RECLAMATION
Managing Water in the West

Oxbow Conservation Area Reach Assessment Middle Fork John Day River

Grant County, Oregon

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Pacific Northwest Regional Office, Boise, Idaho

March 2010

U.S. Department of the Interior

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Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

The Bureau of Reclamation (Reclamation) produced this reach assessment to assist in meeting tributary habitat commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NOAA Fisheries 2008a). This Biological Opinion includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect listed salmon and steelhead across their life cycle. This report provides scientific information to Federal, Tribal, State, and local partners that can be used to develop and monitor field projects that are intended to improve the survival and recovery of salmon and steelhead listed under the Endangered Species Act (NOAA Fisheries 2008a).

The Middle Fork John Day subbasin is located in Grant County, Oregon, and has a drainage area of about 800 square miles with elevations ranging from 2,200 feet at its mouth to over 8,100 feet in the headwaters (Young 1986). The subbasin originates in the Blue Mountains of the Malheur National Forest and flows 75 miles to its confluence with the North Fork John Day River north of Monument, Oregon. The Middle Fork John Day River has Class I waters as classified in the U.S. Forest Service Blue Mountain Stream Survey Program and the priority habitat actions are for rehabilitation and protection (NOAA Fisheries 2008b).

As part of the Columbia River Basin, the John Day River watershed contains salmon and steelhead habitat of the Columbia River fish species. The species of concern found in the Middle Fork John Day River include Middle Columbia River Chinook salmon (*Oncorhynchus tshawysha*), steelhead (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*). Steelhead and bull trout are included in the Endangered Species Act (ESA) Threatened and Endangered list.

Watershed limiting factors are defined as “conditions that limit the ability of habitat to fully sustain populations of salmon.” For the John Day River steelhead major population group (MPG), the limiting factors identified are (NOAA Fisheries 2008b):

- Degradation of tributary habitat-forming processes and functions (loss of channel structure, floodplain connectivity, riparian vegetation, and large woody debris (LWD) recruitment
- Loss of historical habitat because of blocked or impaired fish passage (i.e., push-up dams, culverts, unscreened diversions
- Degraded floodplain connectivity and function (i.e., loss of off-channel habitat, side channels, connected hyporheic zone)
- Degraded channel structure and complexity (i.e., loss of spawning and rearing habitat, LWD, pools)
- Degraded riparian condition (i.e., native riparian vegetative communities, LWD recruitment)
- Altered hydrology (i.e., low summer flow; scouring peak flows due to degraded watershed conditions and/or streamflow alterations; withdrawals for irrigation and other uses)
- Degraded water quality (i.e., abnormal water temperatures; fine sediment; nutrients from runoff, pesticides and other chemicals; water withdrawals that reduce natural streamflows)

The Oxbow reach, located between river miles (RM) 58.0 and RM 55.6 on the Middle Fork John Day River in the Oxbow Conservation Area, is within a 6th field Hydrologic Unit Code (HUC) watershed. The reach is characterized as an unconfined geomorphic reach type based on geologic channel constraints. Typically, unconfined geomorphic reaches have flatter slopes and a complex network of channels that result in a high degree of interaction between the active channel and its floodplain. Prior to human disturbance, the Middle Fork John Day River maintained dynamic equilibrium by actively migrating laterally across its floodplain within the Oxbow reach. This lateral channel migration maintains a balanced energy regime with flatter channel gradient as sediment is reworked before being transported downstream. The natural environmental processes of hydrologic, geomorphic, and biotic regimes create a healthy stream characterized by a dynamic cycle of conversion from river to floodplain and vice versa, producing a continuous renewal of fish habitat. When interaction between these regimes is altered, it can negatively impact the availability of fish habitat upon which aquatic species within the basin depend.

Field surveys and evaluations were conducted in the Oxbow reach during the 2007 and 2008 field seasons to determine the condition of the hydrologic, geomorphic, and biotic regimes. The physical specific indicators were organized in a reach-based ecosystem indicator (REI) table. Some environmental processes in the Oxbow reach are in a degraded state as a result of anthropogenic impacts. The dynamic interactions between the three regimes have been impacted by dredge mining, channelization, bank protection, and clearing of riparian vegetation. These features have reduced the overall floodplain connectivity and resulted in localized changes in sediment transport and deposition. The reach assessment is consistent with the Interior Columbia Technical Regional Team priority objectives of monitoring rehabilitation actions to maintain and improve the riverine ecosystem.

Goals of the assessment: One goal of this reach assessment is to develop an improved understanding of the physical processes acting on the watershed to better identify rehabilitation opportunities and address limiting factors that affect the survival and recovery of ESA-listed and other culturally important fish species. Another goal is to provide a description of environmental baseline conditions through the REI that can complement monitoring activities designed to evaluate the biological response associated with the implementation of habitat improvement projects. The reach assessment had these objectives:

1) Determine the functional arrangement of physical and biological components of the reach.
2) Establish an understanding of the predominant physical processes.
3) Interpret and document deviations from processes that would be expected to have occurred prior to human disturbance.

This reach assessment establishes environmental conditions present in the Oxbow reach in 2007 and 2008 by examining the interactions of the hydrologic, geomorphic, and biotic regimes, and assessing their influences on forming and maintaining fish habitat at the reach scale. A reach is comprised of smaller-scale components that include the active main channel and the floodplain areas which are called subreaches. Subreaches are delineated by lateral and vertical controls with respect to the presence or absence of inner or outer zones. An inner zone is an area where ground-disturbing flows take place, such as the active main channel, related side channels, and active bars. An outer zone is an area that may become inundated at higher flows, but typically does not experience ground-disturbing flows. The outer zone is typically a terrace tread that is generally coincidental with the historic channel migration zone except where the channel has been modified or incised, disconnecting the channel from the historic floodplain (adapted from USFS 2008).

Anthropogenic features can be analyzed to establish impacts to the current (2007/2008) river condition. Subsequently, the 2007/2008 river condition provides an environmental baseline for comparisons with future assessments to establish a time series for comparison and integration with monitoring activities. In the instance of the Oxbow reach, the habitat-forming processes have been unfavorably impacted with 27 percent of the specific reach-based ecosystem indicators (REI) in an **Unacceptable Risk Condition** and 67 percent in an **At Risk Condition** (Appendix A).

Reach-based indicators in the **Unacceptable Risk Condition** for this reach assessment include (1) water temperature, (2) large wood, (3) vegetation condition (disturbance), and (4) vegetation condition (canopy cover). **At Risk Condition** specific indicators include (1) chemical contamination/nutrients, (2) channel substrate, (3) fine sediment, (4) pools, (5) off-channel habitat, (6) floodplain connectivity, (7) bank stability/channel migration, (8) vertical stability, and (9) vegetation condition (structure). The specific indicators found to be in an **Adequate Condition** are turbidity and main channel physical barriers (natural/human).

The geomorphic potential, which is an indicator of the stream's capability to form, connect, and sustain fluvial systems (including fish habitat) by adjusting longitudinally, vertically, and laterally to changes in the hydrologic, geomorphic, and biotic regimes over time, was qualitatively ranked as high, moderate, and low for each reach. Geomorphic potential for the Oxbow reach is interpreted to be altered because of reduced floodplain connectivity, lateral channel migration, and large wood recruitment potential. Reduced floodplain connectivity, reduced lateral channel migration, and the potential for increased vertical channel migration are due to channelization in the inner zone subreaches OR-IZ-3 and OR-IZ-5. There is reduced lateral channel migration due to bank protection in inner zone OR-IZ-4 and outer zones OR-OZ-15 and OR-OZ-16. These subreaches are interpreted to be in an overall **At Risk Condition** as shown in Table 1.

Table 1. Reach-based ecosystem indicators (REI) for the Oxbow reach. Each indicator was interpreted to be in one of three conditions: *Adequate, At Risk, or Unacceptable Risk*.*

Spatial Scale	General Indicator		General Indicator Condition	
Watershed Characteristics	Effective Drainage Network and Watershed Road Density		At Risk	
	Disturbance Regime (Natural/Human)		Unacceptable Risk	
	Flow/Hydrology		At Risk	
	Water Quality		At Risk	
	Habitat Access		At Risk	
Spatial Scale	**General Indicator**	**General Indicator Condition**	**Specific Indicator**	**Specific Indicator Condition**
Reach Characteristics	Water Quality	At Risk	Water Temperature	Unacceptable Risk
			Turbidity	Adequate
			Chemical Contamination/Nutrients	At Risk
	Habitat Access	Adequate	Main Channel Physical Barriers (Natural/Human)	Adequate
	Habitat Quality	At Risk	Channel Substrate	At Risk
			Fine Sediment	At Risk
			Large Wood	Unacceptable Risk
			Pools	At Risk
			Off-channel Habitat	At Risk
	Channel Condition and Dynamics	At Risk	Floodplain Connectivity	At Risk
			Bank Stability/Channel Migration	At Risk
			Vertical Channel Stability	At Risk
	Riparian/Upland Vegetation	Unacceptable Risk	Vegetation Condition (Structure)	At Risk
			Vegetation Condition (Disturbance)	Unacceptable Risk
			Vegetation Condition (Canopy Cover)	Unacceptable Risk

*Existing conditions at the reach scale are based on criteria defined in the REI (Appendix A). Existing conditions at the subreach scale may be substantially different.

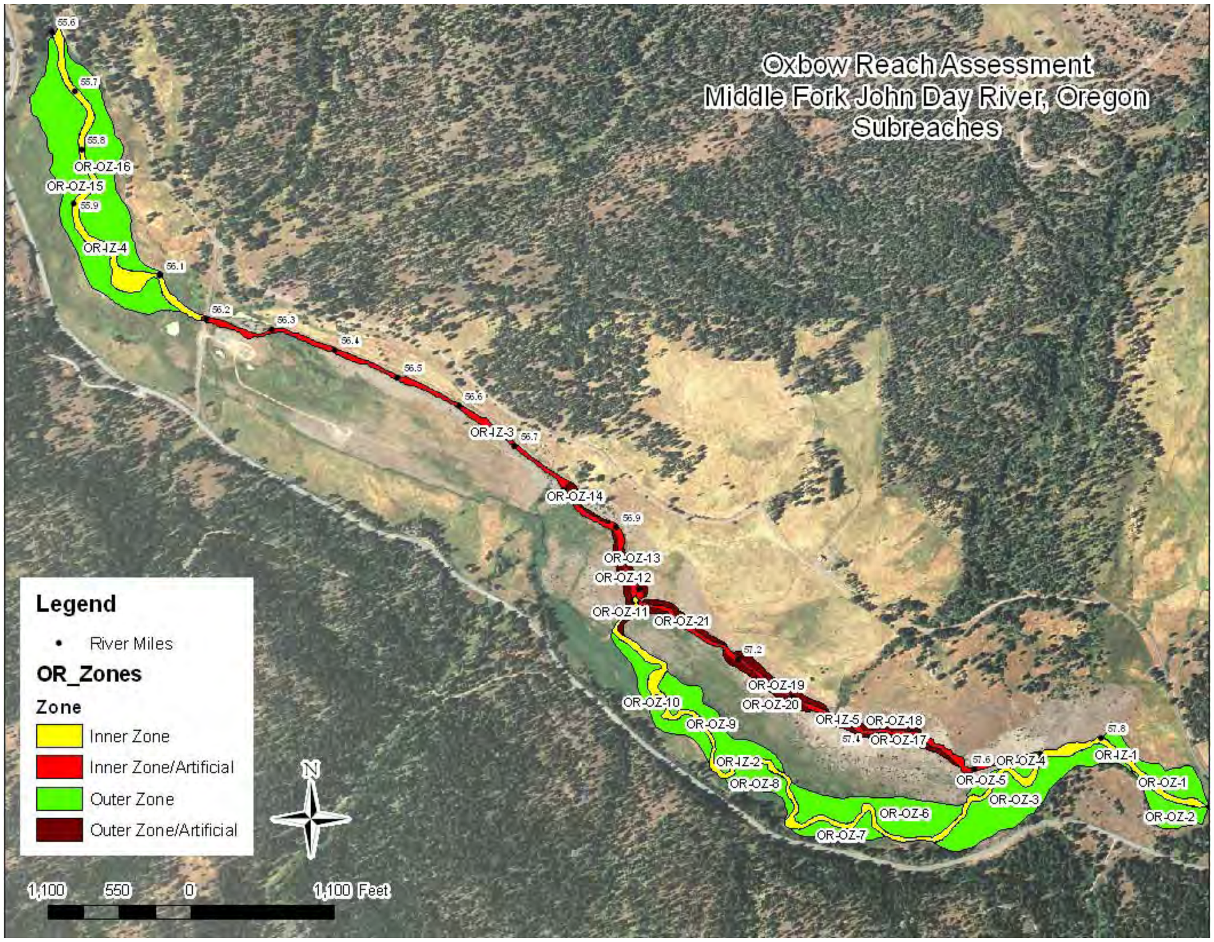

Figure 1. Inner and outer zones, and subreaches along the Oxbow reach, Middle Fork John Day River.

OVERVIEW

The Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers, and Bonneville Power Administration contribute to the implementation of salmonid habitat improvement projects in Columbia River Basin tributaries to help meet commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NOAA 2008). This BiOp includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect listed salmon and steelhead across their life cycle. Habitat improvement projects in various Columbia River tributaries are one aspect of this RPA. Reclamation provides technical assistance to States, Tribes, Federal agencies, and other local partners for identification, design, and construction of stream habitat improvement projects that primarily address streamflow, access, entrainment, and channel complexity limiting factors. This report provides scientific information on geomorphology and hydraulic modeling that can be used to help identify, prioritize, and implement sustainable fish habitat improvement projects and to help focus those projects on addressing key limiting factors to protect and improve survival of salmon and steelhead listed under the Endangered Species Act (ESA).

Tributary and reach assessments were developed to help identify, prioritize, and implement sustainable habitat improvement projects that provide the greatest biological benefits to anadromous and native fish listed under the ESA. Assessments also define environmental baseline conditions that can complement monitoring activities designed to evaluate the physical and biological response associated with the implementation of habitat improvement projects.

Many authors have documented strategies that emphasize maintaining functioning habitat, reconnecting isolated habitat, and restoring processes that form and maintain habitats (Beechie et al. 1996; Kauffman et al. 1997; Beechie and Bolton 1999; Montgomery and Bolton 2003). Habitat actions of this nature often occur at the site or reach scale. Roni et al. (2002) introduced a hierarchical strategy that places site-specific actions within a watershed context.

Tributary and reach assessments telescope in a top-down approach, from a large scale (basin) to a smaller scale (reach) from which habitat actions are implemented (Figure 2). Prior to identifying, prioritizing, and implementing habitat actions, selected physical and/or biological variables are collected and analyzed in the assessment process to establish environmental baseline conditions. Implementation, status and trend, and effectiveness monitoring occurs in reverse in a bottom-up approach, from the reach scale to the basin scale. Integration of the environmental baseline conditions identified in the assessment process with monitoring can improve understanding of the physical processes that underpin the identification, prioritization, and implementation of successful habitat improvement projects and the biological response to those projects.

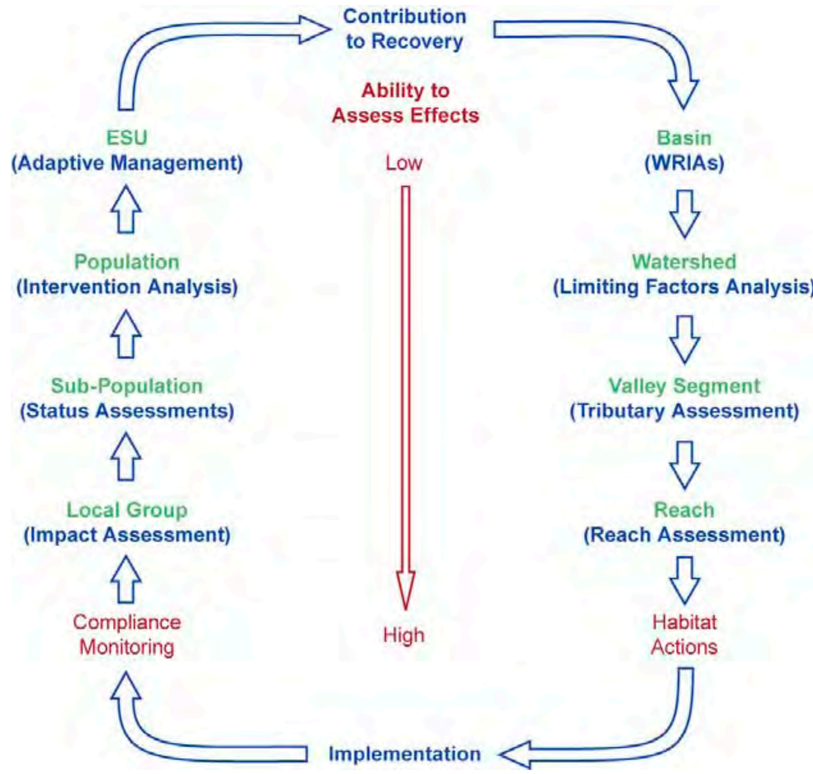

Figure 2. Idealized model showing how assessments and monitoring are hierarchically nested and related. Compiled from Hillman (2006), UCSRB (2007), and Stewart-Oaten and Bence (2001).

Prior to implementing habitat actions, a reach assessment can be conducted to document the status of stream processes and anticipate the effects on potential habitat improvement actions. Baseline data should be collected prior to implementing any habitat action so that changes from environmental baseline conditions can be monitored in the future.

The purpose of a reach assessment is to refine understanding of the geomorphic potential and establish environmental baseline conditions at the reach scale. The assessment evaluates the current condition of a group of indicators. The physical and biological variables, many of which are quantifiable and have geospatial reference, are organized in a reach-based ecosystem indicator (REI) table (Appendix A). The variables measured to populate the REI table document the environmental baseline conditions and are used as information about the condition of general indicators, sometimes referred to as higher-level indicators or pathways. The REI table identifies positive attributes and deficiencies in the hydrologic, geomorphic, and biotic regimes.

Following a reach assessment, a habitat action or series of actions are implemented and documented by including what was done, where it was done, and why it was done (i.e., implementation monitoring). After several habitat actions have been implemented in a reach, a subset of the variables from the REI table can be measured and compared to the baseline REI at regular intervals and changes from the environmental baseline conditions can be assessed.

Results from associated status and trend and effectiveness monitoring efforts can be used to evaluate how the environmental conditions and the species of concern are responding to the habitat actions implemented in the reach. This intervention analysis will determine the overall response of the ecosystem and if the habitat action(s) were ecologically successful. If the response is positive, then the habitat actions were effective and there is no need for adjustments. If the response is flat or negative, the habitat actions may need to be adjusted within an adaptive management framework. Also, biological models can be updated and calibrated with physical and biological data and information as it becomes available over several generations of fish returns. These checks and balances are intended to improve the processes that create and maintain complex habitat types for the species of concern and ultimately contribute to their recovery.

