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Natural Resource Stewardship and Science

Proper Functioning Condition Assessment of the Little Bighorn River

Little Bighorn Battlefield National Monument, Montana

Natural Resource Report NPS/NRSS/WRD/NRR - 2013/707

ON THE COVER
Little Bighorn River at Little Bighorn Battlefield National Monument
Photography by: Michael Martin, NPS-NRSS, Water Resources Division, 2012

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Purpose and Summary of Findings

The National Park Service is preparing a Natural Resource Condition Assessment for Little Bighorn Battlefield National Monument. To inform this assessment, the NPS Water Resources Division was asked to evaluate the functional condition or ecological "health" of the Little Bighorn River riparian area within and adjacent to the park boundary. We used the method described in "A User Guide to Assessing the Proper Functioning Condition and the Supporting Science for Lotic Areas" (U.S. Department of the Interior 1998) to perform this evaluation. We found the entire assessment area to be in "Proper Functioning Condition" as defined by this method, but we identified some specific sites where management actions could further improve riparian area function and health. This report documents our findings and provides some management recommendations for this historically important and culturally significant riparian ecosystem.

Setting/Background

The Little Bighorn River (LBR), which forms the southwest boundary of the Custer Unit of Little Bighorn Battlefield National Monument (LIBI), is a free flowing, perennial river that headwaters in the nearby Bighorn Mountains. The LBR forms a confluence with the Bighorn River about 16 miles downstream and that larger river, in turn, is tributary to the Yellowstone River, a major, regional drainage.

The overall setting of the LBR in this area is a broad alluvial valley eroded out of a thick stratigraphic sequence of Late Cretaceous sediments (Vuke et al. 2007). The most obvious exposure of these bedrock units is the high bluff on the northeast side of the river, which is the Judith River Formation, a near-shore and marine sandstone with interbedded layers of shale and silty shale. This poorly indurated (soft) bedrock formation, even though fairly erodible, exerts substantial morphological control on the channel form and evolution of the LBR.

The alluvial valley in this area varies in width from about 5000 to 6000 feet but a large portion of the valley floor has been excluded from fluvial processes by the construction of I-90, the Burlington Northern Railroad grade, and other infrastructure. However, there is evidence that the river has been situated on the northern and eastern margins of the valley for some time, and may not have been adversely affected by development in the southwestern margins of the valley. On several long reaches of the LBR, including the one adjacent to the Monument, the river is persistently cutting into the Judith River Formation on river right, suggesting some topographic or tectonic influence forcing the river towards that side of the valley. So, despite substantial anthropogenic floodplain encroachment on the left bank (west) side of the valley, the river has been able to maintain a very sinuous and well developed meander pattern within a relatively narrow portion of the valley.

In fact, graphic comparison of channel patterns between an 1891 USGS Custer Battlefield topographic map (1908 ed.) and present-day aerial imagery suggests that the primary meander belt has been in nearly the same location since about the time of the battle and does not appear to have been constricted by 20th Century development (**Figure 1**). Additionally, this comparison indicates that the meanders have shifted substantially within this meander belt but the river has maintained a marked sinuosity over the last 100 years, strongly suggesting vertical stability and a relatively stable gradient. The overall gradient of the valley bottom is well below 1 percent but the channel gradient is much less due to this well-developed channel sinuosity.

The morphology of the valley itself is characterized by several levels of Quaternary alluvium with a variety of landforms including expansive floodplains, several fluvial terrace levels, and classic point bar-cutbank morphology consistent with meandering channels. The alluvial terraces found throughout this geomorphic province are the result of repeated surges of glacial melt water and sediment associated with the Pinedale Glaciation and the post glacial period, encompassing both the Pleistocene and Holocene Epochs (Vuke et al. 2007). The landforms that are of most interest in this assessment are the youngest terraces and the active floodplain and channel, primarily late Holocene deposits. Evidence of continual reworking of these younger sediments is readily apparent in satellite imagery, aerial photos, and published maps where numerous oxbows and meander scrolls are visible all along the length of the LBR (Figure 2).

