

|                         |                             |                              |                    |
|-------------------------|-----------------------------|------------------------------|--------------------|
| <b>County</b>           | Treasure                    | <b>Upstream River Mile</b>   | 269.4              |
| <b>Classification</b>   | UA: Unconfined anabranching | <b>Downstream River Mile</b> | 260.3              |
| <b>General Location</b> | Mission Valley              | <b>Length</b>                | 9.10 mi (14.65 km) |
| <b>General Comments</b> | Mission Valley              |                              |                    |

## Narrative Summary

Reach C7 is 9.1 miles long and is located in the Mission Valley downstream of Hysham. It is an Unconfined Anabranching reach type, which indicates little in the way of valley wall influence coupled with extensive side channels and forested islands. The Mission Valley owes its width to the presence of the Bearpaw Shale in the valley wall. Because this Cretaceous-age shale is relatively erodible and prone to mass failure, over time the river has been able to erode the valley wall more easily than in other reaches, creating the large distinct valleys present today. Because the Mission and Hammond Valleys are so wide, the river developed a complex series of channels and an expansive riparian forest. These reaches are especially rich in terms of aquatic and riparian habitat extent, diversity, and geomorphic complexity.

Just over 2,000 feet of rock riprap lines the banks in Reach C7, protecting 2.3 percent of the bankline.

Prior to 1950 about 4,200 feet of side channel had been blocked in Reach C7, and since then, floodplain dikes have blocked another three miles of side channel. Blocked side channels are located at RM 270.8L, RM 263.5R, and RM 261R. Even with all of the blockages, Reach C7 still has on the order of 17 miles of functional side channel length.

Reach C7 appears to be experiencing an active major avulsion just north of Sanders, where an anabranching channel has been developing into a primary channel over the last decade. As rerouting of the river would shorten the main thread by approximately 1.5 miles, an avulsion is very likely to occur in this area over the next several years. The rate at which the anabranching side channel fully captures the main thread will depend on flood events, as floods will accelerate the avulsion process. This avulsion would take pressure off of the main channel to the south, which is currently threatening the rail line at RM 264.8R and RM 266.2R.

About 9 percent of the total 100-year floodplain has become isolated due to human development in Reach C7. The 5-year floodplain is even more affected; 41 percent of the historic 5-year floodplain is no longer inundated at that frequency. The isolation of the historic 5-year floodplain, due primarily to flow alterations, has been associated with increased development in these areas; currently there are about 95 acres of flood irrigated land and 56 acres of pivot land within the historic 5-year floodplain. Much of the isolated 5-year floodplain area is within the active stream corridor and riparian zone however, exemplifying the potential impacts of flow alterations on frequent floodplain inundation.

Land use is dominated by agriculture, with 277 acres of pivot irrigation development since 1950. There are about 350 acres of flood irrigated land and 31 acres of pivot within the CMZ, but only 4 percent of the CMZ is restricted by physical features.

Riparian mapping data show a net gain of 780 acres of woody vegetation into the active channel corridor since 1950. This has occurred both on migrating point bars that have become vegetated, as well as within abandoned side channels. Reach C7 has about 90 acres of wetland per valley mile, which makes it one of the most concentrated wetland areas in the corridor. There are also 164 acres of Russian olive in the reach.

Reach C7 was sampled as part of the fisheries study. A total of 27 fish species were sampled in the reach, including Sauger, which are recognized by the Montana Natural Heritage Program as a Species of Concern (SOC).

Reach C7 was sampled as part of the avian study. A total of 69 bird species were identified in the reach. Four bird species identified by the Montana Natural Heritage Program as Potential Species of Concern (PSOC) were found, the Black and White Warbler, the Plumbeous Vireo, the Ovenbird, and the Chimney Swift. Two Species of Concern (SOC) were identified, the Black Billed Cuckoo and the Bobolink. Brown Headed Cowbirds were also present. Reach C7 has seen an increase in the forested area that is at low risk of cowbird parasitism since 1950. At that time, there were 86 acres per valley mile of such forest, and that number increased to 102 acres per valley mile by 2001.

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 23 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 4,680 cfs to 2,990 cfs with human development, a reduction of 36 percent. More typical summer low flows, described as the summer 95% flow duration, have dropped from 6,150 cfs under unregulated conditions to 3,320 cfs under regulated conditions at Reach C10 downstream where the analysis begins, a reduction of 46 percent.

CEA-Related observations in Reach C7 include:

- Active and passive loss of thousands of feet of side channel

Recommended Practices (may include Yellowstone River Recommended Practices--YRRPs) for Reach C7 include:

- Side channel reactivation at RM 270.8L, RM 263.5R, and RM 261R
- Russian olive removal

PHYSICAL FEATURES MAP (2011)



## HYDROLOGIC SUMMARY

Hydrologic data available for the Reach Narratives include data from representative gaging stations, modeling from the COE from the Big Horn river upstream, and modeling by the USGS for the Big Horn River to the Missouri River confluence. Gaging stations that best represent the watershed area within any reach are used to describe the flood history within the reach. Hydrology modeling results generated for all reaches provides unregulated and regulated flow values. Seasonal and annual flow duration data generated by the USGS are available for reaches C10 through D13.