PURPOSE AND LOCATION

One goal of this reach assessment is to develop an improved understanding of the physical processes acting on the watershed to better identify rehabilitation opportunities and address limiting factors that affect the survival and recovery of ESA-listed and other culturally important fish species through the following objectives:

- *Determining the functional arrangement of physical and biological components of the response reach.* Establish the geomorphic potential of the river reach through a spatial framework and relevant scaling relationships for the assessment area. This is done through scaling down the response reach to individual subreaches and channel/geomorphic units, which are smaller-scale structural components of the reach. Subreaches are comprised of the active main channel and floodplain areas. Each local geomorphic regime has inherent constraints and capabilities for forming, connecting, and sustaining aquatic river habitat.

- *Establishing an understanding of the predominant physical processes.* Identify linkages between physical and biological processes and anthropogenic impacts based on the understanding of the key physical processes operating in the reach or within and among the context of subreaches; and identify how these processes have been impacted by past and present human activities.

- *Interpreting and documenting the deviations from channel processes anticipated to be present prior to human disturbances.* Describe river conditions at the reach scale based on integrating physical, biological, and habitat information into a REI table. The REI table is a descriptive format for documenting environmental baseline conditions and identifying deficiencies in three regimes: hydrologic, geomorphic, and biotic.

Another goal of this assessment is to provide a description of environmental baseline conditions through the REI table that can complement monitoring activities designed to evaluate the biological response associated with the implementation of habitat improvement projects.

Located in Grant County, Oregon, the Middle Fork John Day River subbasin has a drainage area of about 800 square miles and flows into the North Fork of the John Day River north of Monument, Oregon (Figure 3). The Middle Fork John Day River has Class I waters, meaning it is a municipal watershed and/or fish-bearing stream as classified in the U.S. Forest Service Blue Mountain Stream Survey Program. Rehabilitation and protection actions are recommended to improve the tributary habitat for steelhead recovery (NOAA Fisheries 2008b). These actions would also benefit other anadromous species (salmon, bull trout, and lamprey) utilizing similar habitat.

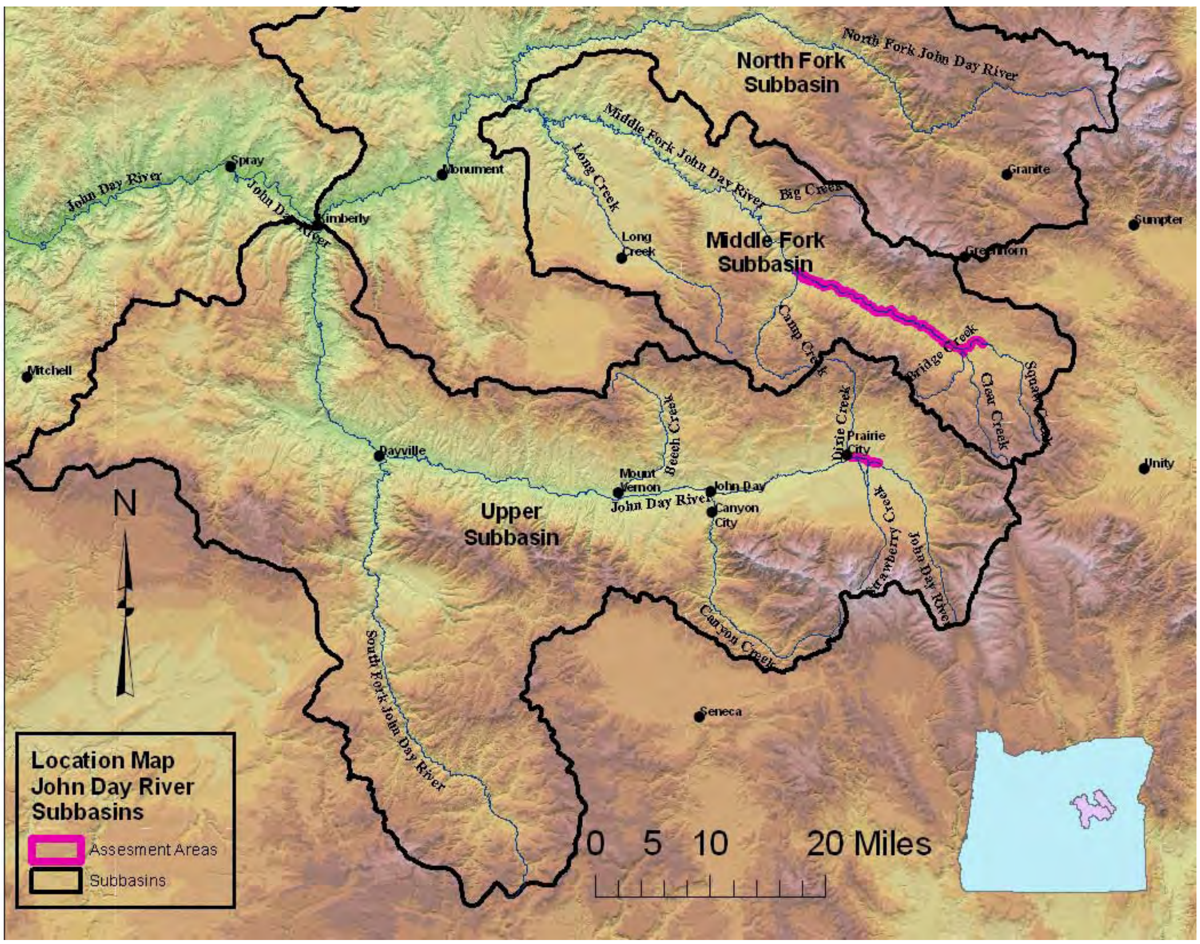

Figure 3. Location map of the Tributary Assessment areas on the Middle Fork and Upper John Day rivers within the Middle Fork and Upper John Day subbasins. The sections in violet denote the valley segments where the tributary assessments were conducted (Reclamation 2008).

The species of concern found in the John Day River include Middle Columbia River spring Chinook salmon (*Oncorhynchus tshawysha*), steelhead (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*). Middle Columbia River steelhead and bull trout are included in the ESA Threatened and Endangered list (NOAA Fisheries 2008b). The proposed *Middle Columbia River Steelhead Distinct Population Segment Endangered Species Act (ESA) Recovery Plan* (Recovery Plan) selected priority actions to improve tributary habitat for steelhead in the Middle Fork John Day River (NOAA Fisheries 2008b). Similar actions should also benefit other salmonid species. Priority actions include the following:

- Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle
- Restore passage and connectivity to habitats blocked or impaired by artificial barriers
- Restore floodplain connectivity and function
- Restore channel structure and complexity
- Restore riparian condition and LWD recruitment
- Restore altered hydrograph to provide appropriate flows during critical periods
- Improve degraded water quality

The Oxbow reach, located between river miles (RM) 58.0 and RM 55.6 on the Middle Fork John Day River, is within a 6th field Hydrologic Unit Code (HUC) watershed in the Oxbow Conservation Area. The reach is characterized as an unconfined geomorphic reach type based on geologic valley constraints. Typically, unconfined geomorphic reaches have flatter slopes and a complex network of channels that result in a high degree of interaction between the active channel and its floodplain. Prior to human disturbance, the Middle Fork John Day River likely maintained dynamic equilibrium by actively migrating laterally across its floodplain within the Oxbow reach. This lateral channel migration maintains a balanced energy regime with a flatter channel gradient as sediment is reworked before being transported downstream.

The natural environmental processes of the hydrologic, geomorphic, and biotic regimes create a healthy stream characterized by a dynamic cycle of conversion from river to floodplain and vice versa, producing a continuous renewal of fish habitat. When the interaction between these regimes is altered, it can negatively impact the availability of fish habitat and could threaten the continuation of the species within the basin. Limiting factors at the watershed scale for the Middle Fork John Day River that are the result of various anthropogenic impacts include the following (NOAA Fisheries 2008b):

- Degradation of tributary habitat-forming processes and functions (loss of channel structure, floodplain connectivity, riparian vegetation, and large woody debris (LWD) recruitment

- Loss of historical habitat because of blocked or impaired fish passage (i.e., push-up dams, culverts, unscreened diversions

- Degraded floodplain connectivity and function (i.e., loss of off-channel habitat, side channels, connected hyporheic zone)

- Degraded channel structure and complexity (i.e., loss of spawning and rearing habitat, LWD, pools)

- Degraded riparian condition (i.e., native riparian vegetative communities, LWD recruitment)

- Altered hydrology (i.e., low summer flow; scouring peak flows due to degraded watershed conditions and/or streamflow alterations; withdrawals for irrigation and other uses)

- Degraded water quality (i.e., abnormal water temperatures; fine sediment; nutrients from runoff, pesticides and other chemicals; water withdrawals that reduce natural streamflows)

Field surveys and evaluations were conducted in the Oxbow reach during the 2007 and 2008 field seasons to determine the condition of the hydrologic, geomorphic, and biotic regimes. Some environmental processes in the Oxbow reach are in a degraded state as a result of anthropogenic impacts. The interactions between the three regimes have been impacted by dredge mining, channelization, bank protection, and clearing of riparian vegetation. These features have reduced the overall floodplain connectivity and resulted in localized changes in sediment transport and deposition. The reach assessment provides information for project monitoring consistent with the Recovery Plan objectives of both protection and rehabilitation actions and the monitoring of these actions.

The Recovery Plan identified potential restoration strategies based on a combination of available data, aquatic ecosystem modeling, and professional judgment of a panel of scientists. Further technical evaluation was conducted by Reclamation to refine the level of detail needed to monitor project implementation to determine their effectiveness on improving aquatic species abundance and productivity.

TRIBUTARY ASSESSMENT

The *Middle Fork and Upper John Day River Tributary Assessments, Grant County, Oregon* (Tributary Assessment) was completed by a multidisciplinary team of hydraulic engineers, geologists, hydrologists, biologists, and botanists (Reclamation 2008). The focus of the Tributary Assessment was to complete a coarse geomorphic analysis of the fluvial system along 23 miles of the Middle Fork John Day River and 3 miles of the Upper John Day River (Figure 3).

The purpose of the Tributary Assessment was to identify major geologic and hydraulic processes active within the valley segment, explore whether geomorphic and hydraulic conditions upstream and downstream from the valley segment affect conditions within the segment, and identify geomorphic reaches within the segment that share common geologic and hydraulic physical attributes. The Tributary Assessment identified twenty geomorphic reaches in the Middle Fork John Day River assessment area (Table 2). These geomorphic reaches were characterized into three general reach types based on geologic channel constraints, referred to as confined, moderately confined, and unconfined.

Subsequent to the completion of the Tributary Assessment, each reach was assigned a qualitative ranking of its geomorphic potential. The geomorphic potential, as used in this document, is defined as the stream's capability to form, connect, and sustain fluvial systems by adjusting longitudinally, vertically, and laterally to changes in the hydrologic, geomorphic, and biotic regimes over time.

Table 2. Geomorphic reach designation, location by river mile, and reach type for Middle Fork John Day River between RM 70.81 and RM 47.95 (Reclamation 2008). The geomorphic potential was subsequently assigned based on the river's capability to form, connect, and sustain fluvial systems by adjusting longitudinally, vertically, and laterally to changes in the hydrologic, geomorphic, and biotic regimes over time.

Reach Designation	River Miles	Reach Type	Geomorphic Potential
MF1	48.0-48.2	Moderately Confined	Moderate
MF2	48.2-51.1	Unconfined	High
MF3	51.1-52.7	Moderately Confined	Moderate
MF4	52.7-53.9	Confined	Low
MF5	53.9-55.3	Moderately Confined	Moderate
MF6	55.3-55.6	Confined	Low
MF7	55.6-56.2	Unconfined	High
MF8	56.2-58.0	Unconfined	High
MF9	58.0-59.1	Unconfined	High
MF10	59.1-60.8	Moderately Confined	Moderate
MF11	60.8-62.5	Confined	Low
MF12	62.5-63.5	Moderately Confined	Moderate
MF13	63.5-66.5	Unconfined	High
MF14	66.5-67.7	Moderately Confined	Moderate
MF15	67.7-68.1	Confined	Low
MF16	68.1-69.0	Unconfined	High
MF17	69.0-69.2	Confined	Low
MF18	69.2-69.7	Moderately Confined	Moderate
MF19	69.7-70.2	Confined	Low
MF20	70.2-70.8	Unconfined	High

The Tributary Assessment found no large-scale change to the balance between incoming water and sediment loads that would indicate a potential for incision or aggradation; however, a slight tendency for degradation in the downstream direction may be present during flood events. Some minor impacts to the sediment regime were detected, including short-term increases in fine sediments from anthropogenic activities, localized changes in channel slopes resulting from channelization, and possibly localized degradation or bed coarsening in small portions of a few reaches (Reclamation 2008).

Stream Survey

At the tributary-scale for the Middle Fork John Day River, the following limiting factors were identified from the Middle Fork John Day River, 2008 Stream Survey Report, Malheur National Forest, Blue Mountain Ranger District (Appendix B). The stream survey was conducted by the U.S. Forest Service under contract with Reclamation.

- Water temperature
    - The Middle Fork John Day River is listed on the 303(d) list for water quality due to exceeding the following criteria for water temperature during the summer months.
        - From the upper end of the Tributary Assessment area at RM 70.8 to Clear Creek at RM 68.0, the Middle Fork John Day River is designated by the State of Oregon Department of Environmental Quality water quality standards for bull trout and juvenile rearing which has optimal temperatures below 12° C (Sturdevant 2008).
        - From Clear Creek at RM 68.0 to the lower end of the Tributary Assessment area at RM 48.0, the Middle Fork John Day River is designated fish use of core coldwater habitat by the State of Oregon Department of Environmental Quality (Sturdevant 2008). This means that the water is expected to maintain temperatures usually considered optimal for salmon and steelhead rearing, or that are suitable for bull trout migration.
- Large Wood
    - Wood counts in the Tributary Assessment area (RM 70.8 to RM 48.0) did not meet the criteria of 20 pieces of medium- and large-sized wood combined per mile of stream. Of the countable wood found throughout the habitat assessment area, 59 percent was small, 32 percent was medium, and 9 percent large.
- Pools
    - The criteria for number of pools per mile vary by channel width. In the Tributary Assessment area, the number of pools per mile did not meet the criteria contained in the REI (Appendix A).

- Riparian Vegetation
  - The riparian vegetation in the Tributary Assessment area is predominantly in a grassland/forbs-to-shrub/seedling condition, implying that there is poor large wood recruitment potential and canopy cover along the river.
- Habitat Complexity
  - The largest impacts to physical processes within the Tributary Assessment area are from dredging, channelization, bank protection, and riparian vegetation clearing. These impacts include reduced channel migration, reduced floodplain connectivity, altered sediment and large wood delivery and retention, and disconnected groundwater sources from the main channel.

REACH CHARACTERIZATION

The Oxbow reach assessment provides the technical evaluation to identify, prioritize, and implement habitat improvement actions. The REI table completed for the reach assessment can be integrated with activities developed to monitor the effectiveness of habitat actions at the reach scale. This assessment establishes environmental baseline conditions of physical processes that are geospatially referenced. This is done through field evaluations of fluvial geomorphic form combined with an understanding of river processes. In turn, this reach-based environmental baseline can be used to assess the influence of implemented habitat actions on habitat formation and maintenance over time, and biological response to those actions when coupled with effectiveness monitoring activities.

The Oxbow reach, which is the focus of this reach assessment, encompasses the unconfined geomorphic reaches MF 8 (RM 58.0 to RM 56.2) and MF 7 (RM 56.2 to RM 55.6) identified in the Tributary Assessment. The valley bottom is classified as a wide mainstream valley (F3) with a valley bottom gradient of less than 3 percent and a generally unconstrained, moderately sinuous channel (Naiman et al. 1992). The stream is predominantly a riffle and run bedform with gravel/cobbles as the dominant substrate (Montgomery and Buffington 1993). Landforms typically include alluvial deposits comprising terraces and alluvial fans (Hillman 2006). Alluvial fan deposits and landslides provide lateral and vertical channel controls on the channel position near Ruby Creek and Butte Creek, but the influence of the Granite Boulder Creek alluvial fan is limited due to substantial dredge mining.

The channel and floodplain area within the Oxbow reach encompasses about 71.9 acres along the Middle Fork John Day River from RM 58.0 to RM 55.6 (Table 3). The active main channel and floodplain areas within the reach were subdivided into two types of morphologically distinct areas to denote greater local control and variability. Called inner and outer zones, these morphologically distinct areas (either natural or constructed) represent areas of existing aquatic habitat within the reach. The zones are delineated by lateral and vertical controls (Figure 4). Inner and outer zones are also categorized as connected or artificial depending on the presence of constructed features or historical anthropogenic activities that influence their lateral or longitudinal connectivity to one another.

Table 3. Acres by zone type on the Oxbow reach, Middle Fork John Day River, Grant County, Oregon.

Inner Zone	Connected Outer Zone	Artificial Inner Zone	Artificial Outer Zone
11.4 acres	48.6 acres	6.5 acres	5.4 acres

An inner zone is characterized by the presence of primary channels, a repetitious sequence of channel units, and relatively uniform physical attributes indicative of localized trends such as transport, transition, and deposition. They are generally associated with ground-disturbing flows with sufficient frequency that mature conifers are rare and a distinct hardwood zone is identifiable (adapted from USFS 2008). However, in the Oxbow reach, this definition was difficult to determine due to the level of riparian disturbance and the fact that the reach may have been more of a wet-meadow type of community prior to human disturbance. As such, the inner zone was primarily mapped based on the physical presence of ground disturbing flows, such as gravel bars and fine sediment deposition. In the Oxbow reach, the active main channel was subdivided into five inner zones based on local trends of transport, transition, and deposition interpreted from the channel unit mapping, channel gradient, channel confinement, and substrate. Inner zones that are not hydraulically connected to the river because of anthropogenic features are described as disconnected inner zones (there are no disconnected inner zones within the Oxbow reach). However, there are artificial, or excavated, inner zones that were constructed through mine tailings, effectively channelizing the river.

In contrast, an outer zone is typically a terrace tread and generally coincidental with the historical channel migration zone unless the channel has been modified or incised, leading to the abandonment of the floodplain. This zone includes floodplain side channels, overflow channels, and oxbows. An outer zone is further distinguished from an inner zone by the presence of flood deposits, a change in vegetation, and bounding geologic landforms such as older terraces, valley walls, alluvial fans, colluvium, or glacial deposits. Outer zones that are not hydraulically connected to the river at higher flows because of anthropogenic features are described as disconnected outer zones (there are no disconnected outer zones within the Oxbow reach). However, there are artificial, or excavated, outer zones that were constructed along channelized sections of the river to allow for floodplain development.