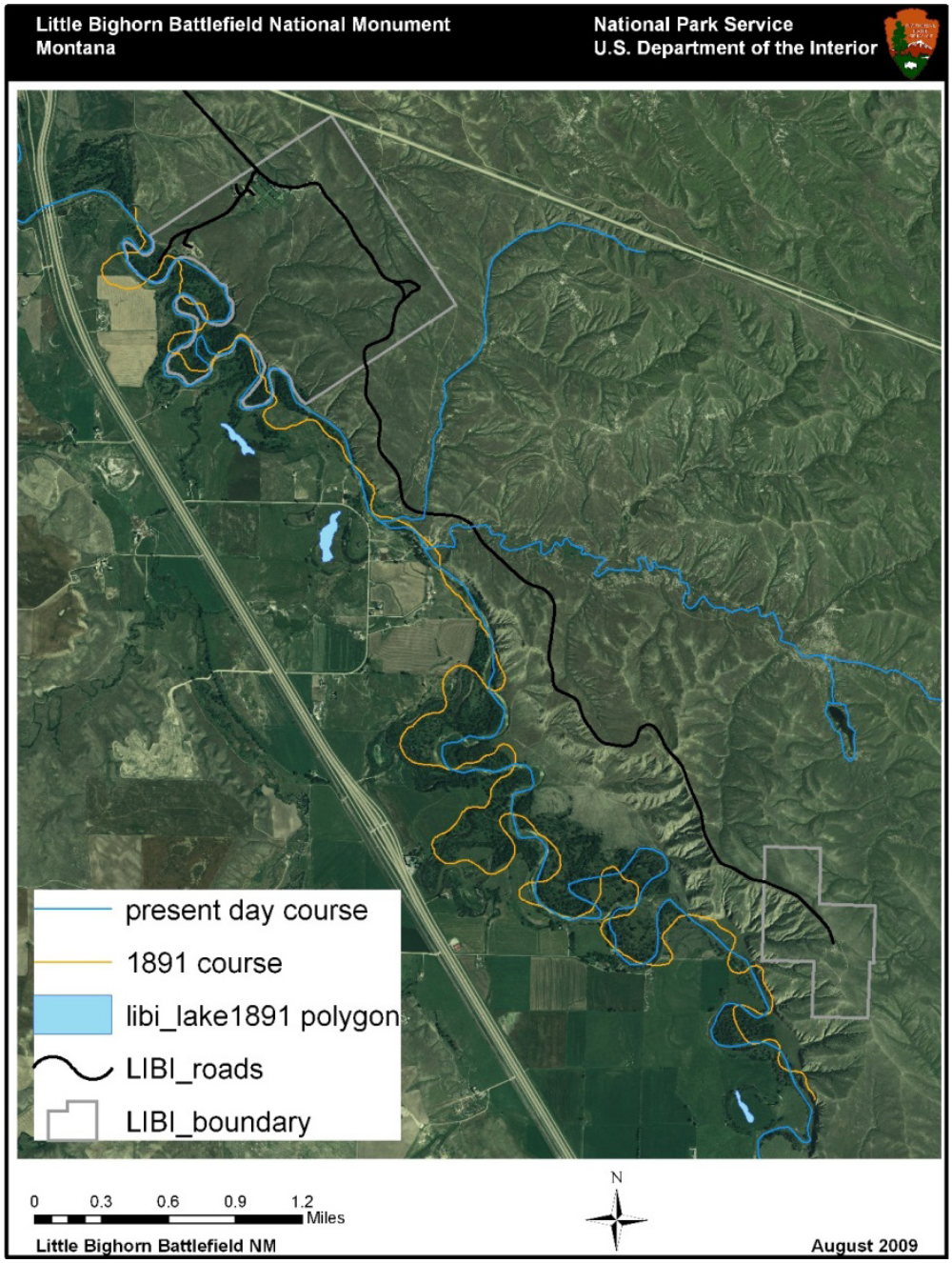

Figure 1. Geographic Information Systems overlay of hand drawn 1891 channel alignment and modern aerial imagery. Note the similar sinuosity of the two channels and the occupation of the same side of the valley.