### Gage Representation (Gage-Based): Miles City

#### Flood History

| Year | Date   | Flow on Date | Return Interval | Gage No             | Downstream Gage | Upstream Gage |
|------|--------|--------------|-----------------|---------------------|-----------------|---------------|
| 1974 | Jun 22 | 75,400       | 10-25 yr        | 6309000             | 6309000         | 6214500       |
| 1997 | Jun 15 | 83,300       | 10-25 yr        | Miles City          | Miles City      | Billings      |
| 1943 | Jun 26 | 83,700       | 10-25 yr        | 1929-2015           | 1929-2015       | 1929-2015     |
| 2011 | May 24 | 85,400       | 10-25 yr        | Distance To (miles) | 76.3            | 95.0          |
| 1944 | Jun 19 | 96,300       | 50-100 yr       |                     |                 |               |
| 1978 | May 22 | 102,000      | 50-100 yr       |                     |                 |               |

#### Discharge

|             | 1.01 Yr | 2 Yr    | 5 Yr    | 10 Yr   | 50 Yr   | 100 Yr  | 500 Yr  | 7Q10 Summer | 95% Sum. Duration |
|-------------|---------|---------|---------|---------|---------|---------|---------|-------------|-------------------|
| Unregulated |         | 61,100  | 77,000  | 87,400  | 110,000 | 120,000 | 144,000 | 4,680       | 3,846             |
| Regulated   |         | 47,000  | 61,300  | 70,700  | 91,400  | 100,000 | 121,000 | 2,990       | 2,227             |
| % Change    |         | -23.08% | -20.39% | -19.11% | -16.91% | -16.67% | -15.97% | -36.11%     | -42.10%           |

## AERIAL PHOTOGRAPHY

A variety of aerial photographic sources provide the basis for much of the Cumulative Effects Assessment analysis. The table below lists the air photos compiled for the reach and the associated discharge at the most representative USGS gaging station.

|      | Source    | Acquisition Date       | Type  | Scale          | Gage    | Discharge |
|------|-----------|------------------------|-------|----------------|---------|-----------|
| 1950 | USGS-EROS | 26-Aug-49              | B/W   | 1:14,800       | 6309000 | 3620      |
| 1976 | USCOE     | 29-Sep-76              | B/W   | 1:24,000       | 6309000 | 9520      |
| 1995 | USGS DOQQ | 7/14/96 - 9/20/97      | B/W   |                | 6295000 | 25300     |
| 2001 | NRCS      | August 2-8, 2001       | CIR   | 1:24,000       | 6295000 | 3500      |
| 2005 | NAIP      | 07/12/2005             | color | 1-meter pixels | 6309000 | 17500     |
| 2007 | Woolpert  | 10/15/2007 - 11/2/0007 | Color |                |         |           |
| 2009 | NAIP      | 8/11/2009              | Color | 1-meter pixels | 6309000 | 12900     |
| 2009 | NAIP      | 7/30/2009              | Color | 1-meter pixels | 6309000 | 13800     |
| 2009 | NAIP      | 7/25/2009              | Color | 1-meter pixels | 6309000 | 13600     |
| 2011 | USCOE     | October 2012           | color | 1-ft pixel     | 6309000 | 8100      |
| 2011 | NAIP      | 7/16/2011              | Color | 1-meter pixels | 6309000 | 57900     |
| 2013 | NAIP      | 07/20/2013             | color | 1-meter pixels | 6309000 |           |
| 2013 | NAIP      | 07/21/2013             | color | 1-meter pixels | 6309000 |           |

## PHYSICAL FEATURES

Several efforts to capture the types and extents of physical features in the corridor have been generated by the CEA study. The 2001 Physical Features Inventory was performed through helicopter/video Rapid Aerial Assessment by the NRCS (NRCS, 2001) and did not include Park County. This inventory includes point and linear features that represent bank armor, irrigation structures, transportation encroachments, and areas of accelerated erosion. Bank armor mapped in the 2001 inventory only reflects features on the active channel margin, and thus excludes off-channel features on historic side channels. Some floodplain restriction features such as dikes and levees in the 2001 Physical Features Inventory may extend well beyond the active channel. In 2013, the 2001 inventory was revised to include Park County. At that time, some attribute inconsistencies in the original data were addressed. This dataset was then updated to reflect conditions in the 2011 NAIP imagery.

For Stillwater, Yellowstone and Dawson Counties, a Physical Features Timeline was generated that includes additional mapping based on aerial photography and assigns approximate dates of feature construction based on observed presence/absence in historic imagery between the 1950s and 2005 (DTM and AGI, 2008). The Physical Features Timeline contains features that were not mapped in the 2001 inventory (e.g. bank armor abandoned in floodplain areas by 2001). As such the total bank armor extent in the 2005 data is commonly greater than that identified in 2001 or 2013.

Note: As the goal for each physical features mapping effort were different, with differing mapping extents, there will be discrepancies between total feature lengths (e.g. length of rock riprap) in each data set.

### 2001 and 2011 Physical Features Bankline Inventories

| Feature Class        | Feature Type               | 2001 Length (ft) | % of Bankline | 2011 Length (ft) | % of Bankline | 2001-2011 Change |
|----------------------|----------------------------|------------------|---------------|------------------|---------------|------------------|
| Stream Stabilization |                            |                  |               |                  |               |                  |
|                      | Rock RipRap                | 2,173            | 2.3%          | 2,173            | 2.3%          | 0                |
|                      | <b>Feature Type Totals</b> | <b>2,173</b>     | <b>2.3%</b>   | <b>2,173</b>     | <b>2.3%</b>   | <b>0</b>         |
| Floodplain Control   |                            |                  |               |                  |               |                  |
|                      | Floodplain Dike/Levee      | 429              | 0.4%          | 429              | 0.4%          | 0                |
|                      | <b>Feature Type Totals</b> | <b>429</b>       | <b>0.4%</b>   | <b>429</b>       | <b>0.4%</b>   | <b>0</b>         |
|                      | <b>Reach Totals</b>        | <b>2,602</b>     | <b>2.7%</b>   | <b>2,602</b>     | <b>2.7%</b>   | <b>0</b>         |