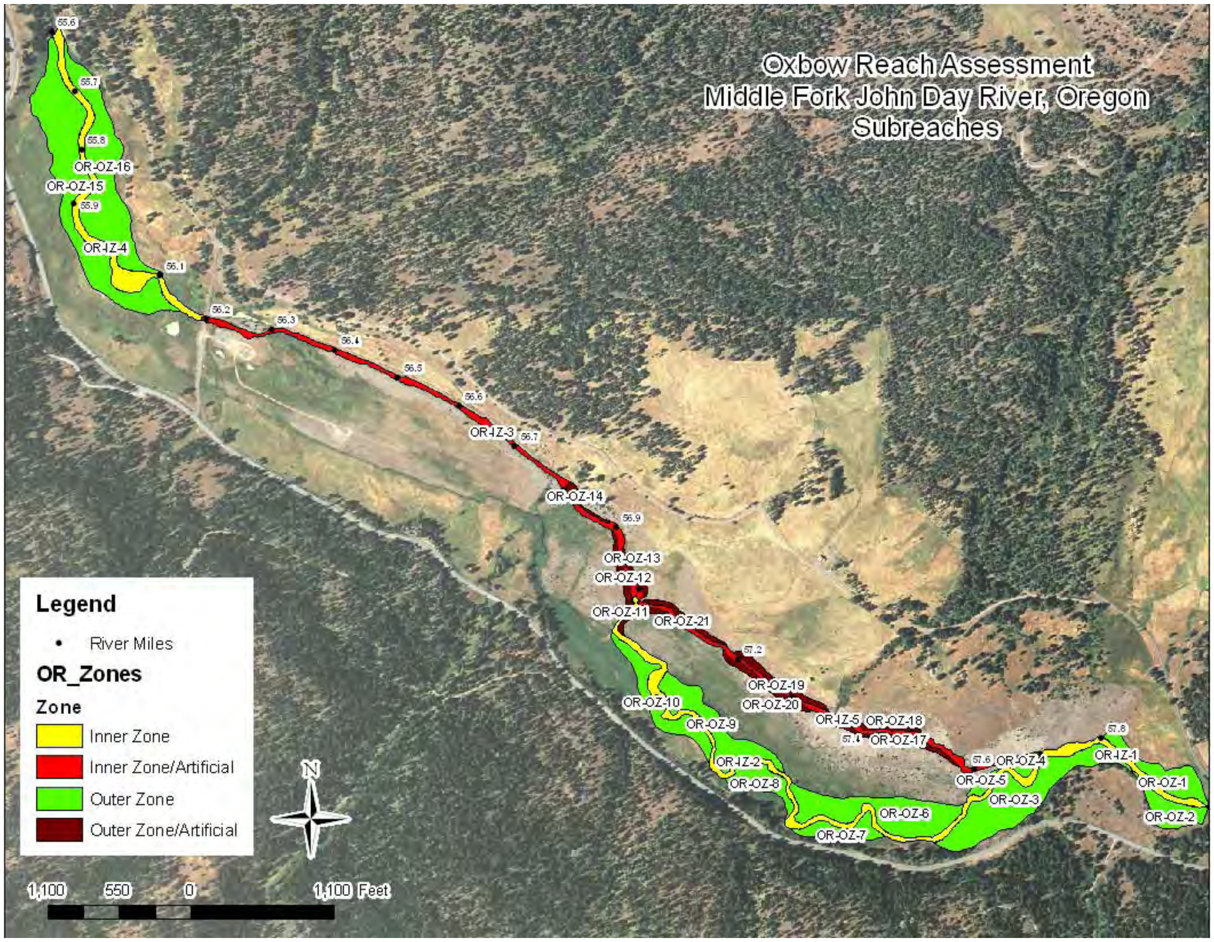

Figure 4. Location of inner zones and outer zones based on a modified application of the Stream Inventory Handbook (USFS 2008).

Reclamation contracted with the U.S. Forest Service to have a Level II Stream Inventory conducted for approximately 20 river miles along the Middle Fork John Day River, which includes the Oxbow reach. The methods used are contained in the Stream Inventory Handbook, Level I & II, Pacific Northwest Region, Region 6, Version 2.8 (USFS 2008). Specific data collected for the Oxbow reach are contained in the REI table (Appendix A) and the complete report is contained in Appendix B.

Reclamation completed a report on the refinement of geologic/geomorphic mapping conducted during the Tributary Assessment and a hydraulic model analysis for the Oxbow reach (Reclamation 2009). This Reach Assessment summarizes some of the primary results from the report.

The purpose of the geologic/geomorphic mapping was to develop a better understanding of the spatial distribution of the surficial geology, related landforms, and the physical processes that are responsible for their formation. Four distinct deposits that could be attributed directly to deposition or reworking by the river included floodplain deposits and three terraces. In

Figure 5, the floodplain in the Oxbow reach is inset into slightly older but distinct terrace deposits (Qa3). The terrace surface ranges from 3 to 5 feet above the active channel (depending on location) and is marked by a much more planar surface than the active floodplain. The floodplain and stream terraces, alluvial fans, and landslides are the most important geomorphic features that influence fluvial processes.

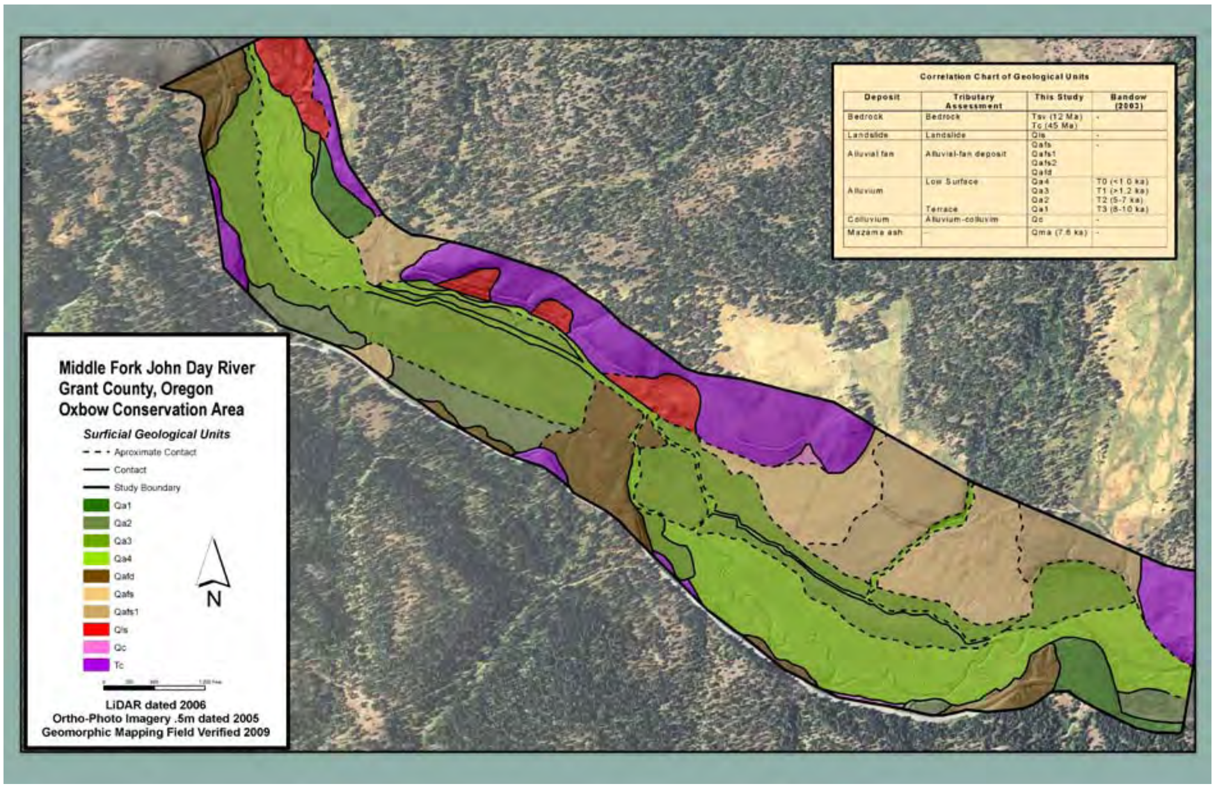

Figure 5. Surficial geology map for the Oxbow reach (Reclamation 2009).

Prior to the dredge mining in the early 1940s, there were five geologic valley constrictions in the Oxbow reach. These locations are:

- The upstream end of the Oxbow reach (RM 58.0) where the floodplain is constricted between bedrock (Tc) on river right and an older terrace (Qa2) on river left.
- Near RM 57.7 where the floodplain is constricted between the Granite Boulder Creek alluvial fan (Qafs) on river right against the Butte Creek alluvial fan (Qafd) on river left.
- Near RM 56.8 where the floodplain was constricted by a landslide (Qls) on river right and the Ruby Creek alluvial fan (Qafd) on river left. The lower part of the Ruby Creek alluvial fan was dredge mined which has changed the topography of the alluvial fan. "Float" or surface exposures of very coarse material (predominantly poorly graded gravel with cobbles and boulders) can be observed at the lower section of the alluvial fan.
- Near RM 56.2 where the floodplain is constricted between the Beaver Creek alluvial fan (Qafs) on river right and older terrace deposits (Qa3) on river left.
- The downstream end of the Oxbow reach (RM 55.6) where the floodplain is constricted between a landslide (Qls) on river right and Ragged Creek alluvial fan (Qafd) on river left.

Between these geologic valley constrictions, the river likely migrated across the unconfined floodplain (Qa3); however, in the early 1940s, dredge mining operations and river channelization occurred within the Oxbow reach. These human impacts created artificial floodplain constrictions between RM 57.7 and 57.0, and RM 57.0 and 56.2.

A two-dimensional hydraulic model was developed for the Oxbow reach to increase understanding of floodplain processes, side channel connectivity, and split flow channel dynamics. Hydraulic parameters, including depth-averaged velocity, bed shear stress, and depth, were determined along the channel thalweg and across the areal extent of the floodplain. Connected floodplain was defined as the area with depths exceeding 0.5 feet outside of the low flow channel. The model evaluated 2-, 5-, 10-, 25-, 50-, and 100-year discharges under existing conditions and with the North Channel blocked (Table 4). Under existing conditions, the floodplain is fairly well inundated during most flood events (Figure 6). From RM 58.0 to RM 56.2, there are poorly defined side channels and flows are conveyed mainly as overbank flow. From RM 56.2 to RM 55.6, multiple secondary flow paths (not well-defined channels) are present across the floodplain that are not well connected and transporting concentrated flow at discharges less than a 10-year peak discharge.

Table 4. 2- through 100-year discharges modeled for the Middle Fork John Day River and inlet flows for Granite Boulder Creek, Ruby Creek, and Beaver Creek, and the outlet.

Discharge	Inlet	Granite Boulder Creek	Ruby Creek	Beaver Creek	Outlet
Q2	881	56	20	20	977
Q5	1332	80	31	32	1475
Q10	1650	98	38	41	1827
Q25	2020	118	47	51	2236
Q50	2380	137	56	60	2633
Q100	2698	156	64	70	2988

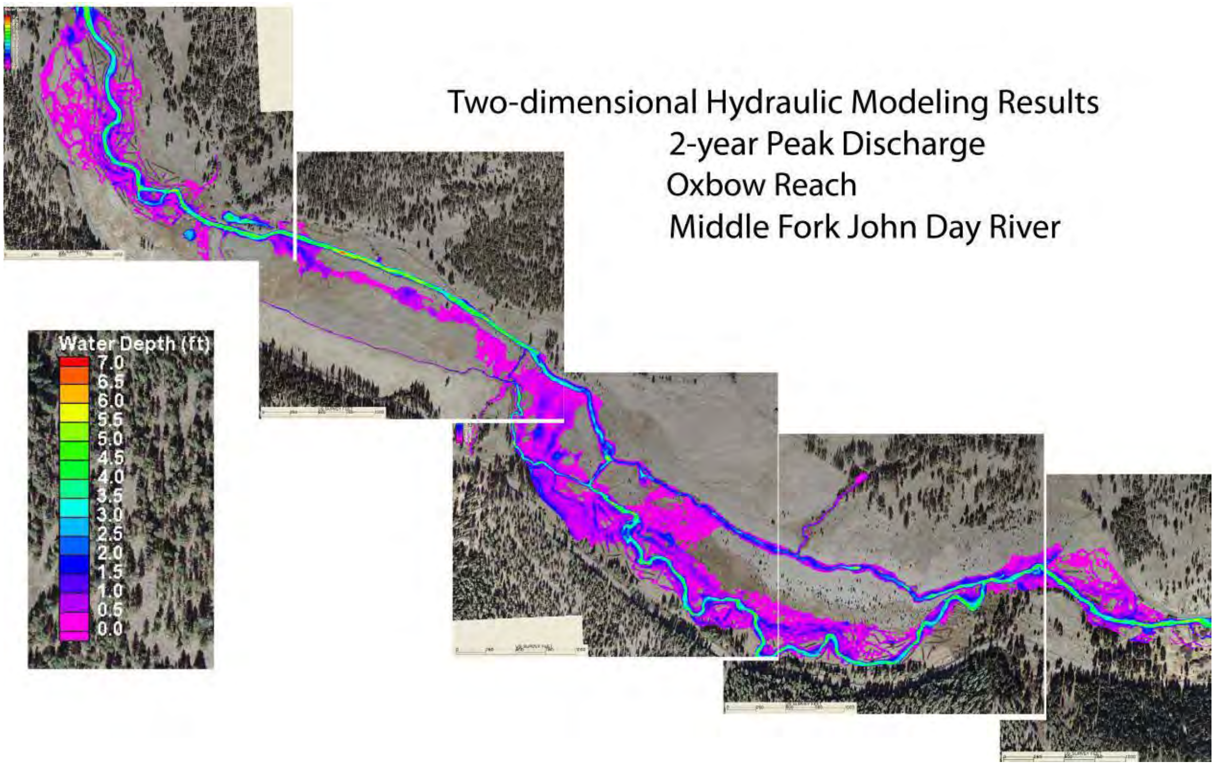

Figure 6. Two-dimensional hydraulic model results at the 2-year peak discharge for the Oxbow reach. Note the model results in this figure include water depths of less than 0.5 feet, which are not considered connected floodplain (Reclamation 2009).

REACH CONDITION

An evaluation of the reach condition was performed as part of this assessment using a combination of all information available at the time of the investigation. The REI table is a compilation of the information and data collection from multi-disciplinary analyses that were conducted prior to or during this investigation (Appendix A). Specific data collected and documented within the analyses are the Stream Survey Report (Appendix B), Initial Site Assessment (Appendix C), Geographic Information System (GIS) Databases (Appendix D), and the Geomorphology and Hydraulic Model Analysis (Reclamation 2009).

Limiting factors are determined at the watershed and reach spatial scales by measuring and synthesizing results from these indicators:

- Watershed Characteristics
  - effective drainage network and watershed road density
  - disturbance regime (natural/human)
  - flow/hydrology
  - water quality
  - habitat access
- Reach Characteristics
  - water quality
  - habitat access
  - habitat quality
  - channel condition and dynamics
  - riparian/upland vegetation

The indicators that are described in the REI table record environmental baseline conditions which are indicative of the condition of the higher-level general indicators at both the watershed and reach spatial scales. The synthesis of the collected information provides a "snapshot" understanding of the combined condition of the hydrologic, geomorphic, and biotic regimes. In turn, this information is used to develop an overall interpretation of reach-based river condition.

Based on the available information and measurements from the field evaluation, each indicator was determined as functioning at one of three conditions based on criteria contained in the REI table: ***Adequate, At Risk, or Unacceptable Risk*** (Table 5).

Table 5. Reach-based ecosystem indicators (REI) for the Oxbow reach. Each indicator was interpreted to be in one of three conditions: A*dequate, At Risk, or Unacceptable Risk*.*

Spatial Scale	General Indicator	General Indicator Condition
Watershed Characteristics	Effective Drainage Network and Watershed Road Density	At Risk
	Disturbance Regime (Natural/Human)	Unacceptable Risk
	Flow/Hydrology	At Risk
	Water Quality	At Risk
	Habitat Access	At Risk

Spatial Scale	General Indicator	General Indicator Condition	Specific Indicator	Specific Indicator Condition
Reach Characteristics	Water Quality	At Risk	Water Temperature	Unacceptable Risk
			Turbidity	Adequate
			Chemical Contamination/Nutrients	At Risk
	Habitat Access	Adequate	Main Channel Physical Barriers (Natural/Human)	Adequate
	Habitat Quality	At Risk	Channel Substrate	At Risk
			Fine Sediment	At Risk
			Large Wood	Unacceptable Risk
			Pools	At Risk
			Off-channel Habitat	At Risk
	Channel Condition and Dynamics	At Risk	Floodplain Connectivity	At Risk
			Bank Stability/Channel Migration	At Risk
			Vertical Channel Stability	At Risk
	Riparian/Upland Vegetation	Unacceptable Risk	Vegetation Condition (Structure)	At Risk
			Vegetation Condition (Disturbance)	Unacceptable Risk
			Vegetation Condition (Canopy Cover)	Unacceptable Risk

* Existing conditions at the reach-scale are based on criteria defined in the REI (Appendix A). Existing conditions at the subreach-scale may be substantially different.

Habitat access, habitat quality, and channel dynamics, which can be used as general indicators of limiting factors, should be monitored to gauge the response of the river to the implemented habitat actions. Monitoring these indicators may provide pro-active opportunities to maintain or improve the overall ecosystem resiliency of the Oxbow reach.

WATERSHED CHARACTERISTICS AND CONDITION

EFFECTIVE DRAINAGE NETWORK AND WATERSHED ROAD DENSITY

Improved roads, railroad grades, dredge mining, and timber harvests with associated unimproved access roads are anthropogenic impacts that are interpreted to have changed the effective drainage network. With limited quantitative data to determine the extent to which this indicator has been affected, this general indicator is qualitatively interpreted to be in an **At Risk Condition**.

DISTURBANCE REGIME (NATURAL/HUMAN)

Historic grazing, dredge mining, timber harvests, road densities, and fires have impacted much of the Middle Fork John Day River watershed (additional information can be found in the Tributary Assessment [Reclamation 2008]). Anthropogenic disturbances generally have long-term negative environmental impacts. Whereas natural disturbances such as fire generally have short-term impacts and recover with time. The cumulative effects of these disturbances have not been quantified, but qualitatively, this general indicator is interpreted to be in an **At Risk Condition**.

FLOW/HYDROLOGY

Sections of the Middle Fork John Day River were dredge mined and/or channelized in the 1940s. Roads and railroad grades have interrupted surface and subsurface flows in both the upland and riparian areas. There are some small irrigation diversions upstream and within the Oxbow reach. Several anthropogenic features impact flow routing and groundwater recharge/storage which led this general indicator to be qualitatively interpreted as an **At Risk Condition**.