Hydrology of the Little Bighorn River

As mentioned, the LBR is a free-flowing, perennial river that headwaters in the nearby mountains. Because of this physiography the annual hydrograph of the LBR is dominated by snowmelt discharge with some influence from summer thunderstorms. Over the last century there have been at least seven USGS gages operated on the LBR between the Wyoming State Line upstream and Hardin, Montana downstream. Of these seven gages two are still in operation, gage #6289000 located at the State Line and gage #6294000 at Hardin. The period of record for both of these gages is respectable, 71 years for the State Line gage and 59 years for the gage near Hardin. Additionally, there was a gage operated near Wyola below Pass Creek (#6290500) that has a period of record of 64 years.

The flood of record for the gage at Hardin occurred on May 19, 1978 with a flow of 22,600 cubic feet per second (cfs). The second largest flood recorded at this gage took place on May 23, 2011,

Figure 2. Google Earth image of the portion of the LBR that borders LIBI. Note the apparent sinuosity and the evidence of abandoned meanders. Also note the proximity of the high bluff (Judith River Formation) to the northeast demarcated by a distinct white outcrop. Lastly, note the presence of pasture land south and west of the river, continuing up to the active channel in some locations. White numbers represent a meander numbering system used during our assessment. White arrows indicate cutbank sites where bank-stabilizing riparian vegetation is absent.

reaching a peak of 17,300 cfs (**Figure 3**). This spring peak, driven by the melting of a deep snowpack, was a sustained high flow for over a month, and also resulted in the flood of record at the State Line gage with a discharge of 17,600 cfs on June 30, 2011.

Flood Frequency

The event of 2011 was an extreme flow. The 500-year flood previously calculated by the USGS for the Hardin Gage is reported as 14,600 cfs. Consequently, the 2011 peak flow was in excess of the calculated 500-year flood by about 18 percent. This is a significant occurrence, as a critical element of our riparian condition assessment was to evaluate the stability of the channel and floodplain form under moderate flood conditions. The fact that this reach of the river experienced an approximate 500-year flood a little more than a year before our site visit allowed us to evaluate the degree that the active floodplain and channel responded to an extreme event. In contrast, at the time of our site visit the mean daily flow on the LBR was about 830 cfs and appeared to be somewhat below the bankfull level. According to the gage record, the mean daily flow for the LBR peaked on June 7 (the day after our site visit) at 908 cfs and within a week had dropped to about 500 cfs. The discharge that we observed was in the range of a 1.1-year flood, which was calculated by the USGS as 818 cfs (USGS 2012).

Functional Condition of Riparian Systems

The purpose of our assessment was to determine the overall functional condition or ecological "health" of the river channel and its associated riparian corridor. To complete this assessment, we used "A User Guide to Assessing the Proper Functioning Condition and the Supporting Science for Lotic Areas" (U.S. Department of the Interior 1998). For this method, "Proper Functioning Condition" (PFC) is the highest rating that can be given to

