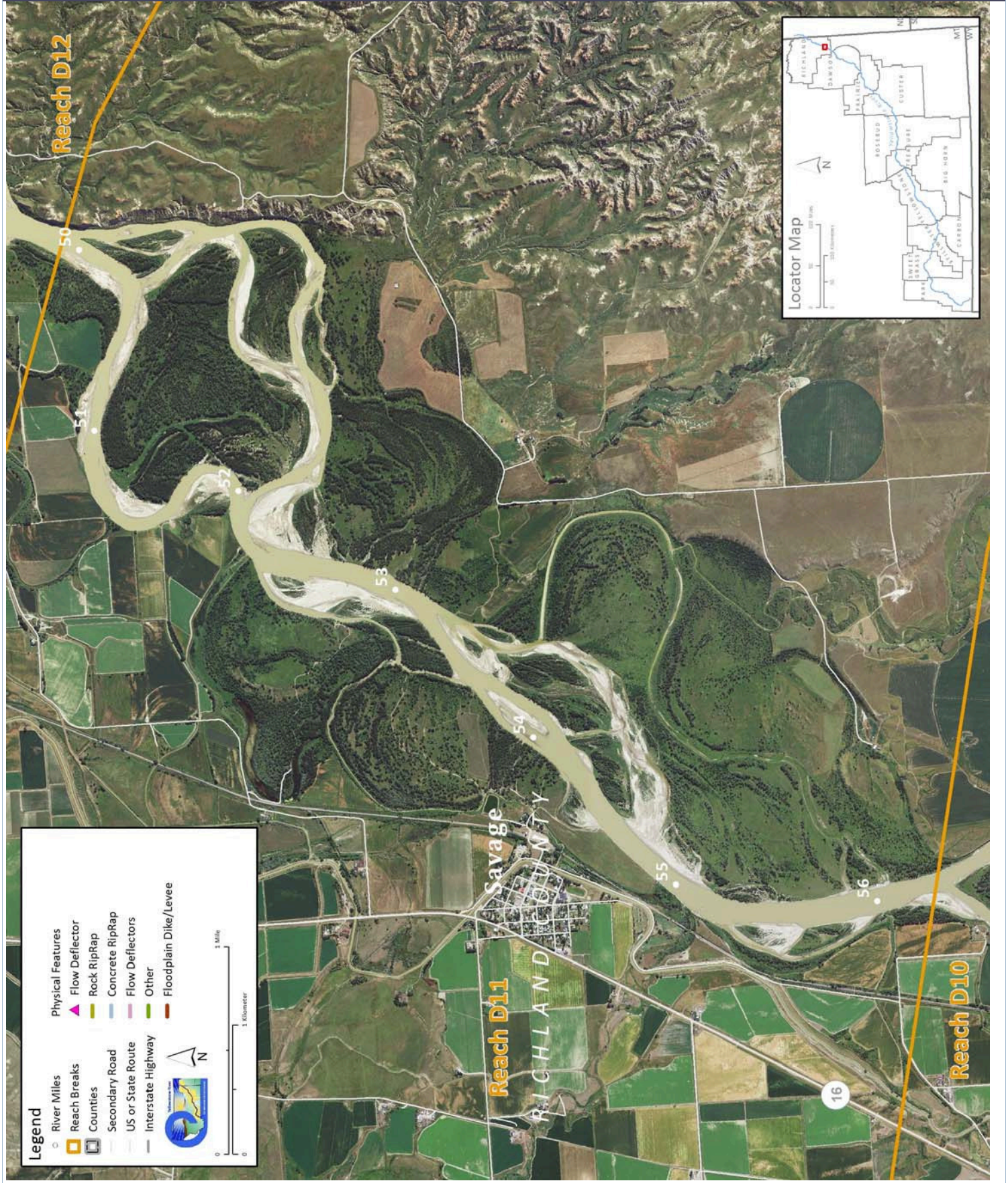
The following table summarizes some key CEA results that have been used to describe overall condition and types of human influences affecting the river. The values are specific to this single reach. Blanks indicate that a particular value was not available for this area. This information is consolidated from a large dataset that is presented in more detail in the full reach narrative report.