WATER QUALITY

Sections of the Middle Fork John Day River are on the 303(d) list for temperature. These sections are further separated as (1) salmon and steelhead spawning areas and (2) core cold water habitat areas. A Total Maximum Daily Load (TMDL) report is currently being written by the Oregon Department of Environmental Quality. Based on the 303(d) listing for temperature, this general indicator is interpreted to be in an **At Risk Condition**.

HABITAT ACCESS

There are no main channel dams within the Middle Fork John Day River watershed that would inhibit fish passage. Therefore, the habitat access general indicator is interpreted to be in an **Adequate Condition**.

REACH CHARACTERISTICS AND CONDITION

WATER QUALITY

The Oxbow reach on the Middle Fork John Day River is on the 303(d) list for water temperature for (1) salmon and steelhead spawning and (2) core cold water habitat. Based on the 303(d) listing, the water temperature specific indicator is interpreted to be in an **Unacceptable Risk Condition**.

The Environmental Protection Agency measured turbidity at two locations that bracket the Oxbow reach. Their sampling results suggest that turbidity does not appear to be negatively impacting the water quality as defined in the criteria; therefore, the turbidity specific indicator is interpreted to be in an **Adequate Condition**.

Dredge mining has occurred along the Middle Fork John Day River and both lode and placer mining have occurred in many of the tributaries. Lode mining may produce or release acid mine drainage and placer miners sometimes use mercury for separating gold from other compounds (i.e., “quick silver”). Within the Oxbow reach, livestock have limited access to the river, but livestock are able to access the river and its tributaries in many locations upstream which may be increasing nutrient and sediment loads. Currently there is insufficient data for dissolved oxygen (DO), pH, sedimentation, and flow modification for the Middle Fork John Day River. These indicators have been added to Oregon’s 2004/2006 Integrated Report Database for monitoring and a TMDL report is currently being written by the Oregon Department of Environmental Quality. Until more data becomes available to further evaluate chemical contamination/nutrients impacts, this specific indicator is interpreted to be in an **At Risk Condition**.

Based on the above discussion of specific indicators, the overall water quality general indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

HABITAT ACCESS

There are no main channel physical barriers that inhibit fish passage at all biologically significant flows within the Oxbow reach. Therefore, the main channel physical barriers specific indicator is interpreted to be in an **Adequate Condition**, and the habitat access general indicator is interpreted to be in an **Adequate Condition**.

HABITAT QUALITY

Within the Oxbow reach, there are stream segments that have been impacted by stream channelization through mine tailings. Stream channelization restricts floodplain access which increases stream energy in these stream segments, resulting in coarsening of the stream bed. Therefore, the channel substrate specific indicator is interpreted to be in an **At Risk Condition**.

Some minor impacts to the sediment regime were detected during the Tributary Assessment, including short-term increases in fine sediments from anthropogenic activities (Reclamation 2008). The percentage of surface fines (particles less than 6 millimeters in diameter) is greater than 12 percent and less than 20 percent in stream segments within the Oxbow reach. Therefore, the fine sediment specific indicator is interpreted to be in an **At Risk Condition**.

Large wood is almost completely absent within the Oxbow reach and the recruitment potential is currently very low. Therefore, the large wood specific indicator is interpreted to be in an **Unacceptable Risk Condition**.

Although pool frequency met the criteria in most stream segments within the Oxbow reach, there were deficiencies in pool quality based on inadequate numbers of large pools (greater than 1 meter deep) and lack of associated fish cover (i.e., instream large wood). Therefore, the pools specific indicator is interpreted to be in an **At Risk Condition**.

There are stream segments that have been impacted by channelization through mine tailings. Artificial channel confinement limits the fluvial processes that create and maintain off-channel habitat in these stream segments. Therefore, the off-channel habitat specific indicator is interpreted to be in an **At Risk Condition**.

Based on the above discussion of specific indicators, the overall habitat quality general indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

CHANNEL CONDITION AND DYNAMICS

Some stream segments within the Oxbow reach have floodplain connectivity during and above a 2-year discharge; however, there are some stream segments that have been channelized, lack an adequate riparian corridor (30-meter width buffer zone along both banks), and have anthropogenic features that negatively impact floodplain processes. Therefore, the floodplain connectivity specific indicator is interpreted to be in an **At Risk Condition**.

Anthropogenic features and channelization impact some stream segments by restricting lateral channel migration which results in localized channel incision, higher entrenchment ratios, and channel bed coarsening. Other stream segments have not been impacted by anthropogenic features, but an insufficient woody riparian corridor may result in accelerated stream bank erosion and generally higher width-to-depth ratios. Because stream segments within the Oxbow reach have been manipulated and there is an insufficient woody riparian corridor, the bank stability/channel migration specific indicator is interpreted to be in an **At Risk Condition**.

As discussed in the previous paragraph, there are some stream segments where lateral channel migration has been restricted and where accelerated bank erosion may be occurring. In the case where lateral channel migration has been restricted, the stream is interpreted to be horizontally stable which may result in vertical instability (i.e., localized incision) if the flow and sediment regimes remain the same as under pre-disturbance conditions. Where accelerated bank erosion and channel widening are occurring, the stream is interpreted to be horizontally unstable, which could induce vertical instability (i.e., localized aggradation). Without historical elevation data for the channel, the vertical channel stability specific indicator is qualitatively interpreted to be in an **At Risk Condition**.

Based on the above discussion of specific indicators, the overall channel condition and dynamics general indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

RIPARIAN/UPLAND VEGETATION

Most of the Oxbow reach's successional class is predominantly in a shrub/seedling condition and there are invasive and noxious plant species present. Due to the low percentage of small and large trees, the vegetation condition (structure) specific indicator is interpreted to be in an **At Risk Condition**.

Dredge mining, livestock grazing, timber harvests, and roads are the primary anthropogenic disturbances that have impacted vegetation within the Oxbow reach. There are a low percentage of large and mature trees in the riparian buffer zone available for recruitment by the stream. Because there have been substantial ground disturbances within the Oxbow reach, the vegetation condition (disturbance) specific indicator is interpreted to be in an **Unacceptable Risk Condition**.

Canopy cover of the river channel was less than 1 percent, while the canopy cover of the left and right bank was slightly higher (2 percent and 8 percent, respectively). The canopy layer was made up of predominantly small trees (8 percent cover, less than 0.3 meters diameter at breast height [DBH]) and less than 1 percent large trees (greater than 0.3 meters DBH). Based on the densitometer summary and the predominant successional class (shrub/seedling successional class), the vegetation condition (canopy cover) specific indicator is interpreted to be in an **Unacceptable Risk Condition**.

Based on the above discussion of specific indicators, the overall riparian/upland vegetation general indicator for the Oxbow reach is interpreted to be in an **Unacceptable Risk Condition**.

DISCUSSION

Based on field observations, channel unit mapping, and the two-dimensional hydraulic model, there are five localized trends of sediment movement within the Oxbow reach that are noted by the designated inner zones. At channel-forming flows (1.5- to 2.0-year recurrence intervals), transport channel segments are morphologically resilient, supply-limited, and convey the majority of sediment inputs. This generally leads to coarsening of the stream bed and may result in localized incision. Transport segments are typically confined geologically or artificially by anthropogenic impacts. Transition channel segments are actively adjusting to changes in sediment supply due to natural or anthropogeic disturbances, and trend toward either a supply-limited condition (localized incision) or transport-limited condition (localized aggradation). Depositional channel segments are morphologically dynamic and transport-limited with channel adjustments (deposition) occuring in response to increased sediment supply. The five inner zones designated in the Oxbow reach are graphically illustrated in Figure 7. Subreaches OR-IZ-1, OR-IZ-2, and OR-IZ-4 are predominantly in a state of transition (OR-IZ-1 and OR-IZ-4 are transport-limited, and OR-IZ-2 is supply-limited). In subreaches OR-IZ-3 and OR-IZ-5, the river has been channelized through mine tailings without a significant floodplain and is in a state of transport.

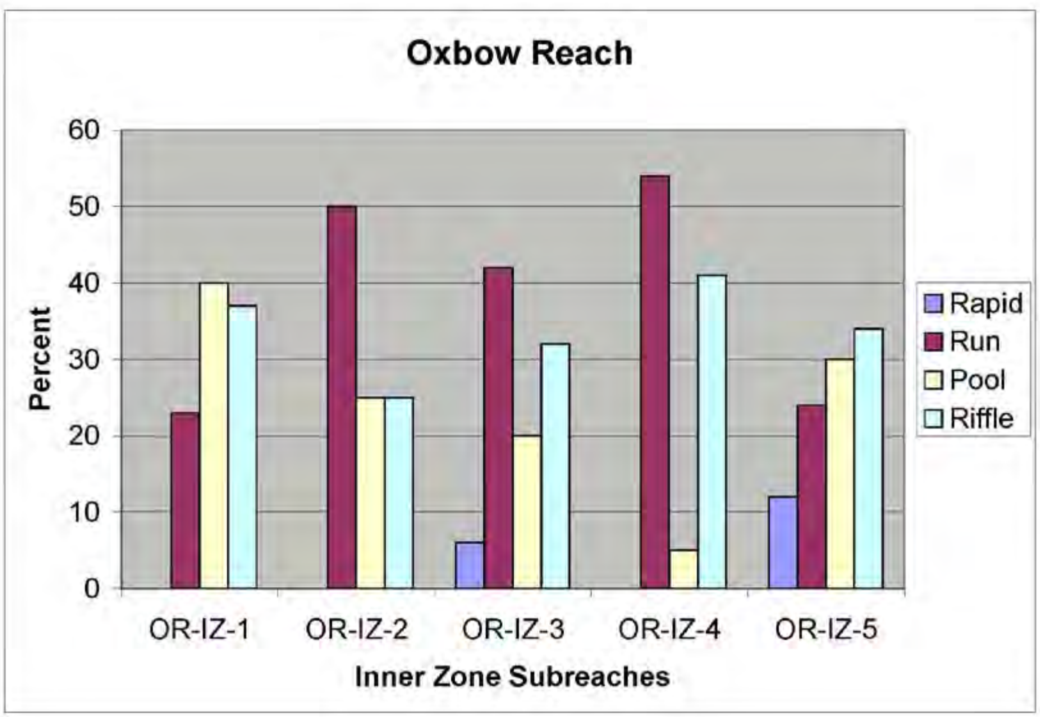

Figure 7. Percent of channel units for each inner zone subreach based on modified classifications from the Stream Inventory Handbook (USFS 2008).

Anthropogenic features can be analyzed to establish impacts to the current stream conditions. Subsequently, the stream condition provides an environmental baseline for comparisons in future assessments. In the instance of the Oxbow reach, the habitat-forming processes have been unfavorably impacted with 27 percent of the specific indicators in an **Unacceptable Risk Condition** and 67 percent being in an **At Risk Condition** (Appendix A).

Unacceptable Risk Condition specific indicators include (1) water temperature, (2) large wood, (3) vegetation condition (disturbance), and (4) vegetation condition (canopy cover). **At Risk Condition** specific indicators include (1) chemical contamination/nutrients, (2) channel substrate, (3) fine sediment, (4) pools, (5) off-channel habitat, (6) floodplain connectivity, (7) bank stability/channel migration, (8) vertical stability, and (9) vegetation condition (structure). The specific indicators found to be in an **Adequate Condition** are turbidity and main channel physical barriers (natural/human).

Geomorphic potential is interpreted to be altered because of reduced floodplain connectivity, lateral channel migration, and large wood recruitment potential. Reduced floodplain connectivity, reduced lateral channel migration, and the potential for increased vertical channel migration (i.e., localized incision) is due to channelization in the inner zone subreaches OR-IZ-3 and OR-IZ-5, which are interpreted to be in an **Unacceptable Risk Condition**. There is reduced lateral channel migration due to bank protection in inner zone OR-IZ-4 and outer zones OR-OZ-15 and OR-OZ-16, which are interpreted to be in an overall **At Risk Condition**.

SUBREACH UNIT PROFILES

Within this section, the anthropogenic features and resulting existing conditions of each inner zone subreach and adjoining outer zone subreaches are summarized. Beginning at the upstream end of the Oxbow reach and working downstream, the inner zone subreaches were analyzed to understand the local trends in sediment transport, transition, or deposition; the impacts of anthropogenic features; and the inner zone subreaches' interactions with the adjacent outer zone subreaches. Channel unit maps are contained in Appendix C.

RM 58.00 – RM 57.70 Subreaches

Between RM 58.00 and RM 57.70 (Figure 8), the river is in a transition condition (transport-limited) as it accesses a moderately wide floodplain (Figure 9 and Figure 10, also see Appendix C). The upstream valley constriction is near RM 58.00 where the floodplain is confined between bedrock (Tc) and an older terrace (Qa2), and the downstream valley constriction near RM 57.70 where the floodplain is confined by the Granite Boulder Creek alluvial fan (Qafs) and the Butte Creek alluvial fan (Qafd). The average channel slope is about 0.51 percent. The predominant channel units are pools and riffles and the dominate substrate consists of cobbles and gravel.

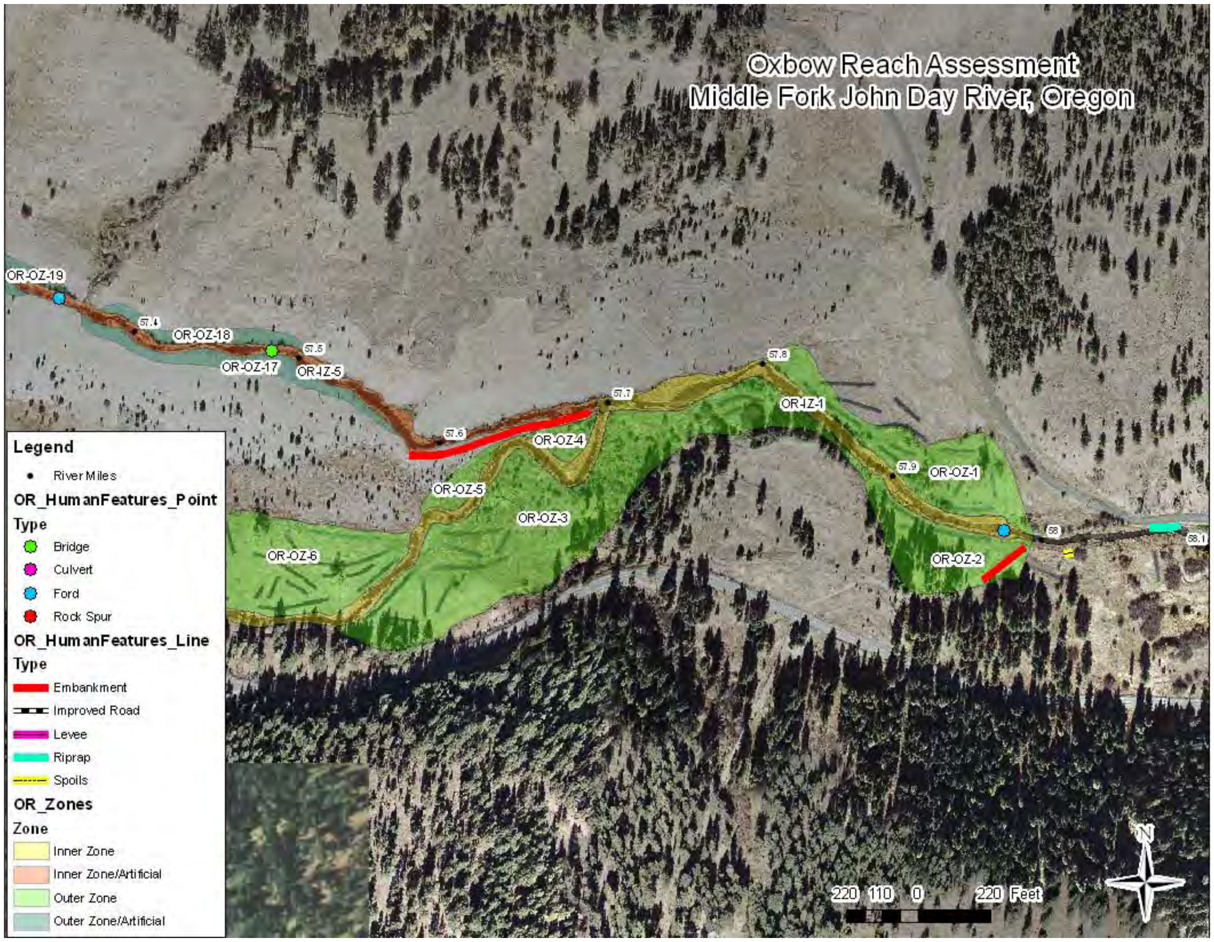

Figure 8. Location map from RM 58.00 to RM 57.70 showing inner and outer zone subreaches and anthropogenic features.

Figure 9. View is to the southwest looking downstream at bank erosion along river left. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

Figure 10. View is to the southwest looking downstream at flow split to the North and South Channels. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

There is one human feature (embankment) in OR-OZ-2 that negatively impacts floodplain processes. A ford crossing occurs in OR-IZ-1 that has minimal impact to processes, but could be contributing fine sediment to the river if its use as a crossing continues. The most notable impacts to this area include the (1) lack of a riparian buffer zone, (2) lack of instream large wood, and (3) lack of large wood recruitment potential (Table 6).

Table 6. Summary of subreaches between RM 23.10 and RM 22.45.

Subreach	River Mile (RM)	Acreage	Human Features	Other Factors
OR-IZ-1 (inner zone)	RM 58.00 – 57.70	1.75 acres	Ford crossing (1)	Riparian buffer (30 meters) - *Unacceptable Risk Condition* Instream large wood - *Unacceptable Risk Condition* Large wood recruitment potential – *Unacceptable Risk Condition*
OR-OZ-1 (outer zone)	RM 58.00 – 57.50 (river right)	2.61 acres	None	Large wood recruitment potential – *Unacceptable Risk Condition*
OR-OZ-2 (outer zone)	RM 58.00 – 57.80 (river left)	2.03 acres	Embankment (164 feet)	Floodplain connectivity - *At Risk Condition*
OR-OZ-3 (outer zone)	RM 57.80 – 57.50 (river left)	7.45 acres	None	Large wood recruitment potential – *Unacceptable Risk Condition*

RM 57.70 – RM 57.00 Subreaches (South Channel)

At RM 57.70, the channel bifurcates into two separate flow paths: the South Channel and the North Channel. Along the South Channel between RM 57.70 and RM 57.00 (Figure 11, also see Appendix C), the river is in a transition condition (supply-limited condition) as it accesses a relatively wide floodplain, but a significant portion of flows and sediment are conveyed through the North Channel. The average channel slope is about 0.41 percent and the predominant channel units are runs, but also include pools and riffles. The dominate substrate consists of gravel and cobbles.