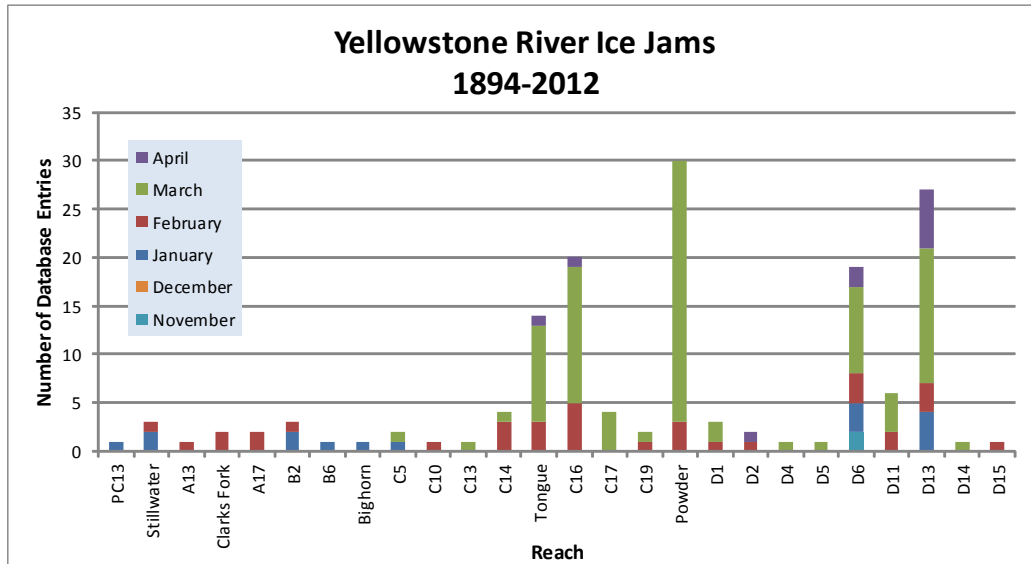
### Intent of Bank Protection: 2001

The 2001 bank protection features were assessed for the 'intent' of what they protect.

| Feature Type  | Irrigated    | Non-Irrig. | Ag. Infrastr. | Road     | Interstate | Railroad | Urban    | Exurban  |
|---------------|--------------|------------|---------------|----------|------------|----------|----------|----------|
| Rock RipRap   | 2,171        | 0          | 0             | 0        | 0          | 0        | 0        | 0        |
| <b>Totals</b> | <b>2,171</b> | <b>0</b>   | <b>0</b>      | <b>0</b> | <b>0</b>   | <b>0</b> | <b>0</b> | <b>0</b> |

## ICE JAMS

Ice jam data were obtained from the National Ice Jam Database maintained by the Ice Engineering Group at Army Corps of Engineers Cold Regions Research and Engineering Laboratory (<https://rsgis.crrel.usace.army.mil/icejam/>). From this database, Yellowstone River ice jams are summarized by reach in the Yellowstone River Historic Events Timeline (DTM and AGI, 2008b). The basic information for each ice jam is presented as a list of events. The graph represents the number of database entries for a reach. Note that a single jam event may have multiple entries.



## GEOMORPHIC

The geomorphology data presented below consist of measured changes in Braiding Parameter since 1950 and blocked side channels. Braiding parameter is a measure of the total length of side channels relative to that of the main channel. The braiding parameter is calculated as the sum of anabranching and primary channel lengths divided by the primary channel length. Secondary channels within the bankfull margins are a function of flow stage and hence were not included in the braiding parameter calculation. If a reach has a braiding parameter of 3, then the total bankfull channel length is three times that of the main channel. The mean braiding parameter measured for all 88 reaches is 1.8.

Blocked side channels that were either plugged with a small dike or cutoff by larger features such as a levee or road prism were identified for the pre and post-1950s eras.

Additional geomorphic parameters are discussed in more detail in the study report and appendices.

### Braiding (Bankfull)

|                    | Primary Chan. Length (ft) | Anab. Ch. Length (ft) | Bankfull Braiding Parameter |               | % Change in Braiding |
|--------------------|---------------------------|-----------------------|-----------------------------|---------------|----------------------|
| 1950               | 44,646                    | 91,763                | 3.06                        | 1950 to 1976: | 9.52%                |
| 1976               | 47,069                    | 110,437               | 3.35                        | 1976 to 1995: | -22.68%              |
| 1995               | 50,128                    | 79,561                | 2.59                        | 1995 to 2001: | 11.49%               |
| 2001               | 48,131                    | 90,696                | 2.88                        | 1950 to 2001: | -5.60%               |
| Change 1950 - 2001 | 3,485                     | -1,066                | -0.17                       |               |                      |

### Length of Side Channels Blocked

|                 |        |
|-----------------|--------|
| Pre-1950s (ft)  | 4,230  |
| Post-1950s (ft) | 15,593 |

## HYDRAULICS

Available hydraulic information includes county-based HEC-RAS modeling efforts by the Army Corps of Engineers with the exclusion of Park County. Floodplain modeling was performed for four conditions representing a developed and undeveloped floodplain, and unregulated and regulated flows for the 1.5, 2, 5, 10, 20, 50, 100, 200, and 500-year events. Park County has limited FEMA hydraulic modeling and was not included in the analysis.