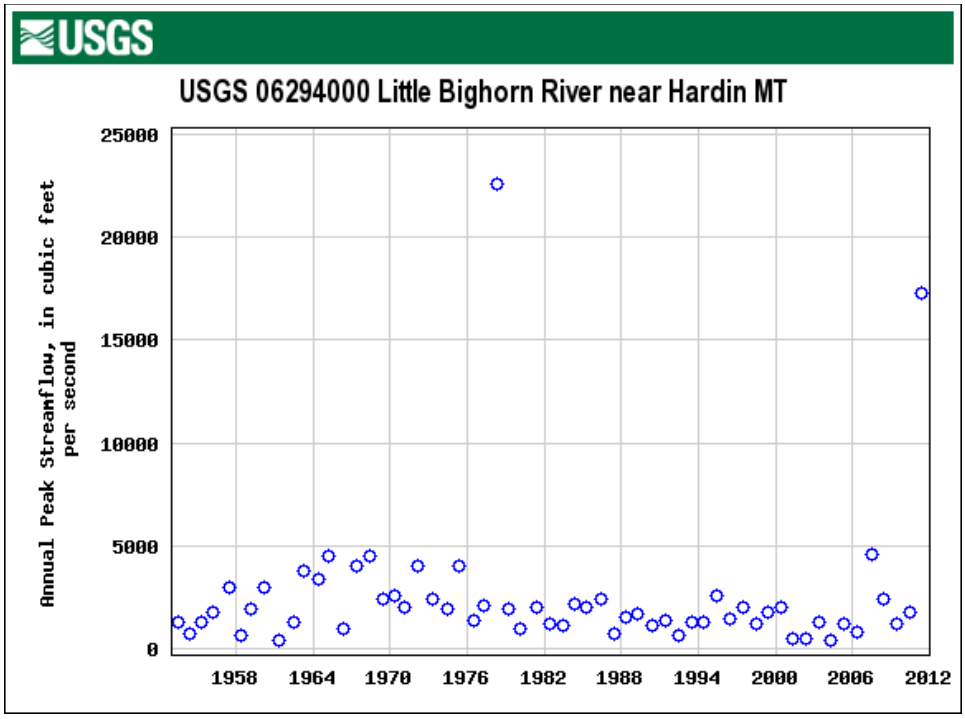

Figure 3. Graph depicting the peak flow record for the gage at Hardin, MT. Note that all peaks from this 59 year record are below 5000 cfs (between the 10- and 25-year floods) except the 1978 and the 2011 flows, which are both in the range of a 500-year flood (USGS, 2012).

a river segment and associated riparian area based on the perceived stability of the physical system, which in turn is dictated by the interaction of geologic formations, soil, water, and vegetation. This determination is derived by an interdisciplinary team of technical experts evaluating 17 hydrologic, vegetation, soil, and geomorphology elements for each riparian assessment area associated with the stream of interest.

A riparian area in PFC is in dynamic equilibrium with its streamflow forces and channel processes. The system adjusts to handle larger runoff events with limited change in channel characteristics and associated riparian-wetland plant communities. This limited change, such as some cutbank erosion and point bar expansion in stream meanders, is within the context of natural stream evolution and provides new geomorphic features for riparian-wetland vegetation recruitment. Because of this resiliency, riparian areas in PFC can maintain aquatic habitat, water quality enhancement, and other important ecosystem functions, even after larger runoff events. In contrast, nonfunctional systems subjected to the same flows might exhibit excessive erosion and sediment loading, loss of aquatic and wetland habitat, and so on.

To determine the rating of a river reach, the team evaluates all 17 elements on standardized data sheets, and supports the results with detailed technical notes. After the individual elements have been assessed, the team assigns one of the following three summary ratings to a site:

"Proper Functioning Condition": Streams and associated riparian areas are functioning properly when adequate vegetation, landform, or large woody debris (where applicable) is present to:

1. Dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality;
2. filter sediment, capture bedload, and aid floodplain development;
3. improve floodwater retention and groundwater recharge;
4. develop root masses that stabilize stream banks against cutting action;
5. develop diverse ponding and channel characteristics to provide habitat and the water depths, durations, temperature regimes, and substrates necessary for fish

production, waterfowl breeding, and other uses; and
6. support greater biodiversity.

"Functional-At Risk": These riparian areas are in functional condition, but an existing soil, water, vegetation, or related attribute makes them susceptible to degradation. For example, a stream reach may exhibit attributes of a properly functioning riparian system, but it may be poised to suffer severe erosion during a moderate flood event in the future due to likely migration of a headcut or increased runoff associated with recent urbanization in the watershed. When this rating is assigned to a stream reach, then its "trend" toward or away from PFC is assessed.