There appears to be localized incision near the head of the South Channel (Figure 12, also see Appendix C). Where the South Channel flows against the valley wall, there is "pocket-pool" habitat created by boulders (Figure 13). Near the downstream end of the South Channel, the river appears to have been straightened as it flows toward the North Channel (Figure 14) and some of the flow is diverted into the Ruby Creek irrigation system (Figure 15).

There is one human feature (spoil pile) in OR-OZ-7 that has minimal impact to floodplain processes. Overall, this area is most notably impacted by (1) lack of riparian buffer zone, (2) lack of instream large wood, and (3) lack of large wood recruitment potential (Table 7).

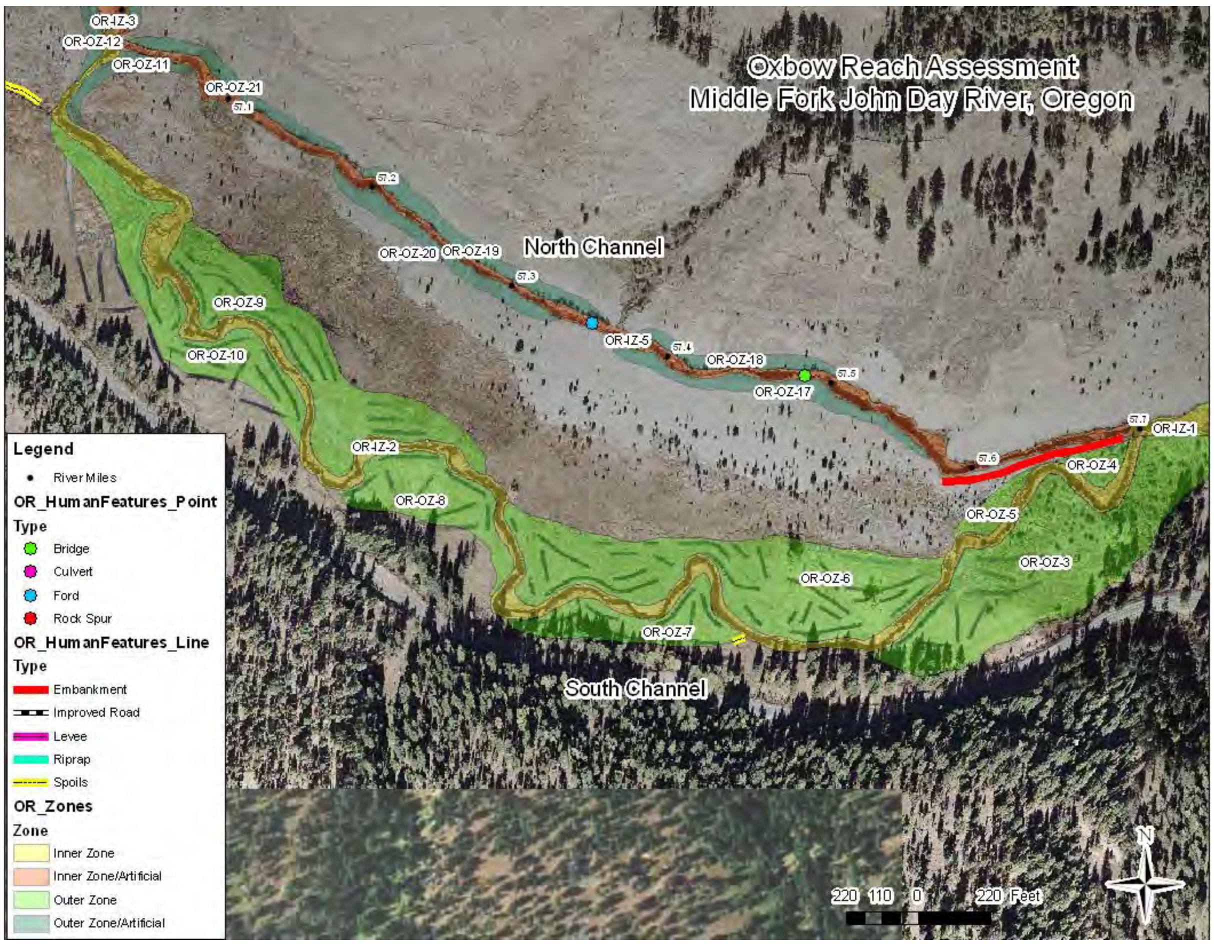

Figure 11. Location map from RM 57.70 to RM 57.00 (South Channel) showing inner and outer zone subreaches and anthropogenic features.

Figure 12. View is to the west looking downstream at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Reclamation photograph by R. McAffee, July 17, 2007.

Figure 13. View is to the northeast looking at "pocket-pools" along the South Channel. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by R. McAffee, July 17, 2007.

Figure 14. View is to the northeast looking downstream where the South Channel appears to have been straightened. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

Figure 15. View is to the west looking at a small continuation of the South Channel (irrigation ditch). Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by R. McAffee, July 17, 2007.

Table 7. Summary of subreaches between RM 57.70 and RM 57.00 (South Channel).

Subreach	River Mile	Acreage	Human Features	Other Factors
OR-IZ-2 (inner zone)	RM 57.70 – 57.00	5.41 acres	None	Riparian buffer (30 meters) - *Unacceptable Risk Condition* Instream large wood - *Unacceptable Risk Condition* Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-4 (outer zone)	RM 57.70 – 57.63 (river right)	0.36 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-5 (outer zone)	RM 57.62 – 57.59 (river right)	0.41 acres	None	Large wood recruitment potential – *Unacceptable Risk Condition*
OR-OZ-6 (outer zone)	RM 57.58 – 57.33 (river right)	6.15 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-7 (outer zone)	RM 57.45 – 57.35 (river left)	1.59 acres	Spoil pile (1)	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-8 (outer zone)	RM 57.34 – 57.28 (river left)	1.92 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-9 (outer zone)	RM 57.32 – 57.12 (river right)	4.10 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-10 (outer zone)	RM 57.25 – 57.00 (river left)	2.99 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-11 (outer zone)	RM 57.00 – 56.98 (river right)	0.44 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*

RM 57.00 – RM 56.20 Subreaches

Between RM 57.00 and RM 56.20 (Figure 16; also see Appendix C), the river is in a transport condition (morphologically resilient and supply-limited) due to channelization through mine tailings (Figure 17 and Figure 18). The upstream valley constriction is near RM 56.80 where the floodplain is confined by Ruby Creek alluvial fan (Qafd) and a landslide (Qls). The downstream valley constriction near RM 56.20 is where the floodplain is confined by Beaver Creek alluvial fan (Qafs) and an older terrace (Qa3). There is minimal activated floodplain area for flows of up to a 100-year discharge due to stream channelization. Average channel slope is about 0.60 percent. Rapids are present along this stream segment, but the predominant channel unit is a run and the dominate substrate consists of cobbles and gravel.

The primary human features are the mine tailings and the channelization of the river through the tailings. Overall, this area is most notably impacted by (1) lack of floodplain connectivity, (2) lack of channel migration, (3) lack of instream large wood, (4) lack of riparian buffer zone, and (5) lack of large wood recruitment potential (Table 8).

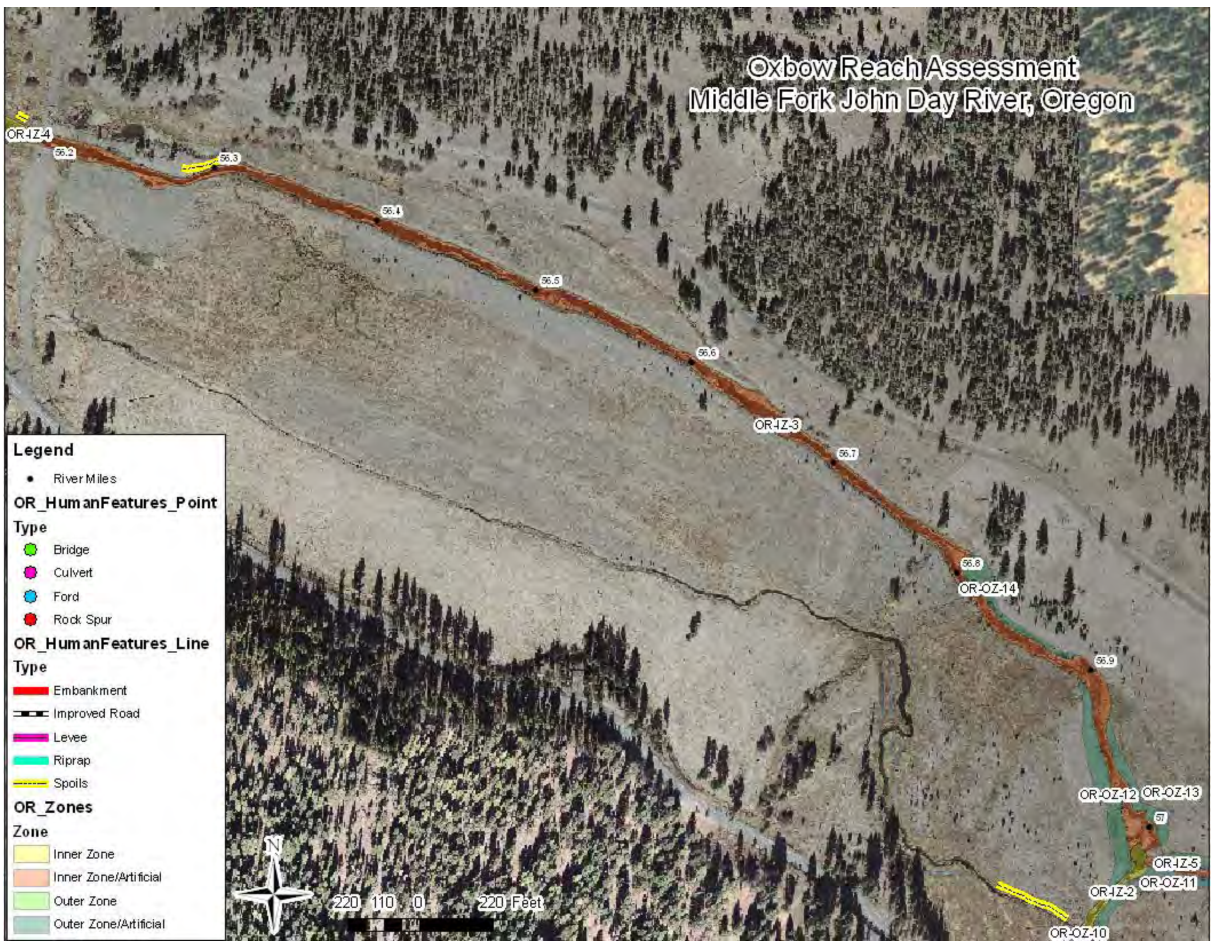

Figure 16. Location map of subreaches between RM 57.00 and RM 56.20 and the anthropogenic features.

Figure 17. View is to the northwest looking downstream below the confluence of the North and South Channels. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

Figure 18. View is to the west looking at the mine tailings along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

Table 8. Summary of subreaches between RM 57.00 and RM 56.20

Subreach	River Mile	Acreage	Human Features	Other Factors
OR-IZ-3 (inner zone)	RM 57.00 – 56.20	3.76 acres	Channelized Dredge tailings	Floodplain connectivity – *Unacceptable Risk Condition* Channel migration - *Unacceptable Risk Condition* Riparian buffer (30 meters) - *Unacceptable Risk Condition* Instream large wood - *Unacceptable Risk Condition* Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-12 (outer zone)	RM 57.00 – 56.90 (river left)	0.63 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-13 (outer zone)	RM 57.01 – 56.92 (river right)	0.29 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-14 (outer zone)	RM 56.89 – 56.80 (river right)	0.33 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*

RM 56.20 – RM 55.60 Subreaches

Between RM 56.20 and RM 55.60 (Figure 19; also see Appendix C), the river is in a transition condition (transport-limited) as it accesses a relatively wide floodplain (Figure 20). The upstream valley constriction is near RM 56.20 where the floodplain is confined between Beaver Creek alluvial fan (Qafs) and an older terrace (Qa3). Average channel slope is about 0.59 percent. Predominant channel units are runs and riffles, and a few pools are also present. The dominate substrate consists of gravel and cobbles.

The human features along OR-IZ-4 include riprap and rock spurs (Figure 20 and Figure 21) that negatively impact lateral channel migration. The river has scoured around some of the rock spurs so that the rock provides “pocket-pool” habitat, but these pools do not provide sufficient fish cover or biomass. Overall, this area is most notably impacted by (1) lack of riparian buffer zone, (2) lack of instream large wood, and (3) lack of large wood recruitment potential (Table 9).

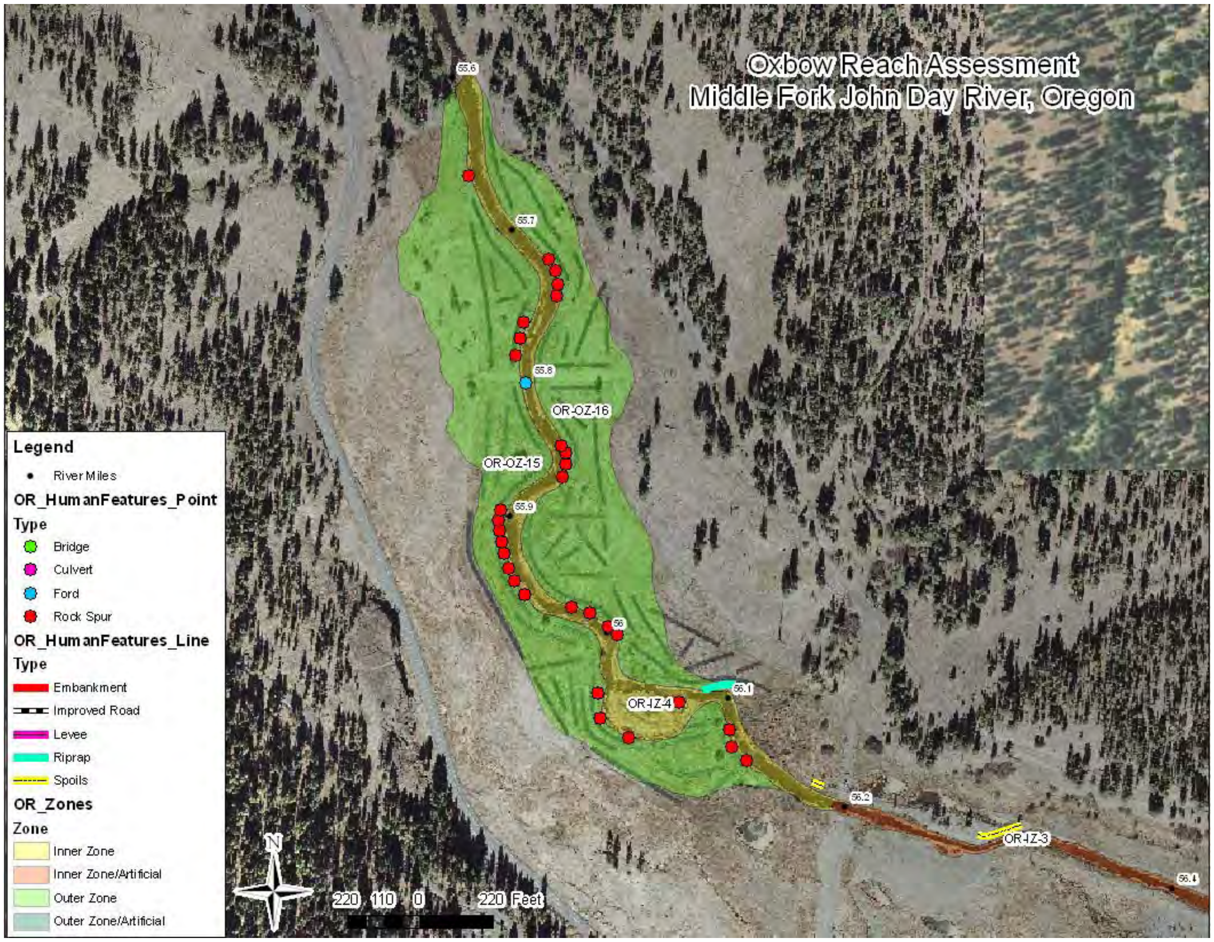

Figure 19. Location map from RM 56.20 to RM 55.60 showing inner and outer zone subreaches and anthropogenic features.

Figure 20. View is to the north looking downstream at rock spurs placed along river right. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 18, 2007.

Figure 21. View is to the northwest looking downstream at rock spurs placed along the left bank of the side channel. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 18, 2007.

Table 9. Summary of subreaches between RM 56.20 and RM 55.60

Subreach	River Mile	Acreage	Human Features	Other Factors
OR-IZ-4 (inner zone)	RM 56.20 – 55.60	4.21 acres	Riprap (106 feet) Rock spurs (31)	Channel migration - *Unacceptable Risk Condition* Riparian buffer (30 meters) - *Unacceptable Risk Condition* Instream large wood - *Unacceptable Risk Condition* Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-15 (outer zone)	RM 56.16 – 55.60 (river left)	10.67 acres	None	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-16 (outer zone)	RM 56.10 – 55.60 (river right)	8.23 acres	None	Large wood recruitment potential – *Unacceptable Risk Condition*

RM 57.70 – RM 57.00 Subreaches (North Channel Area)

Between RM 57.70 and RM 57.00 (Figure 22; also see Appendix C), the river is in a transport condition (supply-limited) as it accesses a narrow, constructed floodplain through the mine tailings along a channelized stream segment (Figure 23). Average channel slope is 0.65 percent. Predominant channel units are riffles, pools, and runs with the highest concentration of rapids in the Oxbow reach. The dominate substrate is gravel and cobbles.

Primary anthropogenic features include mine tailings, stream channelization through the mine tailings, and an artificial flow bifurcation between the North and South Channels (Figure 24). The capacity of the North Channel to convey flows and sediment is limited due to the channel size and the entrance conditions at the bifurcation. Under high flow conditions, the majority of flows are routed through the South Channel with a lesser amount being routed through the North Channel. Conversely, under low flow conditions, the majority of the flows are routed through the North Channel (Reclamation 2009). An embankment that is 565 feet long also impacts the floodplain connectivity (Figure 25). Overall, this area is most notably impacted by (1) lack of floodplain connectivity, (2) lack of channel migration, (3) instream large wood, (4) lack of riparian buffer zone, and (5) lack of large wood recruitment potential (Table 10).