Discharge	Undev.	Developed	% Change	"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)	69,800	54,200	-22.3%			
100 Year (cfs)	144,000	131,000	-9.0%			
Bankfull Channel Area (Ac)	1950	1976	1995	2001	1950-2001	Bankfull channel area is the total footprint of the river inundated at approx. the 2-year flood.
	1,284.2	1,135.9	1,095.2	971.7	-312.5	
Physical Features	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	0	0.0%	0			
Concrete Riprap	0	0.0%	0			
Flow Deflectors	0	0.0%	0			
Total	0	0.0%	0			
Length of Side Channels Blocked (ft)	Pre-1950s	Post-1950s	Numerous side channels have been blocked by small dikes.			
	15,601	0				
Floodplain Turnover	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	387.4	178.3	294.92 acres			
Acres/Year	14.9	7.1				
Acres/Year/Valley Mile	2.8	1.3				
Open Bar Area	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)	-6.2	11.8	-108.9	-103.3		
Floodplain Isolation	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	861.6	36%				
100 Year	104.0	2%				
Restricted Migration Area	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.			
	62.2	1%				
Land Use	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)	3,337.6	4,457.3	Flood (Ac)	610.2	658.4	
Ag. Infrastructure (Ac)	39.9	49.7	Sprinkler (Ac)	0.0	0.0	
Exurban (Ac)	1.6	0.5	Pivot (Ac)	0.0	11.2	
Urban (Ac)	13.0	35.0				
Transportation (Ac)	31.4	39.1				
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.	
	46.2	0.2	46.3	2.0%		
National Wetlands Inventory	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	24.4	4.5	188.2			
Emergent	119.1	22.1				
Scrub/Shrub	44.7	8.3				
Russian Olive (2001) (Appx. 100-yr Floodplain)	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.			
	31.8	1.1%				
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.	
	216.4	252.2	247.2	30.8		

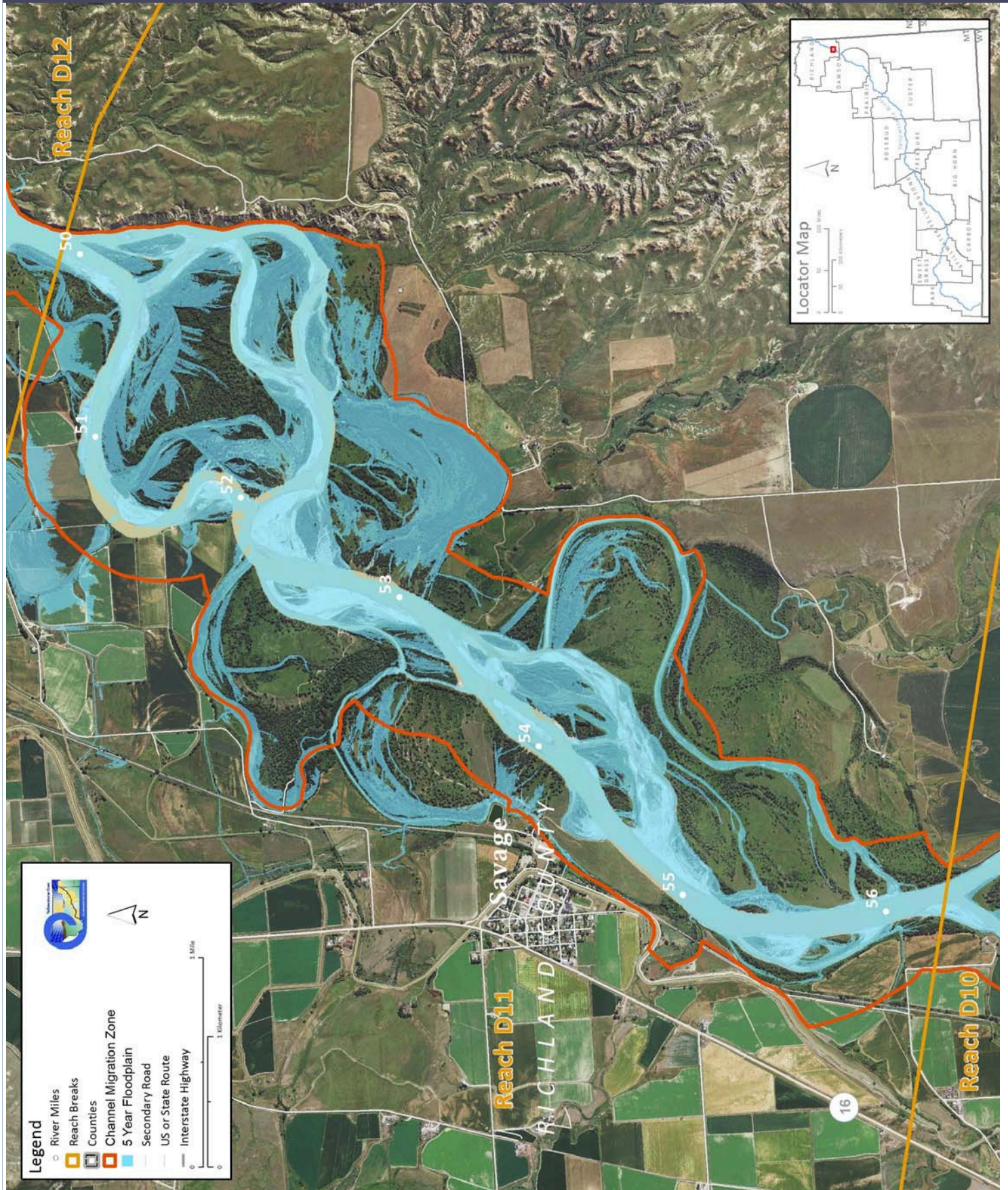
PHYSICAL FEATURES MAP (2011)



PHYSICAL FEATURES MAP (2011)



CHANNEL MIGRATION ZONE MAP



CHANNEL MIGRATION ZONE MAP