The results of HEC-RAS modeling for the 5 and 100-year flood events were assessed to compare the extents of inundated area for the pristine (undeveloped floodplain, unregulated flows) and developed (developed floodplain, regulated flows) conditions. The data sets provided for each flow condition were unioned in the GIS to identify areas where the inundated extent differed. These areas of human-caused floodplain isolation due to either flow alterations or physical features such as levees. For the 100-year flood event, isolated areas greater than 5 acres were attributed with the interpreted reason for isolation (railroad, levee, etc.). The resulting values are presented as acres and percent of the pristine floodplain that has been isolated. The pristine floodplain is defined as the total floodplain footprint minus the area of the mapped 2001 bankfull channel (mapped islands were included in the floodplain area).

### Floodplain Isolation

|   | 100-Year       |                 | 5-Year         |                 |
|---|----------------|-----------------|----------------|-----------------|
|   | Isolated Acres | % of Floodplain | Isolated Acres | % of Floodplain |
| Non-Structural (hydrology, geomorphic, etc.)        | 275            | 6.5%            |                |                 |
| Agriculture (generally relates to field boundaries) | 16             | 0.4%            |                |                 |
| Agriculture (isolated by canal or large ditch)      | 0              | 0.0%            |                |                 |
| Levee/Riprap (protecting agricultural lands)        | 0              | 0.0%            |                |                 |
| Levee/Riprap (protecting urban, industrial, etc.)   | 0              | 0.0%            |                |                 |
| Railroad  | 88             | 2.1%            |                |                 |
| Abandoned Railroad                                  | 0              | 0.0%            |                |                 |
| Transportation (Interstate and other roads)         | 0              | 0.0%            |                |                 |
| <b>Total Not Isolated (Ac)</b>                      | <b>3849</b>    |                 | <b>2820</b>    |                 |
| <b>Total Floodplain Area (Ac)</b>                   | <b>4227</b>    |                 | <b>3928</b>    |                 |
| <b>Total Isolated (Ac)</b>                          | <b>378</b>     | <b>8.9%</b>     | <b>1107</b>    | <b>40.9%</b>    |

The 5-year floodplain is a good allegory for the extent of the riparian zone. Thus, irrigated areas within the 5-year floodplain tend to represent riparian zones that have been converted to agriculture and may result in additional bank protection to protect the agricultural production and irrigation infrastructure.

|  | Flood | Sprinkler | Pivot | Total      |
|--|-------|-----------|-------|------------|
| Irrigated Acres within the 5 Year Flooplain: | 121   | 0         | 104   | <b>225</b> |

## CHANNEL MIGRATION ZONE

A series of Channel Migration Maps were developed for the Yellowstone River from Gardiner to its mouth in McKenzie County, North Dakota (Thatcher, Swindell, and Boyd, 2009). These maps and their accompanying report can be accessed from the YRCDC Website. The channel migration zone (CMZ) developed for the Yellowstone River is defined as a composite area made up of the existing channel, the historic channel since 1950 (Historic Migration Zone, or HMZ), and an Erosion Buffer that encompasses areas prone to channel erosion over the next 100 years. Areas within this CMZ that have been isolated by constructed features such as armor or floodplain dikes are attributed as “Restricted Migration Areas” (RMA). Beyond the CMZ boundaries, outlying areas that pose risks of channel avulsion are identified as “Avulsion Potential Zones”.

| Mean 50-Yr Migration Distance (ft) | Erosion Buffer (ft) | Total CMZ Acreage | Restricted CMZ Acreage | % Restricted Migration Area | Total AHZ Acreage | Restricted AHZ Acreage | % Restricted Avulsion Area |
|------------------------------------|---------------------|-------------------|------------------------|-----------------------------|-------------------|------------------------|----------------------------|
| 506                                | 1,012               | 4,478             | 173                    | 4%                          | 241               | 0                      | 0%                         |

### 2011 Restricted Migration Area Summary

Note that these data reflect the observed conditions in the 2011 aerial photography (NAIP for Park and Sweet Grass Counties, COE for the rest of the river).

| Reason for Restriction | Land Use Protected | RMA Acres  | Percent of CMZ |
|------------------------|--------------------|------------|----------------|
| Road/Railroad          | Prism              |            |                |
|                        | Railroad           | 101        | 2.1%           |
| RipRap                 | Irrigated          | 72         | 1.5%           |
| <b>Totals</b>          |                    | <b>173</b> | <b>3.7%</b>    |

### Land Uses within the CMZ (Acres)

| Flood Irrigation | Sprinkler Irrigation | Pivot Irrigation | Urban/ ExUrban | Transportation |
|------------------|----------------------|------------------|----------------|----------------|
| 351.2            | 0.0                  | 30.8             | 0.0            | 21.6           |



## LAND USE

Land uses were mapped from aerial photography Gardiner to the confluence of the Missouri River in North Dakota for four time periods: 1950s, 1976, 2001, and 2011. Mapping was performed at approximately 1:6,000 to ensure consistent mapping across all data sets. Typically, if a feature could not be easily mapped at the target mapping scale, it was not separated out from the adjacent land use.

A four-tiered system was used to allow analysis at a variety of levels. Tier 1 breaks land use into Agricultural and Non-Agricultural uses. Tier two subdivided uses into productive Agricultural Land and Infrastructure for the Agricultural land, and Urban, Exurban and Transportation categories for the Non-Agricultural land. Tier three further breaks down land uses into more refined categories such as Irrigated or Non-Irrigated and Residential, Commercial, or Industrial. Finally, Tier 4 focuses primarily on the productive agricultural lands, identifying the type of irrigation (Pivot, Sprinkler or Flood).