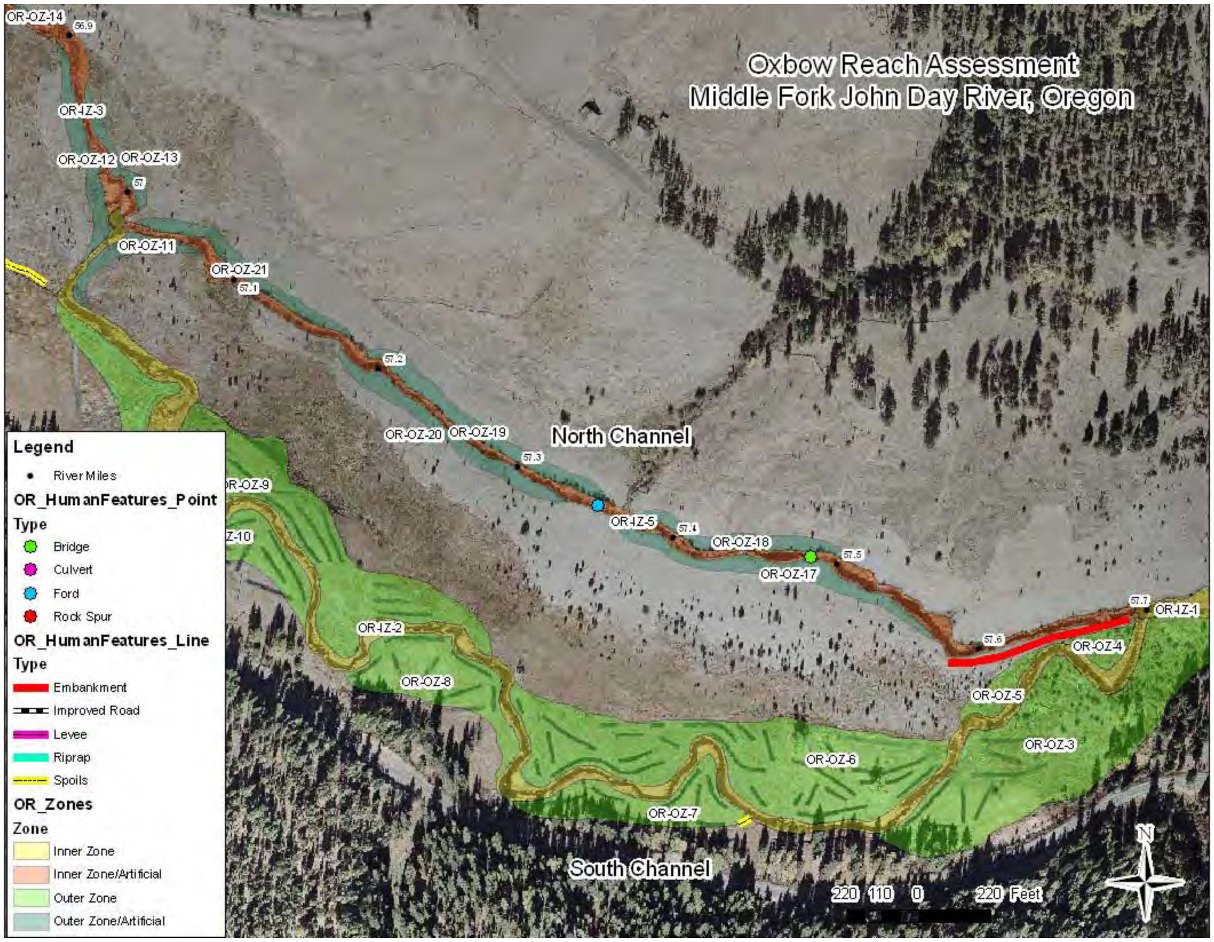

Figure 22. Location map from RM 57.70 to RM 57.00 (North Channel) showing inner and outer zone subreaches and anthropogenic features.

Figure 23. View is to the northwest looking downstream along the North Channel. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

Figure 24. View is to the southwest looking downstream at flow split to the North (right) and South (left) Channels. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by E. Lyon, July 17, 2007.

Figure 25. View is to the west looking at an embankment that bisects the floodplain between the North and South Channels. Oxbow Reach – Middle Fork John Day River, Oregon – Bureau of Reclamation photograph by R. McAffee, July 17, 2007.

Table 10. Summary of subreaches between RM 57.70 and RM 57.00 (North Channel Area).

Subreach	River Mile	Acreage	Human Features	Other Factors
OR-IZ-5 (inner zone)	RM 57.70 – 57.00	2.72 acres	Channelized Dredge tailings Artificial floodplain Embankment (565 feet) Footbridge (1) Ford crossing (1)	Floodplain connectivity - *At Risk Condition* Channel migration - *Unacceptable Risk Condition* Riparian buffer (30 meters) - *Unacceptable Risk Condition* Instream large wood - *Unacceptable Risk Condition* Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-17 (outer zone)	RM 57.58 –57.38 (river left)	0.93 acres	Artificial	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-18 (outer zone)	RM 57.50 – 57.38 (river right)	0.56 acres	Artificial	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-19 (outer zone)	RM 57.35 – 57.20 (river right)	0.85 acres	Artificial	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-20 (outer zone)	RM 57.33 – 57.18 (river left)	0.77 acres	Artificial	Large wood recruitment potential - *Unacceptable Risk Condition*
OR-OZ-21 (outer zone)	RM 57.18 – 57.01 (river right)	0.61 acres	Artificial	Large wood recruitment potential - *Unacceptable Risk Condition*

SUMMARY AND CONCLUSIONS

The Oxbow reach, located in the Oxbow Conservation Area between RM 58.0 and RM 55.6 on the Middle Fork John Day River, is within a 6th field HUC watershed. The Oxbow reach is characterized as an unconfined geomorphic reach type based on geologic valley constraints. In its pre-disturbance state, the Middle Fork likely maintained dynamic equilibrium by actively migrating laterally across its floodplain within the Oxbow reach. This lateral channel migration maintained a lower energy, flatter channel gradient, and supported a dynamic cycle of conversion from river to floodplain and vice versa, producing a continuous renewal of fish habitat. Alteration of the stream processes has negatively impacted the availability of fish habitat within the reach.

Field surveys and evaluations were conducted in the Oxbow reach during the 2007 and 2008 field seasons to determine the condition of hydrologic, geomorphic, and biotic regimes. Some environmental processes in the Oxbow reach are in a degraded state as a result of anthropogenic impacts. The dynamic interactions between the three regimes have been impacted by dredge mining, channelization, bank protection, road embankments, and clearing of riparian vegetation.

The geomorphic potential is interpreted to be altered because of reduced floodplain connectivity, reduced lateral channel migration, and reduced channel complexity. Reduced floodplain connectivity and lateral channel migration is due to channelizing the stream through mine tailings in subreaches OR-IZ-3 and OR-IZ-5. Some embankments also negatively impact floodplain connectivity in subreaches OR-IZ-5 and OR-OZ-2. Reduced channel migration is due to rock spurs and riprap in subreach OR-IZ-4. The river has scoured around some rock spurs that have formed “pocket-pools,” but there is insufficient fish cover and biomass associated with these pocket-pools. Reduced channel complexity throughout the active channel (subreaches OR-IZ-1, -2, -3, -4, and -5) is due to several factors including decreased lateral channel migration, lack of instream large wood, and lack of large wood recruitment potential.

Warm water temperature is symptomatic of a potential watershed condition that negatively impacts much of the Middle Fork John Day River, including the Oxbow reach. This condition may or may not be caused naturally. In either case, the condition is potentially exacerbated because of clearing and grazing along the riparian buffer zone and/or irrigation diversions reducing summer flows.

Overall, the results of this assessment document the current environmental conditions of specific physical indicators for the Oxbow reach prior to the implementation of habitat actions. Repeating a similar assessment (i.e., impact assessment) following implementation would document changes in the conditions of the specific physical indicators. These results, coupled with current status and trend monitoring of specific biological indicators, could then be used to determine the effectiveness of the habitat actions on addressing limiting factors and the trajectory of the salmonid populations (i.e., intervention analysis).

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Parenthetical Reference	Bibliographic Citation
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GLOSSARY

Some terms in this glossary appear in this reach assessment report.

TERM	DEFINITION
2D-hydraulic analysis	A two-dimensional computer model that simulates hydraulic variables, such as depth-averaged velocity, depth, and bed shear stress, both longitudinally and laterally across an input terrain. Model results are used to produce water surface profiles and innundation areas for discharges of interest.
adaptive management	Adaptive management is a process that promotes flexible decisionmaking that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood, with an aim to reduce uncertainty over time via system monitoring. In this way, decisionmaking simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management (adapted from National Research Council 2004).
alluvial fan	A low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan or a segment of a cone, deposited by a stream at the place where it issues from a narrow mountain valley upon a plain or broad valley, or where a tributary stream is near or at its junction with the main stream, or wherever a constriction in a valley abruptly ceases or the gradient of the stream suddenly decreases; it is steepest near the mouth of the valley where its apex points upstream, and it slopes gently and convexly outward with a gradually decreasing gradient (Neuendorf et al. 2005).
alluvium	A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream, as a sorted or semi-sorted sediment on the river bed and floodplain (Neuendorf et al. 2005).
anadromous (fish)	A fish, such as the Pacific salmon, that spawns and spends its early life in freshwater but moves into the ocean where it attains sexual maturity and spends most of its life span.
anthropogenic	Caused by human activities.
bedrock	A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material (Neuendorf et al. 2005). The bedrock is generally resistant to fluvial erosion over a span of several decades, but may erode over longer time periods.
canopy cover (of a stream)	Vegetation projecting over a stream, including crown cover (generally more than 1 meter [3.3 feet] above the water surface) and overhang cover (less than 1 meter [3.3 feet] above the water).
cfs	Cubic feet per second; a measure of water flows

TERM	DEFINITION
channel morphology	The physical dimension, shape, form, pattern, profile, and structure of a stream channel.
channel planform	Characteristics of the river channel that determine its two-dimensional pattern as viewed on the ground surface, aerial photograph, or map.
channel stability	The ability of a stream, over time and under the present climatic conditions, to transport the sediment and flows produced by its watershed in such a manner that the stream maintains its dimension, pattern, and profile without either raising or lowering the level of the streambed.
channelization	Alteration of a natural channel typically by straightening and deepening the stream channel to permit the water to move faster, to reduce flooding, or to drain wetlands.
constructed features	Human-made features that are constructed in the river and/or floodplain areas (e.g., levees, bridges, riprap).
controls	A feature that is highly resistant to erosion by flowing water and limits the ability of a river or stream to migrate across a valley in either the lateral (horizontal) or vertical direction or both. Geologic controls are naturally occuring features such as bedrock outcrops, landslides, or alluvial fans that erode slowly over long periods of time. Human-constructed features such as highways, railroads, bridge abutments, or riprap may also act as controls and limit the ability of a river to migrate.
degradation	Wearing down of the land surface through the processes of erosion and/or weathering including the lowering of a stream bed due to scouring (incision). Also refers to loss of functional elements within an ecosystem and subsequent negative impacts to fluvial processes and dependant life forms.
depositional channel segments	At channel forming flows (1.5- to 2.0-year recurrance interval), depositional channel segments are morphologically dynamic and transport-limited with channel adjustments (deposition) occuring in response to increased sediment supply.
diversity	Genetic and phenotypic (life history traits, behavior, and morphology) variation within a population.
ecosystem	A unit in ecology consisting of the environment with its living elements, plus the non-living factors, that exist in and affect it (Neuendorf et al. 2005).
floodplain	The surface or strip of relatively smooth land adjacent to a river channel constructed by the present river in its existing regimen and covered with water when the river overflows its banks. It is built on alluvium, carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current. A river has one floodplain and may have one or more terraces representing abandoned floodplains (Neuendorf et al. 2005).

TERM	DEFINITION
fluvial process	Those processes related to the movement of flowing water that shape the surface of the earth through the erosion, transport, and deposition of sediment, soil particles, and organic debris.
general indicator	Interpretation of one or more specific indicators (i.e., water quality) that is used to define or refine potential environmental deficiencies caused by natural or anthropogenic impacts that negatively affect a life stage(s) of the species of concern (i.e., limiting factor). General indicators (sometimes referred to as pathways) are typically analyzed at the reach, valley segment, watershed, and basin scales.
geomorphic potential	The capability of streams to form, connect and sustain fluvial systems (including fish habitat) by dynamically adjusting longitudinally, vertically and laterally to changes in the hydrologic, geomorphic, and biotic regimes over time.
geomorphic reach	An area containing the active channel and its floodplain bounded by vertical and/or lateral geologic controls, such as alluvial fans or bedrock outcrops, and frequently separated from other reaches by abrupt changes in channel slope and valley confinement. Within a geomorphic reach, similar fluvial processes govern channel planform and geometry through driving variables of flow and sediment. A geomorphic reach is comprised of a relatively consistent floodplain type and degree of valley confinement. Geomorphic reaches may vary in length from 100 meters in small, headwater streams to several miles in larger systems (Frissell et al. 1986).
geomorphology	The study of the classification, description, nature, origin, and development of present landforms and their relationships to underlying structures, and of the history of geologic changes caused by the actions of flowing water.
GIS	Geographical information system. An organized collection of computer hardware, software, and geographic data designed to capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.
habitat action	Proposed restoration or protection strategy to improve the potential for sustainable habitat on which Endangered Species Act-listed salmonids depend. Examples of habitat actions include the removal or alteration of project features to restore floodplain connectivity to the channel, reconnection of historic side channels, placement of large woody debris, reforestation of the low surface, or implementation of management techniques.
habitat connectivity (stream)	Suitable stream conditions that allow fish and other aquatic organisms to access habitat areas needed to fulfill all life stages.
indicator	A variable used to forecast the value or change in the value of another variable; for example, using temperature, turbidity, and chemical contaminents or nutrients to measure water quality.

Term	Definition
inner zone (IZ)	Area where ground-disturbing flows take place; characterized by the presence of primary (perennial) and secondary (ephemeral) side channels, a repetitious sequence of channel units, and relatively uniform physical attributes indicative of localized transport, transition, and deposition.
intervention analysis	Analysis of variables based on samples collected at an impact site before and after an intervention, such as a habitat action, so that effects of the intervention may be determined.
large woody debris (LWD)	Large downed trees or parts of trees that are transported by the river during high flows and are often deposited on gravel bars or at the heads of side channels as flow velocity decreases. The trees can be downed through river erosion, wind, fire, landslides, debris flows, or human-induced activities. Generally refers to the woody material in the river channel and floodplain whose smallest diameter is at least 12 inches and has a length greater than 35 feet in eastern Cascade streams.
limiting factor	Any factor in the environment that limits a population from achieving complete viability with respect to any Viable Salmonid Population (VSP) parameter.
overflow channel	A channel that is expressed by no or little vegetation through a vegetated area. There is no evidence of water at low stream discharges. The channel appears to have carried water recently during a flood event. The upstream and/or downstream ends of the overflow channel usually connect to the main channel.
outer zone (OZ)	Area that may become inundated at higher flows, but does not experience a ground-disturbing flow; generally coincidental with the historic channel migration zone unless the channel has been modified or incised leading to the abandonment of the floodplain. (also knows as the floodprone zone)
peak flow	Greatest stream discharge recorded over a specified period of time, usually a year, but often a season.
reach-based ecosystem indicators (REI)	Qualitative and/or quantifiable physical indicators that are referenced to watershed characteristics and reach characteristics.
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
response reach	A reach that is more responsive to change and often characterized by unconfined and moderately confined alluvial plains/channels that lack lateral geologic controls within close proximity to the channel which often define confined channels. A response reach can be further subdivided into individual subreach units that comprise morphologically distinct areas providing geomorphic control and transitional habitat and biological potential at a finer scale.
riparian area	An area adjacent to a stream, wetland, or other body of water that is transitional between land and water ecosystems. Riparian areas usually have distinctive soils and vegetation community/composition resulting from the interaction of the water body and adjacent soil.

TERM	DEFINITION
riprap	Large angular rocks that are placed along a river bank to prevent or slow erosion.
river mile (RM)	Miles from the mouth of a river or its confluence with the next downstream river.
side channel	A channel that is not part of the main channel, but appears to have water during low-flow conditions and has evidence for recent higher flow (e.g., may include unvegetated areas [bars] adjacent to the channel). At least the upstream end of the channel connects to, or nearly connects to, the main channel. The downstream end may connect to the main channel or to an overflow channel. May also be referred to as a secondary channel.
spawning and rearing habitat	Stream reaches and the associated watershed areas that provide all habitat components necessary for adult spawning and juvenile rearing for a local salmonid population. Spawning and rearing habitat generally supports multiple year classes of juveniles of resident and migratory fish, and may also support subadults and adults from local populations.
subbasin	A subbasin represents the drainage area upslope of any point along a channel network (Montgomery and Bolton 2003). Downstream boundaries of subbasins are typically defined in this assessment at the location of a confluence between a tributary and mainstem channel. An example would be the Middle Fork John Day River subbasin.
subreach units	Distinct areas comprised of the floodplain and off-channel and active-channel areas. They are delineated by lateral and vertical controls with respect to position and elevation based on the presence/absence of inner or outer riparian zones.
terrace	A relatively stable, planar surface formed when the river abandons the floodplain that it had previously deposited. It often parallels the river channel, but is high enough above the channel that it rarely, if ever, is covered by water and sediment. The deposits underlying the terrace surface are alluvial, either channel or overbank deposits, or both. Because a terrace represents a former floodplain, it can be used to interpret the history of the river.
transition channel segment	At channel forming flows (1.5- to 2.0-year recurrance interval), transition channel segments are actively adjusting to changes in sediment supply due to natural or anthropogenic distubances, and trend toward either a supply-limited condition (localized incision) or transport-limited (localized aggradation).
transport channel segment	At channel forming flows (1.5- to 2.0-year recurrance interval), transport channel segments are morphologically resilient and supply-limited and convey sediment inputs causing coarsening of the stream bed and/or localized incision.
tributary	A stream feeding, joining, or flowing into a larger stream or lake (Neuendorf et al. 2005).

TERM	DEFINITION
valley segment	An area of river within a watershed sometimes referred to as a subwatershed that is comprised of smaller geomorphic reaches. Within a valley segment, multiple floodplain types exist and may range between wide, highly complex floodplains with frequently accessed side channels to narrow and minimally complex floodplains with no side channels. Typical scales of a valley segment are on the order of a few to tens of miles in longitudinal length.
vertical migration	Movement of a stream channel in a vertical direction; the filling and raising or the removal or erosion of streambed material that changes the elevation of the stream channel.
viable salmonid population	An independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame. Viability at the independent population scale is evaluated based on the parameters of abundance, productivity, spatial structure, and diversity (ICBTRT 2007).
watershed	The area of land from which rainfall and/or snow melt drains into a stream or other water body. Watersheds are also sometimes referred to as drainage basins. Ridges of higher ground form the boundaries between watersheds. At these boundaries, rain falling on one side flows toward the low point of one watershed, while rain falling on the other side of the boundary flows toward the low point of a different watershed.