"Nonfunctional": These are riparian areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, sustaining desirable channel form and riparian habitat characteristics, and so on as described in the PFC definition. The absence of certain physical attributes such as a floodplain where one should exist is an indicator of nonfunctional conditions.

Assessment Results and Discussion

Little Bighorn River, entire reach within/adjacent to the Monument

Rating: Proper Functioning Condition

The checklist sheet showing how we rated the 17 elements for the LBR, and the detailed remarks supporting our rating of "Proper Functioning Condition" for this assessment reach, are provided in the Appendix of this report.

Based on previous field work at LIBI and examination of aerial imagery of the river and riparian system, there was no obvious reason to separate the LBR into different reaches for individual assessment. Therefore, the entire length of the river within and adjacent to the Monument is covered in the following discussion. This assessment included about 3.5 river miles of the LBR where it borders the Custer Unit of LIBI (Figure 2).

In examining the aerial image of the study area, note the sinuous channel pattern and the evidence of abandoned meanders, as well as the relatively constant channel width (with some variability) along this reach. Meandering rivers of this type generally migrate through their associated floodplains, eroding older terrace and floodplain alluvium at the cutbanks and depositing new alluvium on the point bars (insides of meander bends). Evidence of this process is visible in the image with many of the point bars expressing a different vegetation signature. Ground reconnaissance during the site visit confirmed that many of the point bars are slowly aggrading and support a sequential gradation of riparian vegetation. Additionally, abandoned meanders, cutoff channels and the various terrace levels exemplify natural stream channel evolution in this type of system. These observations led us to the conclusion that channel sinuosity, width/depth ratio, and gradient in this reach are in balance with the landscape setting.

Of particular note in this analysis is the fact that this reach experienced a flood about a year ago that was in excess of the calculated 500-year flood for this reach of the river. Flood debris left behind on many of the overbank areas stands as proof that flows far exceeded the channel capacity in this reach. Nevertheless, there was no widespread bank failure, excessive deposition, or related geomorphic instability. Consequently, we concluded that the channel and floodplain are able to pass the water and sediment being delivered by the watershed without excessive erosion or deposition. More specifically, the watershed is not contributing to riparian wetland degradation. Additionally, onsite observations of near bankfull flow at the time of the site visit coupled with a review of the gage history, strongly indicates that the relatively low terraces adjacent to the active channel and floodplain as well as the point bars in the meander bends are inundated in relatively frequent flood events.

Due to the apparent stable channel morphology present along this reach, particularly the relatively constant channel width, we concluded that the riparian corridor has reached its potential width through most of this reach. Of very notable exception are the segments where the entire left bank floodplain (privately owned) is used for agriculture and the riparian vegetation has been completely removed (Figure 4). Generally, meandering rivers that have lost significant riparian vegetation undergo channel widening and may reach a state of instability. Some channel widening is obvious at isolated locations and examination of satellite imagery suggests that the channel adjacent to these agricultural fields has widened

Figure 4. Absence of bank-stabilizing riparian vegetation on a cutbank in an agricultural field (meander 1, on private land) increases bank erosion, channel widening, and sediment loading

Figure 5. A very narrow neck of land (center) between meanders 4 and 6 will eventually erode and cause the river to abandon meander 5.

somewhat, but no dramatic channel changes were observed. Nevertheless, the complete lack of riparian vegetation, especially the woody species, raises concern of potential instability.