### Land Use Timeline - Tiers 2 and 3

| Feature Class                      | Feature Type         | Acres        |              |              |              | % of Reach Area |              |              |              |
|------------------------------------|----------------------|--------------|--------------|--------------|--------------|-----------------|--------------|--------------|--------------|
|                                    |                      | 1950         | 1976         | 2001         | 2011         | 1950            | 1976         | 2001         | 2011         |
| <b>Agricultural Infrastructure</b> |                      |              |              |              |              |                 |              |              |              |
|                                    | Canal                | 10           | 10           | 10           | 10           | 0.1%            | 0.1%         | 0.1%         | 0.1%         |
|                                    | Agricultural Roads   | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | Other Infrastructure | 67           | 91           | 118          | 118          | 0.7%            | 1.0%         | 1.3%         | 1.3%         |
|                                    | <b>Totals</b>        | <b>77</b>    | <b>101</b>   | <b>128</b>   | <b>128</b>   | <b>0.8%</b>     | <b>1.1%</b>  | <b>1.4%</b>  | <b>1.4%</b>  |
| <b>Agricultural Land</b>           |                      |              |              |              |              |                 |              |              |              |
|                                    | Non-Irrigated        | 3,501        | 3,872        | 4,499        | 4,468        | 37.4%           | 41.3%        | 48.0%        | 47.7%        |
|                                    | Irrigated            | 3,277        | 2,473        | 2,255        | 2,228        | 35.0%           | 26.4%        | 24.1%        | 23.8%        |
|                                    | <b>Totals</b>        | <b>6,778</b> | <b>6,345</b> | <b>6,755</b> | <b>6,696</b> | <b>72.3%</b>    | <b>67.7%</b> | <b>72.1%</b> | <b>71.4%</b> |
| <b>Channel</b>                     |                      |              |              |              |              |                 |              |              |              |
|                                    | Channel              | 2,416        | 2,821        | 2,378        | 2,437        | 25.8%           | 30.1%        | 25.4%        | 26.0%        |
|                                    | <b>Totals</b>        | <b>2,416</b> | <b>2,821</b> | <b>2,378</b> | <b>2,437</b> | <b>25.8%</b>    | <b>30.1%</b> | <b>25.4%</b> | <b>26.0%</b> |
| <b>ExUrban</b>                     |                      |              |              |              |              |                 |              |              |              |
|                                    | ExUrban Other        | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | ExUrban Undeveloped  | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | ExUrban Industrial   | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | ExUrban Commercial   | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | ExUrban Residential  | 0            | 1            | 8            | 8            | 0.0%            | 0.0%         | 0.1%         | 0.1%         |
|                                    | <b>Totals</b>        | <b>0</b>     | <b>1</b>     | <b>8</b>     | <b>8</b>     | <b>0.0%</b>     | <b>0.0%</b>  | <b>0.1%</b>  | <b>0.1%</b>  |
| <b>Transportation</b>              |                      |              |              |              |              |                 |              |              |              |
|                                    | Public Road          | 62           | 62           | 62           | 62           | 0.7%            | 0.7%         | 0.7%         | 0.7%         |
|                                    | Interstate           | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | Railroad             | 40           | 42           | 42           | 42           | 0.4%            | 0.4%         | 0.4%         | 0.4%         |
|                                    | <b>Totals</b>        | <b>102</b>   | <b>104</b>   | <b>104</b>   | <b>104</b>   | <b>1.1%</b>     | <b>1.1%</b>  | <b>1.1%</b>  | <b>1.1%</b>  |
| <b>Urban</b>                       |                      |              |              |              |              |                 |              |              |              |
|                                    | Urban Other          | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | Urban Residential    | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | Urban Commercial     | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | Urban Undeveloped    | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | Urban Industrial     | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         |
|                                    | <b>Totals</b>        | <b>0</b>     | <b>0</b>     | <b>0</b>     | <b>0</b>     | <b>0.0%</b>     | <b>0.0%</b>  | <b>0.0%</b>  | <b>0.0%</b>  |

### Land Use Timeline - Tiers 3 and 4

| Feature Class    | Feature Type  | Acres        |              |              |              | % of Reach Area |              |              |              | Change Between Years<br>(% of Agricultural Land) |              |              |               |
|------------------|---------------|--------------|--------------|--------------|--------------|-----------------|--------------|--------------|--------------|--|--------------|--------------|---------------|
|                  |               | 1950         | 1976         | 2001         | 2011         | 1950            | 1976         | 2001         | 2011         | '50-76   | '76-01       | '01-11       | '50-11        |
| <b>Irrigated</b> |               |              |              |              |              |                 |              |              |              |  |              |              |               |
|                  | Sprinkler     | 0            | 0            | 0            | 0            | 0.0%            | 0.0%         | 0.0%         | 0.0%         | 0.0%   | 0.0%         | 0.0%         | 0.0%          |
|                  | Pivot         | 0            | 0            | 56           | 276          | 0.0%            | 0.0%         | 0.8%         | 4.1%         | 0.0%   | 0.8%         | 3.3%         | 4.1%          |
|                  | Flood         | 3,277        | 2,473        | 2,199        | 1,951        | 48.3%           | 39.0%        | 32.6%        | 29.1%        | -9.4%  | -6.4%        | -3.4%        | -19.2%        |
|                  | <b>Totals</b> | <b>3,277</b> | <b>2,473</b> | <b>2,255</b> | <b>2,228</b> | <b>48.3%</b>    | <b>39.0%</b> | <b>33.4%</b> | <b>33.3%</b> | <b>-9.4%</b>                                     | <b>-5.6%</b> | <b>-0.1%</b> | <b>-15.1%</b> |