APPENDICES

APPENDIX A

Reach-based Ecosystem Indicators Tables

Appendix A

Reach-based Ecosystem Indicators (REI) Version 1.1

The reach-based ecosystem indicators table has been compiled from literature review, data contained in the *Middle Fork and Upper John Day River Tributary Assessments* (Reclamation 2008), *Geomorphology and Hydraulic Modeling of the Oxbow Conservation Area* (Reclamation 2009), *Middle Fork John Day River Habitat Assessment* (USFS 2008), and from new data collected for this reach assessment. The ranges of criteria presented here are not absolute and should be adjusted for each unique subbasin as data become available. Evaluation and rating of each indicator was performed through an iterative process in a work group setting by the interdisciplinary team. Workgroup members included Terril Stevenson, Edward W. Lyon, Jr., Mark Croghan, Brian Cochran, Toni Turner, Elaina Gordon, and Ralph Klinger.

General Regional Characteristics

At the regional spatial scale, evaluated characteristics provide the regional setting where the reach assessment occurs and includes the ecoregion: drainage basin, valley segments, and channel segments. It also helps inform effectiveness monitoring efforts on the overall condition watershed.

Watershed Characteristics

At the watershed/subwatershed spatial scales, several specific indicators are analyzed to identify the condition of the general indicators (sometimes referred to as pathways). At this spatial scale, an overall watershed/subwatershed condition can be interpreted to determine if deficiencies at the reach-scale are symptomatic of a larger problem that needs be addressed.

Reach Characteristics

Physical Variables

At the reach spatial scale, individual specific indicators are qualitatively and/or quantitatively analyzed to interpret the current condition of the indicator (i.e., **Adequate**, **At Risk,** or **Unacceptable Risk**). This analysis helps identify the processes that are currently functioning adequately and those that have deficiencies. In addition, these specific indicators form the environmental baseline for monitoring the effectiveness of implemented habitat actions.

GENERAL REGIONAL CHARACTERISTICS

REGIONAL SETTING

Ecoregion	**Bailey Classification**	Domain – Dry Domain	Division – Temperate Steppe Regime Mountains	Province – Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow Province	Section – Blue Mountains Section

DRAINAGE BASIN CHARACTERISTICS

Geomorphic Features	Middle Fork John Day Basin Area	Basin Relief	Drainage Density	Hydrologic Unit Code	Stream Order (HUC)	Stream Classification	Land Ownership
	~800 mi^2	2,200 feet - 8,100 feet	1.8	17070203	5	Classification I: municipal watershed and/or fish-bearing stream	>50% Private; Headwaters predominantly Public

VALLEY SEGMENT CHARACTERISTICS

Valley Characteristics	Valley Bottom Type	Valley Bottom Width	Valley Bottom Gradient (Avg.)	Valley Confinement	Channel Patterns
	Wide mainstream valley (F3)	694 feet	0.60%	Unconfined	Variable

CHANNEL SEGMENT CHARACTERISTICS

Channel Characteristics	Valley Type	Elevation (feet)	Channel Type	Bed-form Type	Channel Gradient (Avg.)	Sinuosity (Avg.)
	Alluvial	3,663 - 3,713	C	Pool-riffle	0.55%	1.2

WATERSHED CHARACTERISTICS

GENERAL INDICATOR: EFFECTIVE DRAINAGE NETWORK AND WATERSHED ROAD DENSITY

Criteria: The following criteria were developed by USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Watershed Condition	Effective Drainage Network and Watershed Road Density	Increase in Drainage Network/ Road Density	Zero or minimum increases in active channel length correlated with human caused disturbance. And Road density <1 miles/miles^2.	Low to moderate increase in active channel length correlated with human caused disturbances. And Road density 1-2.4 miles/miles^2.	Greater than moderate increase in active channel length correlated with human caused disturbances. And Road density >2.4 miles/miles^2.

Data: U.S. Department of Agriculture, 2005, Draft Environmental Impact Statement and Proposed Forest Plan Amendment, Middle Fork John Day Range Planning Project (http://www.fs.fed.us/r6/malheur/projects/mfjd-range/documents/chapter-3-roads-specialuses.pdf).

	Upper Middle Fork	Lower Middle Fork	Elk	Sullens	Blue Mountain	Bear Creek	Camp Creek	Austin
Open Road Miles	176.66	221.12	0.56	320.37	65.79	7.33	3.30	2.70
Closed Road Miles	204.18	278.14	0.00	109.12	103.80	9.07	1.45	1.23
Total Road Miles	380.84	499.26	0.56	429.49	169.59	16.4	4.75	3.93

Data: Analysis of watershed road density using basin area divided by total road miles.

MFJD Basin Area	792.1 mi^2
MFJD Total Road Miles (Minimum)	1,504.8 mi
Watershed Road Density (Minimum)	1.9 mi/mi^2

Narrative:

At the watershed-scale, the minimum road density on Forest Service lands is in an **At Risk Condition**. Unimproved roads have negative impacts on the routing of run-off flows and provide elevated fine sediment from erosion and road embankment failures. Under the Northwest Forest Plan, the Forest Service is addressing these watershed issues. However, the Forest Service analysis does not include improved roads or railroad grades and additional information could indicate a higher density that could meet an **Unacceptable Risk Condition**.

At the reach-scale, sections of the Middle Fork John Day River have been dredge mined and channelized since the 1940s. Road and railroad construction have interrupted surface and subsurface flows in both the upland and riparian areas. Often surface and subsurface flows are captured by road ditches, road/railroad embankments, and ponds against the embankments, causing the flows to be routed off the landscape more quickly.

Overall, the density of improved roads, railroad grades, dredge mining, and timber harvests with associated unimproved access roads are anthropogenic impacts that are interpreted to have changed the effective drainage network. Therefore, the effective drainage network and watershed density general indicator is interpreted to be in an ***At Risk Condition***.

GENERAL INDICATOR: DISTURBANCE REGIME (NATURAL/HUMAN)

Criteria: The following criteria were modified from USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Watershed Condition	Disturbance Regime	Natural/ Human Caused	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. Natural processes are stable.	Scour events, debris torrents, or catastrophic fires are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. Natural processes are unstable.

Data: Fire disturbance summarized from the Tributary Assessment (Reclamation 2008: Appendix A).

Names	Year	Area of fire (acres)	Number of years of Recovery	Percentage of watershed area disturbed by this event	Successional Class (estimate)
Fire 20 and 23	1910	32,844	~100	28%	Large Tree
Ditch Creek	1961	27,269	~50	23%	Small Tree
Buck	1981	460	~30	<1%	Sapling/ Pole – Small Tree
Grouse Knob and Jumpoff	1986	1,378	~25	1%	Sapling/Pole
Road Creek	1988	12	~20	<1%	Sapling/Pole
Indian Rock and Reed	1994	3,749	~15	3%	Shrub/Seedling – Sapling/Pole
Phipps and Summit	1996	38,029	~15	33%	Shrub/Seedling – Sapling/Pole
Easy	2002	5,842	~10	5%	Shrub/Seedling
Bull Spring 2	2003	1,268	~5	1%	Grass/Forb – Shrub/Seedling
Sharps Ridge	2006	5,466	<5	5%	Grass/Forb

Data: Analysis of watershed road density using basin area divided by total road miles.

MFJD Basin Area	792.1 mi^2
MFJD Total Road Miles (Minimum)	1,504.8 mi
Watershed Road Density (Minimum)	1.9 mi/mi^2

Narrative:

Historic grazing, dredge mining, timber harvests, road density, and fires have impacted much of the Middle Fork John Day River watershed (additional information can be found in the Tributary Assessment [Reclamation 2008]). Anthropogenic activities (grazing, dredge mining, timber harvests, and road building) have long-term negative impacts on the ecosystem. The cumulative effects of these activities have not been quantified, but qualitatively, human disturbance is interpreted to be in an **At Risk Condition**.

Burned areas are recovering from the impacts at varying successional stages. Fires are generally considered a natural short-term disturbance and recover to a grass/forb and sapling/pole condition that provides slope stability. Fire suppression efforts over the last century have led to increased availability of fuels that is believed to result in larger fires with higher fire intensities. Disturbances by fires are interpreted to be in an **At Risk Condition**.

Overall, the disturbance regime (natural/human) general indicator is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: FLOW/HYDROLOGY

Criteria: The following criteria were developed by USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Watershed Condition	Flow/hydrology	Change in Peak/Base Flows	Magnitude, timing, duration and frequency of peak/base flows within a watershed are not altered relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	Some evidence of altered magnitude, timing duration and/or frequency of peak/base flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	Pronounced changes in magnitude, timing, duration and/or frequency of peak/base flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.

Narrative:
Sections of the Middle Fork John Day River have been dredge mined and channelized since the 1940s. Roads and railroad grades have interrupted surface and subsurface flows in both the upland and riparian areas. There are some small irrigation diversions upstream and within the Oxbow reach (Reclamation 2008). These diversions may impact low flow conditions during the spring and fall that may exacerbate elevated water temperatures. The Tributary Assessment did not detect a substantial change in the magnitude or timing in peaks flows (Reclamation 2008); however, several anthropogenic features and activities have impacted flow routing and groundwater recharge/storage. Therefore, there is some qualitative evidence of change in the delivery of peak/base flows, so the flow/hydrology general indicator is interpreted to be in an ***At Risk Condition***.

GENERAL INDICATOR: WATER QUALITY

Criteria: The following criteria were developed by Oregon Department of Environmental Quality.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Water Quality	Water Temperature	7-DADMax	7-DADMax performance standards (ODEQ): Salmon spawning Sept-May 13°C Core cold-water summer salmonid habitat 16°C (rearing and migration) Bull trout (all stages): 12°C	7-DADMax performance standards exceeded by ≤15%	7-DADMax performance standards exceeded by >15%

Data: Oregon Department of Environmental Quality (http://www.deq.state.or.us/wq/assessment/rpt0406/results.asp).

River Mile	RM 42.9	RM 53.5	RM 57	RM 61.4
Monitoring Site	LASAR 25251	LASAR 28869	LASAR 25253	LASAR 25430
Location	Lat: 44.7286 Long: -118.8438 NAD83	Lat: 44.6643 Long: -118.6987 NAD83	Lat: 44.6421 Long: -118.6462 NAD83	Lat: 44.6221 Long: -118.5773 NAD83
Dates	9/1/2000 – 10/10/2000	6/8/2002 – 11/10/2002	4/28/2001 – 10/26/2001	5/26/2001 – 9/21/2001
Days	34	19	40	32
7-day-average maximum	> 13°C	> 13°C	> 13°C	> 13°C
Status	303(d) list	303(d) list	303(d) list	303(d) list
Criteria	Temperature: Salmon and steelhead spawning: 13.0°C	Temperature: Salmon and steelhead spawning: 13.0°C	Temperature: Salmon and steelhead spawning: 13.0°C	Temperature: Salmon and steelhead spawning: 13.0°C
Dates	8/4/2000 – 8/31/2000	6/16/2002 – 8/31/2002	6/16/2001 – 8/31/2001	6/16/2001 – 8/31/2001
Days	28	73	77	76
7-day-average maximum	> 16°C	> 16°C	> 16°C	> 16°C
Status	303(d) list	303(d) list	303(d) list	303(d) list
Criteria	Temperature: Core cold water habitat: 16°C	Temperature: Core cold water habitat: 16°C	Temperature: Core cold water habitat: 16°C	Temperature: Core cold water habitat: 16°C

Narrative:
The Middle Fork John Day River is on the 303(d) list for temperature for (1) salmon and steelhead spawning, and (2) core cold water habitat. A Total Maximum Daily Load (TMDL) report is currently being written by the Oregon Department of Environmental Quality (ODEQ). Based on the 303(d) listing for temperature and reduction in shading along the river this indicator is interpreted to be in an ***Unacceptable Risk Condition***.

GENERAL INDICATOR: HABITAT ACCESS

Narrative:
There are no main channel fish passage barriers in the Middle Fork John Day River watershed. Therefore, the habitat access general indicator is interpreted to be in an ***Adequate Condition***.

REACH CHARACTERISTICS

GENERAL INDICATOR: WATER TEMPERATURE

Criteria: The following criteria were developed by Oregon Department of Environmental Quality.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Water Quality	Water Temperature	7-DADMax	7-DADMax performance standards (ODEQ): Salmon spawning Sept-May 13°C Core cold-water summer salmonid habitat 16°C (rearing and migration) Bull trout (all stages): 12°C	7-DADMax performance standards exceeded by ≤15%	7-DADMax performance standards exceeded by >15%

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Avg. Temp °C	15.7	19.3	19.0
Max. Temp °C	16.0	20.0	20.0
Date(s) Surveyed	07/15/2008	07/15/2008	07/23/2008
Time Range Readings	1011-1038	1253-1530	1148-1440
Number of Readings	2	4	5

Narrative:
The Oxbow reach on the Middle Fork John Day River is on the 303(d) list for temperature for (1) salmon and steelhead spawning and (2) core cold water habitat. A TMDL report is currently being written by the Oregon Department of Environmental Quality (ODEQ). In addition, the riparian canopy cover (10-meter buffer zone along both banks) that provides shading has been severally impacted by agricultural disturbances and livestock grazing. Based on the 303(d) listing for temperature this indicator is interpreted to be in an ***Unacceptable Risk Condition***.

GENERAL INDICATOR: TURBIDITY

Criteria: The performance standard for this indicator is from Hillman and Giorgi (2002) and Oregon State Department Environmental Quality.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Water Quality	Turbidity	Nephelometric Turbidity Units (NTU)	Performance Standard: Acute <70 NTU Chronic <50 NTU For streams that naturally exceed these standards: Turbidity should not exceed natural baseline levels at the 95% CL. <15% exceedance. Or Turbidity shall not exceed: 10 percent increase over natural turbidity (ODEQ – OAR 340-041).	15-50% exceedance.	>50% exceedance.

Data: Environmental Protection Agency STORET Database (http://iaspub.epa.gov/waters10/attains_get_services.storet).

Station	Location	Date	Turbidity
WORP99-0794	Lat: 44.62, Long: -118.57, NAD27	07/16/2001	1.84 NTU
WORP99-0973	Lat: 44.77, Long: -118.87, NAD27	06/11/2003	1.28 NTU
	Lat: 44.77, Long: -118.87, NAD27	08/25/2003	0.643 NTU

Narrative:
Turbidity is measured in Nephelometric Trubidity Units (NTU) which is a measure of the cloudiness of the water caused by suspended solids. Environmental Protection Agency (EPA) has measured turbidity at two locations that bracket the Oxbow reach. Their sampling results suggest that the turbidity indicator is in an ***Adequate Condition*** as defined by the criteria.

GENERAL INDICATOR: CHEMICAL CONTAMINATION/NUTRIENTS

Criteria: The following criteria were developed by USFWS (1998) and Oregon State Department of Environmental Quality.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Water Quality	Chemical Contamination/ Nutrients	Metals/ Pollutants, pH, DO, Nitrogen, Phosphorous	Low levels of chemical contamination from land use sources, no excessive nutrients, no CWA 303(d) designated reaches. **Or** Oregon State Department of Environmental Quality standards – OAR 340-041.	Moderate levels of chemical contamination from land use sources, some excess nutrients; one CWA 303(d) designated reach.	High levels of chemical contamination from land use sources, high levels of excess nutrients, more than one CWA 303(d) designated reach.

Data: Environmental Protection Agency STORET Database (http://iaspub.epa.gov/waters10/attains_get_services.storet).

Station: WORP99-0794 Location: Lat: 44.62, Long: -118.57, NAD27			**Station: WORP99-0973 Location: Lat: 44.77, Long: -118.87, NAD27**				
Characteristic	**Date**	**Value**	**Characteristic**	**Date**	**Value**	**Date**	**Value**
Calcium	07/16/2001	0.4005 meq/L	Calcium	06/11/2003	0.3267 meq/L	08/25/2003	0.6682 meq/L
Carbon, inorganic	"	13190 ug/l	Carbon, inorganic	"	7720 ug/l	"	13910 ug/l
Carbon, organic	"	1480 ug/l	Carbon, organic	"	1660 ug/l	"	2510 ug/l
Chloride	"	0.0223 meq/L	Chloride	"	0.0104 meq/L	"	0.0262 meq/L
Dissolved Oxygen	"	8600 ug/l	Dissolved Oxygen	"		"	8300 ug/l
Magnesium	"	0.4379 meq/L	Magnesium	"	0.2441 meq/L	"	0.5178 meq/L
Nitrogen, ammonia as N	"	0.001 meq/L	Nitrogen, ammonia as N	"	0 meq/L	"	0.001 meq/L
NO3	"	0 meq/L	Nitrogen, nitrate (NO3) as N	"	0 meq/L	"	0 meq/L
pH	"	8.65	pH	"	8.19	"	9.27
Potassium	"	0.0776 meq/L	Potassium	"	0.0214 meq/L	"	0.0548 meq/L
Selenium	"	0 ug/l	Selenium	"	0 ug/l	"	0 ug/l
Sodium	"	0.2436 meq/L	Sodium	"	0.1343 meq/L	"	0.2561 meq/L
Solids, Total Suspended (TSS)	"	2700 ug/l	Solids, Total Suspended (TSS)	"	4400 ug/l	"	2200 ug/l
Specific conductance	"	118 uS/cm	Specific conductance	"	72 uS/cm	"	141 uS/cm
Sulfur, sulfate (SO4) as S	"	0.015 meq/L	Sulfur, sulfate (SO4) as S	"	0.028 meq/L	"	0.04 meq/L
Zinc	"	4 ug/l	Zinc	"	0 ug/l	"	2 ug/l

Narrative:

Dredge mining occurred along the Middle Fork John Day River, and both lode and placer mining occurred in many of the tributaries. Lode mining may produce/release acid mine drainage and both dredge mining and placer mining may use mercury for separating gold from other compounds (i.e., “quick silver”). Hahn and Associates, Inc. (2000) found mercury concentrations to be elevated near Granite Boulder Creek, but no mercury concentrations exceeded sediment or surface water-related ecological screening levels. However, these mining activities have and could continue to occur in the Middle Fork John Day River tributaries upstream and adjacent to the Oxbow reach, suggesting a continued risk to the Oxbow reach.

Improved roads were constructed along some lengths of the Middle Fork John Day River with several crossing locations within and upstream of the Oxbow reach. Roads are maintained during the winter by applying sand and magnesium chloride (MgCl) that pose uncertain risks to the river. In addition, spills from vehicles traveling along the roads pose an unknown risk to the river.

Livestock are able to access the river and its tributaries which may be increasing nutrient and sediment loads. The Oxbow Conservation Area is engaged in the CREP planting program, which limits cattle access on the floodplain and to the river. Currently there are insufficient data for dissolved oxygen (DO), pH, sedimentation, and flow modification for the Middle Fork John Day River. These indicators have been added to the Oregon’s 2004/2006 Integrated Report Database for monitoring and a TMDL report is currently being written by the Oregon Department of Environmental Quality (DEQ).

The Middle Fork John Day River and its tributaries will probably have impacts from continued mining activities. Livestock best management practices are being used along the Oxbow reach, but livestock use in the tributaries may provide elevated nutrient levels to the Middle Fork John Day River. Road locations along the river pose uncertain hazards to the river from road maintenance and possible spills from vehicle accidents. Overall, the chemical contamination/nutrients specific indicator is interpreted to be in an **At Risk Condition** (for specific standards and criteria refer to Oregon State Department of Environmental Quality standards – OAR 340-041).