In river segments where bedrock bluffs restrict lateral migration on the outside of meander bends, the riparian zones have likely reached their potential lateral extent and meander evolution may occur as chute cutoffs along point bars or neck cutoffs at meander transitions. Neck cutoffs, which may circumvent entire meanders, are rather dramatic channel changes but they are completely within the natural evolution of this type of stream, and may produce large oxbows that can support a wide variety of wetland/riparian vegetation. One such neck cutoff is about to occur between meanders 4 and 6 **(Figure 5).**

As mentioned previously, an integral part of the PFC analysis is evaluation of the riparian vegetation present along the channel and floodplain. Plains cottonwood (*Populus deltoides)* is the dominant woody species on terrace levels that are slightly higher than the active floodplain (except where they appear to have been cleared on private land). These mature stands appear to be very healthy, with little evidence of water stress and plentiful seed production. Sapling to small tree age classes did not exist on many point bar and low terrace sites, especially in meanders 1

Figure 6. Cottonwood seedlings cover large portions of point bars and other active floodplain surfaces, from just below to 3 feet above bankfull stage.

and 2 (**Figure 2**). However, a few dozen vigorous seedlings and saplings were observed on bars farther upstream. Most notable was the abundance of cottonwood seedlings on virtually all point bars and side channel bars throughout the assessment reach, from just below to 3 feet above bankfull stage (**Figure 6**). Although seedlings at some locations showed signs of water stress and other low-lying seedlings will not survive high-energy flows from future runoff events, the huge numbers of seedlings over a broad elevation range suggests that a new cottonwood recruitment age class may be establishing, most likely triggered by the 2011 flood.

On the active floodplain (lowest terraces and point bars), sand bar willow *(Salix exigua)*, peachleaf willow (*Salix amygdaloides)*, and green ash (*Fraxinus pennsylvanica)* are also dominant woody species, all with multiple age classes in most locations. Woods' rose (*Rosa woodsii)* is also common on point bars and other near-channel locations. These native riparian species contribute significantly to the stability of channel banks, bars, and low terraces by way of soil anchoring and energy dissipation during overbank flows.

Herbaceous wetland species such as water sedge *(Carex aquatilis)*, wild licorice *(Glycyrrhiza lepidota)*, Chairmaker's bulrush *(Schoenoplectus americanus)*, and horsetail (*Equisetum sp.*) dominate the herbaceous component of the active floodplain and appear to be healthy and spreading via rhizomes. These native riparian-wetland species provide adequate root masses and above ground biomass to protect riverbanks from excessive erosion, dissipate energy during flood flows, filter sediment, provide habitat diversity, and provide other desirable riparian-wetland functions.

These generally healthy woody and herbaceous plant communities are clearly contributing to stream energy dissipation, sediment filtration, channel and floodplain resilience/stability and maintenance of habitat quality. The PFC Checklist for this reach (Appendix 1) shows that all applicable elements were rated positively, indicating to the team that the reach is in Proper Functioning Condition. "Remarks" on the back of the checklist page provide the team's justifications for many of the individual checklist responses. In addition to the specific elements of the assessment, we generally viewed the channel and associated floodplain as a "healthy system" based on the observations

Figure 7. Cottonwood roots help bind streambank soils and slow the cutting action of high energy flows.

detailed in this report. However, the following section describes some riparian management issues and recommendations.

Other Riparian Management Issues

1) Three cutbank sites on adjacent properties with pasture/agricultural land uses (**Figure 2**) are missing most bank-stabilizing riparian vegetation, especially woody species. These sites are eroding into uplands more rapidly and the channel is noticeably wider than at comparable sites in the park with well-developed riparian vegetation, which raises a concern of channel instability. The left bank on meander 6, shown in **Figure 7**, illustrates how cottonwood roots can help stabilize streambank soils against the erosive forces associated with high flows. The reaches lacking riparian vegetation are in private ownership and LIBI has little control over land use practices. However, preservation of a healthy river system should be of interest to all riparian landowners, not only because of ecosystem and other environmental values, but because channel instability would very likely destroy portions of the agricultural fields and pastures. Perhaps there is an opportunity to re-establish a corridor of protective riparian vegetation along these degraded reaches through consultation with local landowners.

2) Livestock have degraded riparian-wetland conditions on private property immediately upstream of LIBI (trampling, minimal vegetation on low terraces). Within the park, there are livestock trails throughout the riparian zone. Hoof prints and manure indicated they are mostly used by horses, but likely used by deer too. Horses (and presumably cattle) can cross the river at will – there is no consistent fencing on the NPS side on the floodplain (the uplands of the park are fenced on the bluffs above the river). If livestock begin to exert heavy pressure on floodplain vegetation, the park should consider fencing sections of the floodplain.