Non-Irrigated

|               |              |              |              |              |              |              |              |              |             |             |             |              |
|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|--------------|
| Multi-Use     | 3,451        | 3,806        | 4,336        | 4,393        | 50.9%        | 60.0%        | 64.2%        | 65.6%        | 9.1%        | 4.2%        | 1.4%        | 14.7%        |
| Hay/Pasture   | 50           | 66           | 164          | 75           | 0.7%         | 1.0%         | 2.4%         | 1.1%         | 0.3%        | 1.4%        | -1.3%       | 0.4%         |
| <b>Totals</b> | <b>3,501</b> | <b>3,872</b> | <b>4,499</b> | <b>4,468</b> | <b>51.7%</b> | <b>61.0%</b> | <b>66.6%</b> | <b>66.7%</b> | <b>9.4%</b> | <b>5.6%</b> | <b>0.1%</b> | <b>15.1%</b> |

## RIPARIAN

Riparian mapping data are derived from the Yellowstone River Riparian Vegetation Mapping study (DTM/AGI 2008). This study coarsely mapped the riparian vegetation communities using 1950's, 1976-1977, and 2001 aerial imagery in a GIS environment. The polygons are digitized at a scale of approximately 1:7,500, with a minimum mapping unit of approximately 10 acres. The goal of the delineation was to capture areas of similar vegetation structure as they appeared on the aerial imagery, while maintaining a consistent scale.

The "Riparian Turnover" values quantify the total area within the active channel area that converted from either woody vegetation to open bar or water, or from open bar or water to woody vegetation. A comparison of these values allows some consideration of overall riparian encroachment into the river corridor from 1950 to 2001.

### Riparian Mapping

| Statistic | Shrub (Acres) |       |       | Closed Timber (Acres) |         |         | Open Timber (Acres) |       |       |
|-----------|---------------|-------|-------|-----------------------|---------|---------|---------------------|-------|-------|
|           | 1950          | 1976  | 2001  | 1950                  | 1976    | 2001    | 1950                | 1976  | 2001  |
| Min       | 0.2           | 0.1   | 0.0   | 0.7                   | 1.0     | 0.8     | 1.9                 | 2.0   | 1.5   |
| Max       | 82.2          | 38.9  | 65.8  | 358.0                 | 226.4   | 275.4   | 259.3               | 195.1 | 376.3 |
| Average   | 10.4          | 8.2   | 10.6  | 74.6                  | 54.7    | 47.7    | 58.8                | 29.5  | 61.9  |
| Sum       | 396.3         | 448.9 | 435.6 | 1,491.6               | 1,639.9 | 1,431.2 | 588.3               | 502.1 | 927.9 |

### Riparian Turnover

Conversion of riparian areas to channel, or from channel to riparian between the 1950's and 2001 data set.

Riparian to Channel (acres) 395.3

Channel to Riparian (acres) 564.8

**Riparian Encroachment (acres) 169.5**

### Riparian Recruitment

|  |  |              |
|--|--|--------------|
| Creation of riparian areas between 1950s and 2001. | 1950s Channel Mapped as 2011 Riparian (Ac)   | 570.1        |
|  | 1950s Floodplain Mapped as 2011 Channel (Ac) | 215.2        |
|  | <b>Total Recruitment (1950s to 2011)(Ac)</b> | <b>785.3</b> |

## WETLANDS

Wetland areas were mapped to National Wetland Inventory standards by the Montana Natural Heritage Program. Palustrine wetlands within the mapped 100-year inundation boundary were extracted and summarized into four categories: Riverine (Unconsolidated Bottom - UB, Aquatic Bed - AB, and Unconsolidated Shore - US), Emergent - EM, Scrub-Shrub - SS, and Forested - FO.

|                   | Riverine | Emergent | Scrub/Shrub | Forested | Total        |
|-------------------|----------|----------|-------------|----------|--------------|
| Mapped Acres      | 15.7     | 406.2    | 130.4       | 0.0      | <b>552.3</b> |
| Acres/Valley Mile | 2.5      | 65.4     | 21.0        | 0.0      |              |

## RUSSIAN OLIVE

Russian olive is considered an invasive species and its presence in the Yellowstone River corridor is fairly recent. As such, its spread can be used as a general indicator of invasive plants within the corridor. It has the added benefit of being easily identified in multi-spectral aerial photography, making it possible to inventory large areas using remote techniques.

In 2011, Natural Resources Conservation Service (NRCS) in Bozeman, MT conducted an inventory of Russian olive locations in the Yellowstone River watershed. This study utilized the Feature Analyst extension within ArcGIS to interpret multi-spectral 2008 NAIP imagery for the presence of Russian olive. The resulting analysis was converted from raster format to a polygon ESRI shape file for distribution and further analysis within a GIS environment.

This work scope was tasked with integrating the resulting Russian olive inventory into the Yellowstone River Conservation Districts Council (YRDC) Cumulative Effects Assessment (CEA) GIS and associated reach-based database. Additionally, analysis of Russian olive within the corridor was conducted to characterize its distribution in throughout the corridor and its association with other corridor data sets.

|                        | Floodplain Area (Ac) | % of Floodplain | Other Area (Ac) | Inside RMA (Ac) | Inside '50s Channel (Ac) | Inside 50s Island (Ac) |
|------------------------|----------------------|-----------------|-----------------|-----------------|--------------------------|------------------------|
| Russian Olive in Reach | 164.35               | 2.08%           | 10.40           | 2.29            | 35.11                    | 36.34                  |

## FISHERIES SUMMARY

Fisheries data available for the Reach Narratives include low-flow and high-flow habitat mapping of 2001 conditions for 406 miles of river, extending from the mouth upstream to a point approximately 8 miles upstream of Park City. Habitat mapping was performed remotely on the 2001 CIR aerial photography utilizing habitat classifications developed by Montana Fish, Wildlife, and Parks (DTM 2009). Historic habitat mapping using the 1950's imagery is limited to Reach B1 (high-flow) and D9 (low and high-flow).