3) We saw 10 - 20 scattered tamarisks (*Tamarix chinensis*), from small sapling to small tree size, on point bars/side channel bars of meanders 2, 3 and 6. We also saw 30 - 40 scattered Russian olives (*Elaeagnus angustifolia*), from shrub to tree size (up to 25 - 30 feet tall), with the larger trees on neighboring private land. Continued control of these highly invasive, non-native riparian shrubs/trees is important for the continued health of this riparian system.

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Appendix – PFC Lotic (Riparian) Standard Checklist

Name of Riparian Area: Little Bighorn Battlefield NM – Little Bighorn River

Date: 6/5/2012 – 6/6/2012 Segment/Reach ID: Entire reach within LIBI

River Miles: 3.5 miles

ID Team Observers: Joel Wagner, Mike Martin, Jalyn Cummings, Mike Britten

Yes	No	N/A	HYDROLOGY
X			1) Floodplain above bankfull is inundated in "relatively frequent" events
		X	2) Where beaver dams are present they are active and stable
X			3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)
X			4) Riparian-wetland area is widening or has achieved potential extent
X			5) Upland watershed is not contributing to riparian-wetland degradation

Yes	No	N/A	VEGETATION
X			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
X			7) There is diverse composition of riparian-wetland vegetation for maintenance/recovery)
X			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
X			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events
X			10) Riparian-wetland plants exhibit high vigor
X			11) Adequate riparian-wetland vegetative cover is present to protect banks and dissipate energy during high flows
		X	12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

Yes	No	N/A	EROSION/DEPOSITION
X			13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
X			14) Point bars are revegetating with riparian-wetland vegetation
X			15) Lateral stream movement is associated with natural sinuosity
X			16) System is vertically stable
X			17) Stream is in balance with the water and sediment being supplied by the water-shed (i.e., no excessive erosion or deposition)

(Revised 1999)

Remarks (numbers correspond to checklist items)

1. Recent sediment deposits are common on the point bars and lower terraces. Channel/floodplain form is as expected in this valley (no channel incision). Multiple active point bars indicate relatively frequent flooding, sediment deposition, and sustaining of riparian vegetation.

2. Evidence of recent and past beaver activity common throughout reach (e.g., chewed willow branches, girdled/cut cottonwoods of various ages, trails connecting the river and floodplain). However, there are no beaver dams on this reach or immediately upstream of LIBI.

3. Overall channel sinuosity, gradient, width/depth ratio and channel/floodplain form are in balance with the landscape setting. There are three locations where cutbanks are migrating into an agricultural field (meander 1 in Figure 2 of this report) or pastures (meanders 3 and 5), with minimal riparian vegetation present to protect banks. Channels appear to be somewhat wider (and presumably shallower) at these locations compared to cutbank locations with riparian vegetation. While of resource management interest, these sites don't threaten the stability of the entire reach.

4. Riparian zone approaching or at potential extent for the great majority of the reach, except in areas where agriculture/pasturing on adjacent properties has removed riparian vegetation and allowed some channel widening. Overall, stream length has remained essentially unchanged since the 1800s, even though meanders have continuously worked the valley bottom.

5. Cutbanks where riparian vegetation was apparently removed for agriculture or pastures are contributing anthropogenic sediment from uplands, though not enough to answer "no."