Fisheries field sampling data have been provided by Ann Marie Reinhold (MSU). In this study, the Yellowstone River from Park City to Sidney was divided into five segments. Within each segment, fish were sampled in reaches modified by riprap ("treatment reaches") and relatively unmodified reaches ("control reaches"). Fish sampling was conducted during summer and autumn of 2009, 2010, and 2011. Boat electrofishing, trammel nets, mini-fyke nets and bag seines were used to collect data from river bends.

Fish presence data is only presented for those reaches that were sampled.

The Low Flow Habitat Mapping followed schema developed by Montana Fish Wildlife and Parks to identify key habitat units for certain aquatic species.

## Fish Species Observed in Reach/Region

Species of Concern

| Reach                               | Region  | Reach                               | Region  | Reach                               | Region  | Reach                               | Region   |
|-------------------------------------|---|-------------------------------------|---|-------------------------------------|---|-------------------------------------|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> Bigmouth buffalo  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Flathead chub             | <input type="checkbox"/>            | <input type="checkbox"/> Northern redbelly dace         | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Stonecat               |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> Black bullhead    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Freshwater drum           | <input type="checkbox"/>            | <input type="checkbox"/> Pallid sturgeon                | <input type="checkbox"/>            | <input type="checkbox"/> Sturgeon chub                     |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Black crappie     | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Goldeye                   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Pumpkinseed         | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Sucker species         |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> Blue sucker       | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Green sunfish             | <input type="checkbox"/>            | <input type="checkbox"/> Rainbow trout                  | <input type="checkbox"/>            | <input type="checkbox"/> Sunfish species                   |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Bluegill          | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Lake chub                 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> River carpsucker    | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Walleye                |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Brook stickleback | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Largemouth bass           | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Rock bass           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Western silvery minnow |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> Brown trout       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Longnose dace             | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Sand shiner         | <input type="checkbox"/>            | <input type="checkbox"/> White bass                        |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Burbot            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Longnose sucker           | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Sauger              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> White crappie          |
| <input type="checkbox"/>            | <input type="checkbox"/> Catfish species              | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Minnow species            | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Shorthead redhorse  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> White sucker           |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Channel catfish   | <input type="checkbox"/>            | <input type="checkbox"/> Mottled sculpin                      | <input type="checkbox"/>            | <input type="checkbox"/> Shortnose gar                  | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Yellow bullhead        |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Common carp       | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Mountain sucker           | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Shovelnose sturgeon | <input type="checkbox"/>            | <input type="checkbox"/> Yellow perch                      |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> Creek chub        | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Mountain whitefish        | <input type="checkbox"/>            | <input type="checkbox"/> Sicklefin chub                 |                                     |  |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Emerald shiner    | <input type="checkbox"/>            | <input checked="" type="checkbox"/> Northern pike             | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Smallmouth bass     |                                     |  |
| <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Fathead minnow    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Northern plains killifish | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> Smallmouth buffalo  |                                     |  |

## Low Flow Fisheries Habitat Mapping

2001 (Acres)

| Habitat                      | Bankfull | Low Flow | % of Low Flow |
|------------------------------|----------|----------|---------------|
| Scour Pool                   | 377.7    | 279.2    | 11.7%         |
| Rip Rap Bottom               | 46.3     | 34.2     | 1.4%          |
| Bluff Pool                   | 53.5     | 35.9     | 1.5%          |
| Secondary Channel            | 147.9    | 81.2     | 3.4%          |
| Secondary Channel (Seasonal) | 360.7    | 262.0    | 11.0%         |
| Channel Crossover            | 231.0    | 153.2    | 6.4%          |
| Point Bar                    |          | 72.9     | 3.1%          |
| Side Bar                     |          | 127.7    | 5.4%          |
| Mid-channel Bar              |          | 36.7     | 1.5%          |
| Island                       | 1,161.0  | 1,161.6  | 48.8%         |
| Dry Channel                  |          | 133.4    | 5.6%          |

## AVIAN

Birds were sampled in 2006 and 2007 by Danielle Jones of Montana State University. Point count methods were used at 304 randomly chosen sites in 21 braided or anabranching reaches. Each site was visited multiple times within a season, and sites were visited in both years. Birds were sampled in grassland, shrubland, and cottonwood forest habitats. Additional bird data was collected by Amy Cilimburg of Montana Audubon in summer 2012. High priority areas for data collection were identified with the assistance of the YRDC Technical Advisory Committee. The Audubon methodology recorded data for a wider variety of bird species relative to the MSU study, including raptors and waterfowl.