6. Abundant cottonwood seedlings (*Populus deltoides*) observed on virtually all point bars and side channel bars on a broad range of elevations (just below to 3 feet above bankfull stage). This suggests that a recruitment age class may be establishing. Lack of cottonwood sapling age class noted throughout meanders 1 and 2, though a few dozen large, healthy seedlings/small saplings (0.5 – 5 feet tall) were observed on bars further upstream, 1 - 3 feet above bankfull stage. A few mid-sized (0.3 - 1.3 foot dbh) cottonwoods were observed in an abandoned channel within meander 3. Mature cottonwoods are common on older floodplain surfaces where expected (except where apparently cleared on private land). Sand bar willow (*Salix exigua*) is abundant on most river bars, especially point bars, ranging from seedlings/small shrubs 1 - 3 feet tall to thick stands 6 - 12 feet tall. Peach-leaf willow (*S. amygdaloides*) is not nearly as common as sand bar willow, but is scattered on bars throughout the reach as young shrubs/trees.

7. See information on cottonwoods and willows in note 6 above. In addition, many vigorous green ashes (*Fraxinus pennsylvanica*) of sapling to small tree age classes were observed on bars throughout the reach, typically at elevations higher than willows and cottonwoods. Woods' rose (*Rosa woodsii*) is also common on point bars and some streambank locations. Dozens of box elders (*Acer negundo*) are scattered along the reach at higher floodplain elevations (i.e., not on low-lying bars). Poison ivy (*Toxicodendron rydbergii)* is a dominant species on the floodplain in cottonwood – green ash forest types. Western snowberry (*Symphoricarpos occidentalis*) and chokecherry (*Prunus virginiana*) are also common on higher floodplain sites.

9. A diverse, soil-binding herbaceous plant community on channel banks and point bars is likely to maintain channel stability in frequent to moderate floods. Dominants include water sedge (*Carex aquatilis*), wild licorice (*Glycyrrhiza lepidota*), Chair-maker's bulrush (*Schoenoplectus americanus*), and horsetail (*Equisetum* sp.). All are rhizomatous with root masses capable of withstanding frequent to moderately frequent flood flows. Woody species described in 6 above are also important in streambank stabilization (except on cutbanks where they were cleared).

11 Cutbanks on private lands (described in 3 above) are a resource management concern but do not threaten to destabilize the broader reach. Bluff-controlled banks on straight reaches have little or no bank-stabilizing vegetation, but this is a natural condition in these locations.

13. No evidence of channel instability, even after > 500-year flow in 2011.

Functional Rating

Trend for Functional – At Risk:

Proper Functioning Condition	X	Upward	
Functional – At Risk		Downward	
Nonfunctional		Not Apparent	

Notes:

1. Three cutbanks on adjacent properties with pasture/agricultural land uses are missing most stabilizing riparian vegetation. These are cutting into uplands more rapidly and the channel is noticeably wider than at comparable sites in the park with well-developed riparian vegetation. Resulting sediment inputs create some localized channel adjustments, but don't threaten the stability of the entire reach (i.e., they don't justify "functional at-risk" or "nonfunctional" ratings). This issue is outside NPS's immediate control, but riparian condition could be improved if landowners planted cottonwoods and maintained vegetated buffers on these banks. The left bank on meander 6 illustrates how cottonwood roots stabilize banks.

2. Livestock have degraded riparian-wetland conditions on private property immediately upstream of LIBI (trampling, minimal vegetation on low terraces). Within the park, there are livestock trails throughout the riparian zone. Hoof prints and manure indicated they are mostly used by horses, but likely used by deer too. Horses (and presumably cattle) can cross the river at will – there is no consistent fencing on the NPS side on the floodplain (the uplands of the park are fenced on the bluffs above the river). If livestock begin to exert heavy pressure on floodplain vegetation, the park should consider fencing sections of the floodplain.

3. We saw 10 - 20 scattered tamarisk (*Tamarix chinensis*), from small sapling to small tree size (6 - 10 feet tall), on point bars/side channel bars of meanders 2, 3 and 6. We also saw 30 - 40 scattered Russian olives (*Elaeagnus angustifolia*), from shrub to tree size (up to 25 - 30 feet tall), with the larger trees on neighboring private land. Continued control of these highly invasive, non-native riparian shrubs/trees is important for the health of this riparian system.

Are factors contributing to unacceptable conditions outside the control of the manager?

Yes _____ No X

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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