| Bird Species Observed in Reach/Region   |  | Species of Concern  | Potential Species of Concern  |
|---|--|---|---|
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> American Robin          | <input type="checkbox"/> <input checked="" type="checkbox"/> Chipping Sparrow                  | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Killdeer              | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Song Sparrow            |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> American Crow           | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Clay-collared Sparrow  | <input type="checkbox"/> <input checked="" type="checkbox"/> Lark Bunting                     | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Spotted Sandpiper       |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> American Goldfinch      | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Cliff Swallow          | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Lark Sparrow          | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Spotted Towhee          |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> American Kestrel        | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Common Grackle         | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Lazuli Bunting        | <input type="checkbox"/> <input checked="" type="checkbox"/> Sharp-shinned Hawk                 |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> American Redstart       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Common Merganser       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Least Flycatcher      | <input type="checkbox"/> <input checked="" type="checkbox"/> Swainson's Thrush                  |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Bald Eagle              | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Common Nighthawk       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Mallard               | <input type="checkbox"/> <input checked="" type="checkbox"/> Sandhill Crane                     |
| <input type="checkbox"/> <input type="checkbox"/> Baltimore Oriole                              | <input type="checkbox"/> <input type="checkbox"/> Common Raven                                 | <input type="checkbox"/> <input type="checkbox"/> Mountain Bluebird                           | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Tree Swallow            |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Barn Swallow            | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Common Yellowthroat    | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Mourning Dove         | <input type="checkbox"/> <input checked="" type="checkbox"/> Turkey Vulture                     |
| <input type="checkbox"/> <input checked="" type="checkbox"/> Belted Kingfisher                  | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Cooper's Hawk          | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Northern Flicker      | <input type="checkbox"/> <input checked="" type="checkbox"/> Upland Sandpiper                   |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Black-billed Cuckoo     | <input type="checkbox"/> <input checked="" type="checkbox"/> Dickcissel                        | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Orchard Oriole        | <input type="checkbox"/> <input checked="" type="checkbox"/> Vesper Sparrow                     |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Black-billed Magpie     | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Downy Woodpecker       | <input type="checkbox"/> <input type="checkbox"/> Osprey                                      | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Violet-green Swallow    |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Black-capped Chickadee  | <input type="checkbox"/> <input checked="" type="checkbox"/> Eastern Bluebird                  | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Ovenbird              | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Warbling Vireo          |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Black-and-white Warbler | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Eastern Kingbird       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Plumbeous Vireo       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Western Kingbird        |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Black-headed Grosbeak   | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Eurasian Collared-dove | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Red-headed Woodpecker | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Western Meadowlark      |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Blue Jay                | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> European Starling      | <input type="checkbox"/> <input type="checkbox"/> Red-naped Sapsucker                         | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Western Wood-pewee      |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Bobolink                | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Field Sparrow          | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Red Crossbill         | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> White-breasted Nuthatch |
| <input type="checkbox"/> <input checked="" type="checkbox"/> Brewer's Blackbird                 | <input type="checkbox"/> <input checked="" type="checkbox"/> Franklin's Gull                   | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Ring-necked Pheasant  | <input type="checkbox"/> <input checked="" type="checkbox"/> White-throated Swift               |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Brown-headed Cowbird    | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Grasshopper Sparrow    | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Red-tailed hawk       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Wild Turkey             |
| <input type="checkbox"/> <input checked="" type="checkbox"/> Brown Creeper                      | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Gray Catbird           | <input type="checkbox"/> <input checked="" type="checkbox"/> Rock Dove                        | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Wood Duck               |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Brown Thrasher          | <input type="checkbox"/> <input checked="" type="checkbox"/> Great Blue Heron                  | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Red-winged Blackbird  | <input type="checkbox"/> <input type="checkbox"/> Yellow-bellied Sapsucker                      |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Bullock's Oriole        | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Great Horned Owl       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Red-eyed Vireo        | <input type="checkbox"/> <input type="checkbox"/> Yellow-billed Cuckoo                          |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Canada Goose            | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Hairy Woodpecker       | <input type="checkbox"/> <input type="checkbox"/> Red-breasted Grosbeak                       | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Yellow-breasted Chat    |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Cedar Waxwing           | <input type="checkbox"/> <input type="checkbox"/> House Finch                                  | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Say's Phoebe          | <input type="checkbox"/> <input type="checkbox"/> Yellow-headed Blackbird                       |
| <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Chimney Swift           | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> House Wren             | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Savannah Sparrow      | <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> Yellow Warbler          |

## CULTURAL INVENTORY SUMMARY

The Yellowstone River Cultural Inventory - 2006 documents the variety and intensity of different perspectives and values held by people who share the Yellowstone River. Between May and November of 2006, a total of 313 individuals participated in the study. They represented agricultural, civic, recreational, or residential interest groups. Also, individuals from the Crow and the Northern Cheyenne tribes were included.

There are three particular goals associated with the investigation. The first goal is to document how the people of the Yellowstone River describe the physical character of the river and how they think the physical processes, such as floods and erosion, should be managed. Within this goal, efforts have been made to document participants' views regarding the many different bank stabilization techniques employed by landowners. The second goal is to document the degree to which the riparian zone associated with the river is recognized and valued by the participants. The third goal is to document concerns regarding the management of the river's resources. Special attention is given to the ways in which residents from diverse geographical settings and diverse interest groups view river management and uses. The results illustrate the commonalities of thought and the complexities of concerns expressed by those who share the resources of the Yellowstone River.

### Summary of Cultural Views in Region C

In the study segment, Powder River to Big Horn River, three conversations emerged across the four interest groups. The first conversation focuses on the "familiar way of life." The conversation exposes a local identity that is tied to agriculture and to traditional forms of recreation, such as hunting and fishing. When asked if the familiar management practices are sufficient in terms of sharing the river's resources, some locals express concerns. The second conversation explicitly acknowledges that the demand for recreational access to the river's resources is in its infancy in terms of representing a problem. The third conversation focuses on controlling the river with rip-rap and dikes.