GENERAL INDICATOR: MAIN CHANNEL PHYSICAL BARRIERS (NATURAL/HUMAN)

Criteria: The following criteria have been modified from USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Access	Main Channel Physical Barriers	Barriers (Natural/Human)	No manmade barriers present in the mainstem that limit upstream or downstream migration at any flow.	Manmade barriers present in the mainstem that prevent upstream or downstream migration at some flows that are biologically significant.	Manmade barriers present in the mainstem that prevent upstream or downstream migration at multiple or all flows.

Narrative:
There are irrigation diversion dams along the Middle Fork John Day River and its tributaries. Overall, physical barriers have adequate fish passage at all biologically significant flows and the assessment team interprets the main channel physical barriers (natural/human) specific indicator to be in an **Adequate Condition**.

GENERAL INDICATOR: CHANNEL SUBSTRATE

Criteria: Performance standards for these criteria are from Hillman and Giorgi (2002).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Channel Substrate	Dominant Substrate/Fine Sediment	Gravels or small cobbles make-up >50% of the bed materials in spawning areas. Reach embeddedness in rearing areas <20%. <12% fines (<0.85mm) in spawning gravel or ≤12% surface fines of ≤6mm.	Gravels or small cobbles make-up 30-50% of the bed materials in spawning areas. Reach embeddedness in rearing areas 20-30%. 12-17% fines (<0.85mm) in spawning gravel or 12-20% surface fines of ≤6mm.	Gravels or small cobbles make-up <30% of the bed materials in spawning areas. Reach embeddedness in rearing areas >30%. >17% fines (<0.85mm) in spawning gravel or >20% surface fines of ≤6mm.

Data: U.S. Forest Service Stream Survey based on visual estimates (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Percent Sand (<2 mm)	10	16.7	24
Percent Gravel (2-64 mm)	25	20	37
Percent Cobbles (64-256 mm)	45	33.3	34
Percent Boulder (256-4096 mm)	20	30	5
Percent Bedrock (>4096 mm)	0	0	0

Data: U.S. Forest Service Stream Survey based on pebble counts (Appendix B).

River Mile	55.6-56.2	56.2-58.0	57.0-57.7
Habitat Reach	**7**	**8-North**	**8-South**
D16	<2 mm	<2 mm	No Data
D50	32-45 mm	64-90 mm	No Data
D84	64-90 mm	180-256 mm	No Data

Data: Tributary Assessment based on pebble counts (Reclamation 2008).

River Mile	Pebble Count	Type	Location	Northing (NAD 83)	Easting (NAD 83)	Percent Fines (<6 mm)	D16 (mm)	D35 (mm)	D50 (mm)	D84 (mm)	D95 (mm)	Max. Size (mm)
56.0	MF-06-27	Surface	Bar	364817.475	8675832.265	1%	16.0	22.6	26.6	43.4	61.8	90.0
57.0	MF-06-26	Surface	Bar	362459.891	8679971.009	8%	8.1	10.7	13.5	21.3	28.3	45.0
57.5	MF-06-25	Surface	Channel	361465.201	8682105.224	1%	47.0	69.4	88.6	148.6	199.1	256.0
South Channel	MF-06-05	Surface	Bar	361372.655	8683368.532	2%	13.1	21.2	27.0	51.9	71.7	128.0

Data: Volumetric samples from Tributary Assessment (Reclamation 2008) and from June 2009.

River Mile	Sample Name	Sample Description	Percent < 2mm	Percent < 6mm	D16	D35	D50	D84	D90	D95
South Channel	MF-06-05	Surface	7%	13%	8.31	21.18	32.84	67.95	79.63	92.22
South Channel	SS-MF-06-05	Subsurface	22%	32%	1.11	5.99	14.71	39.58	48.07	60.97
57.0	MF-2009-01	Surface	6%	11%	9.00	17.66	22.88	39.38	42.91	49.14
57.0	SS-MF-2009-01	Subsurface	26%	40%	0.89	4.13	9.04	25.35	29.57	35.58
55.9	MF-2009-02	Surface	15%	24%	2.26	12.16	19.93	44.95	65.00	76.48
55.9	SS-MF-2009-02	Subsurface	32%	44%	0.73	2.52	8.65	43.01	54.56	68.27

Interpretation:

River Mile	55.6-56.2	56.2-58.0	57.0-57.7
Habitat Reach	**7**	**8-North**	**8-South**
Dominant Substrate	Gravel	Cobbles	Gravel
Embeddedness	No Data	No Data	No Data
Fine Sediment (visual estimates and bulk samples)	<12% Surface Fines	>12% Surface Fines	>12% Surface Fines
Condition	At Risk for dominate substrate	Unacceptable Risk for dominant substrate	At Risk for fine sediment

Narrative:

Substrate data for river segment RM 55.6 to RM 56.2 indicate the substrate is predominantly cobbles and gravel with about 11 percent surface fines (embeddedness was not measured) suggesting this river segment is in an **At Risk Condition** for dominant substrate. Along the North Channel between RM 56.2 and RM 58.0, sediment data indicate the substrate is predominantly cobbles with some boulders with 16 to 24 percent percent surface fines (embeddedness was not measured) suggesting this river segment is in an **Unacceptable Risk Condition** for both dominant substrate and fine sediment. Finally, in the South Channel between RM 57.0 and RM 57.7, sediment data indicate the substrate is predominantly gravel and cobbles with about 13 to 24 percent surface fines (embeddedness was not measured) suggesting this river segment is in an **At Risk Condition** for fine sediment.

Overall, the channel substrate specific indicator is interpreted to be in an **At Risk Condition** due to stream channelization that has resulted in the coarsening of the stream bed and a high percentage of fine sediment.

GENERAL INDICATOR: LARGE WOOD

Criteria: The following criteria were developed by USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Large Wood	Pieces Per Mile at Bankfull	>20 pieces/mile >12" diameter >35 ft length; and adequate sources of woody debris available for both long- and short-term recruitment.	Currently levels are being maintained at minimum levels desired for "adequate", but potential sources for long-term woody debris recruitment is lacking to maintain these minimum values.	Current levels are not at those desired values for "adequate", and potential sources of woody debris for short- and/or long-term recruitment are lacking.

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Miles	0.58	1.76	1.12
Large Wood	0	0	0.9
Medium Wood	0	0.57	0
Small Wood	0	1.1	3.6
Total	0	1.7	4.5
Frequency of Large Wood	0	0	0.047

Data: Tributary Assessment (Reclamation 2008).

Tributary Assessment Reach	LWD-sized Trees Along Buffer Zone (82 feet along both banks)
MF 07	0.2 acres
MF 08	0.7 acres

Interpretation:

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Large Wood	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition
Recruitment Potential	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition

Narrative:
Large wood is almost completely absent in the Oxbow reach and the recruitment potential is currently very low. The large wood specific indicator is interpreted to be in an **Unacceptable Risk Condition** due to the lack of wood in the system and the lack of large wood recruitment potential.

GENERAL INDICATOR: POOLS

Criteria: The following criteria were developed by USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Pools	Pool Frequency and Quality Large Pools (in adult holding, juvenile rearing, and over-wintering reaches where streams are >3 m in wetted width at base flow)	Pool frequency: Channel width No. pools/mile 0-5 feet 39 5-10 feet 60 10-15 feet 48 15-20 feet 39 20-30 feet 23 30-35 feet 18 35-40 feet 10 40-65 feet 9 65-100 feet 4 Pools have good cover and cool water and only minor reduction of pool volume by fine sediment. Each reach has many large pools >1 m deep with good fish cover.	Pool frequency is similar to values in "functioning adequately", but pools have inadequate cover/temperature, and/or there has been a moderate reduction of pool volume by fine sediment. Reaches have few large pools (>1 m) present with good fish cover.	Pool frequency is considerably lower than values for "functioning adequately", also cover/temperature is inadequate, and there has been a major reduction of pool volume by fine sediment. Reaches have no deep pools (>1 m) with good fish cover.

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Miles	0.58 miles	1.76 miles	1.12 miles
Number of Pools	13	23	33
Number of Pools/Surveyed Mile of Stream	22.4	13.1	29.5
Frequency of Pools	0.142	0.053	0.093
Number of Pools > 3 Feet Deep/Surveyed Mile of Stream	8.62	8.52	11.6
Avg. Residual Pool Depth	1.76	2.33	0.037
Avg. Bankfull Width (feet)	42.5 feet	26.0 feet	21.0 feet
Percentage of Pools Formed By:			
Beaver	0	0	0
Wood	3	15	7
Bedrock	0	0	0
Boulder	32	11	2
Stream Bend	32	52	70
Tributary	0	0	0
Culvert	0	0	0
Dam	0	2	2
Restoration	32	0	0
Other	0	15	2
Unknown	0	7	16

Data: Initial Site Assessment - Channel unit mapping summary (Appendix C).

Channel Unit	Number	Acres	Percentage
Pool	29	1.8051	21%
Rapid	7	0.2891	3%
Riffle	84	2.9645	35%
Run	81	3.5619	41%
Totals	201	8.6206	100%

Data: Initial Site Assessment - Channel unit mapping by inner zone subreaches (Appendix C)

River Mile	55.6-56.2	56.2-57.0	57.0-57.7 (North)	57.0-57.7 (South)	57.7-58.0
Total Acres	2.093	2.043	1.341	2.329	0.745
Percent Pools	5%	20%	37%	22%	40%
Percent Rapids	0%	6%	12%	0%	0%
Percent Riffles	43%	32%	31%	29%	39%
Percent Runs	52%	42%	20%	49%	21%

Interpretation:

River Mile	55.6-56.2	56.2-58.0	57.0-57.7
Habitat Reach	**7**	**8-North**	**8-South**
Frequency and Quality	At Risk Condition due to lack of fish cover	At Risk Condition due to low frequency of pools and lack of fish cover	At Risk Condition due to lack of fish cover and large pools
Large Pools (>1 m Deep)	At Risk Condition due to lack of deep pools	At Risk Condition due to lack of deep pools	At Risk Condition due to lack of deep pools
Percent of Pool Habitat	At Risk Condition due to a lack of pool habitat area	Adequate based on areal extent	Adequate based on areal extent

Narrative:
For pool-riffle bedform types, Montgomery and Buffington (1993) suggest a pool spacing of every 5 to 7 channel widths. This spacing implies that pools should make-up approximately 14 to 20 percent of the habitat area. Based on channel unit mapping, most of the Oxbow reach has an adequate percentage of pool habitat except between RM 55.6 and 56.2. For the Oxbow reach, pool frequency is adequate except between RM 56.2 and 58.0. The percentage of pool habitat area appears to be deficient between RM 55.6 and 56.2. There is a deficiency in the number of large pools (greater than 1 meter deep) and many pools have minimal fish cover. Based on the criteria, the pool frequency and quality specific indicators for the Oxbow reach are interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: OFF-CHANNEL HABITAT

Criteria: The following criteria have been modified from USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Off-channel Habitat	Connectivity with Main Channel	Reach has many ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are low energy areas. No manmade barriers present along the mainstem that prevent access to off-channel areas.	Reach has some ponds, oxbows, backwaters, and other off-channel areas with cover; side channels are generally high energy areas. Manmade barriers present that prevent access to off-channel habitat at some flows that are biologically significant.	Reach has few or no ponds, oxbows, backwaters, and other off-channel areas. Manmade barriers present that prevent access to off-channel habitat at multiple or all flows.

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Slow Water (%)	43.3%	34.8%	48%
Number of Slow Water Units	13	23	33
Fast Water (%)	3.0%	43.9%	35%
Number of Fast Water Units	9	29	24
Fast Water/Slow Water Ratio	0.69	1.26	0.75
Side Channel (%)	13.3%	10.6%	16%
Number of Side Channel Units	4	7	11
Tributary (%)	13.3%	10.6%	1%
Number of Tributaries	4	7	1
Entrenchment Ratio	3.8	20.0	2.6

Data: Two-dimensional hydraulic model results (Reclamation 2008).

River Mile	**55.6-56.2**	**56.2-57.0**	**57.0-57.7 (North)**	**57.0-57.7 (South)**	**57.7-58.0**
2-year Flow/Floodplain Connectivity	Good	Poor	Poor	Good	Good
10-year Flow/Floodplain Connectivity	Good	Poor	Poor	Good	Good
100-year Flow/Floodplain Connectivity	Good	Poor	Poor	Good	Good

Good – stream accesses floodplain and dissipates energy
Fair – stream accesses floodplain, but stream energy remains focused in the main channel
Poor – stream does not effectively access floodplain and stream energy is focused in the main channel

Interpretation:

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Off-channel Habitat	At Risk Condition	Unacceptable Risk Condition	Adequate Condition

Narrative:

Connectivity of off-channel habitat for river segment RM 55.6 to RM 56.2 indicate a limited number of side channel units (13.3 percent side channel habitat) with fairly good floodplain connectivity suggesting this river segment is in an **At Risk Condition**. The North Channel between RM 56.2 and RM 58.0 has been channelized through mine tailings and in some locations an artificial floodplain has been constructed by lowering the elevation of the tailings. However, there is a limited quantity of off-channel habitat due to the mine tailings (10.6 percent side channel habitat), suggesting this river segment is in an **Unacceptable Risk Condition**. The South Channel between RM 57.0 and RM 57.7 has the highest number of off-channel habitat (16 percent side channel habitat) with good floodplain connectivity, suggesting this river segment is in an **Adequate Condition**.

The overall condition of the Oxbow reach for the off-channel habitat specific indicator is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: FLOODPLAIN CONNECTIVITY

Criteria: The following criteria have been modified from USFWS (1998).

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel Condition	Channel Dynamics	Floodplain Connectivity	Floodplain areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	Reduced linkage of wetland, floodplains, and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas; wetland area drastically reduced and riparian vegetation/succession altered significantly.

Data: U.S. Forest Service Stream survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Mapped Gradient	0.4	0.6	0.5
Mapped Sinuosity	1.2	1.1	1.3
Avg. Bankfull W/D ratio	21.3	12.4	15.6
Entrenchment Ratio	3.8	20.0	2.6
Rosgen Stream Class	C	C	C
Dominant Substrate	Gravel	Cobbles	Gravel

Data: Initial Site Assessment (Appendix C).

River Mile	**55.6-56.2**	**56.2-58.0 (North)**	**57.0-57.7 (South)**
Rock Spurs	31	0	0
Riprap (linear feet)	100 feet	0	0
Embankment	0	1,534 feet	0
Levee	0	0	1
Spoil Piles	0	2	1
Footbridge	0	1	0
Ford	1	2	0

Data: Two-dimensional hydraulic model results (Reclamation 2009).

River Mile	**55.6-56.2**	**56.2-58.0 (North)**	**57.0-57.7 (South)**
2-year Flow/Floodplain Connectivity	Good	Poor	Good
10-year Flow/Floodplain Connectivity	Good	Poor	Good
100-year Flow/Floodplain Connectivity	Good	Poor	Good

Good – stream accesses floodplain and dissipates energy
Fair – stream accesses floodplain, but stream energy remains focused in the main channel
Poor – stream does not effectively access floodplain and stream energy is focused in the main channel

Interpretation:

River Mile	55.6-56.2	57.0-57.7 (North)	57.0-57.7 (South)
Condition	At Risk Condition	Unacceptable Risk Condition	Adequate Condition

Narrative:

River segment RM 56.2 to RM 58.0 (North Channel) has a high entrenchment ratio (20.0) and low sinuousity (1.1) due to stream channelization through mine tailings. There is also about 1,500 feet of embankment in this river segment that inhibits floodplain processes. In addition, the two-dimensional hydraulic model suggests there is poor floodplain connectivity for the 2-year through 100-year floods. This river segment is interpreted to be in an **Unacceptable Risk Condition** for floodplain connectivity.

River segments RM 55.6 to RM 56.2 and RM 57.0 to RM 57.7 (South Channel) have low entrenchment ratios (3.8 and 2.6, respectively) and there are minimal topographic features to impede floodplain access. The two-dimensional hydraulic model suggests there is good floodplain connectivity for the 2-year flood. However, localized incision may have occurred where the stream has been manipulated (North/South Channels bifurcation and areas with bank protection) that has decreased floodplain connectivity. Therefore, these river segments are interpreted to be in an **At Risk Condition** for floodplain connectivity.

Overall, the floodplain connectivity specific indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: BANK STABILITY/CHANNEL MIGRATION

Criteria: The criteria for bank stability/channel migration were agreed upon by the assessment team as a relative condition of the specific indicator.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel	Dynamics	Bank Stability/ Channel Migration	Channel is migrating at or near natural rates.	Limited amount of channel migration is occurring at a faster/slower rate relative to natural rates, but significant change in channel width or planform is not detectable; large woody debris is still being recruited.	Little or no channel migration is occurring because of human actions preventing reworking of the floodplain and large woody debris recruitment; or channel migration is occurring at an accelerated rate such that channel width has a least doubled, possibly resulting in a channel planform change, and sediment supply has noticeably increased from bank erosion.

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North**	**8-South**
Miles	0.58 miles	1.76 miles	1.12 miles
Unstable Right Bank (%)	1.1%	0%	1.2%
Unstable Left Bank (%)	2.9%	0%	1.1%
Unstable Both Banks (%)	4.1%	0%	2.3%
Undercut Right Bank (%)	0.3%	0%	5.1%
Undercut Left Bank (%)	1.8%	1.7%	6.8%
Undercut Both Banks (%)	2.1%	1.7%	11.9%

Data: Initial Site Assessment (Appendix C).

River Mile	**55.6-56.2**	**56.2-58.0 (North)**	**57.0-57.7 (South)**
Rock Spurs	31	0	0
Riprap (linear feet)	100 feet	0	0
Embankment	0	1,534 feet	0
Levee	0	0	1
Spoil Piles	0	2	1
Footbridge	0	1	0
Ford	1	2	0

Interpretation:

River Mile	**55.6-56.2**	**56.2-58.0 (North)**	**57.0-57.7 (South)**
Bank Stability/Channel Migration	At Risk Condition	Unacceptable Risk Condition	Adequate Condition

Narrative:

Bank stability and channel migration rates can be impacted by such variables as coarse bank materials, bank protection, changes in streamflow, and the type vegetation along the riparian buffer zone (30-meter width along both banks). In river segment RM 56.2 to RM 58.0 (North Channel), there has been a very low rate lateral channel migration and bank erosion (0 percent unstable both banks and 1.7 percent undercut both banks) due to channelization through mine tailings and an inability of the channel to access the floodplain. Embankments (about 950 feet) along the river also inhibit lateral channel migration. Therefore, this river segment is interpreted to be in an **Unacceptable Risk Condition**.

River segment RM 57.0 to RM 57.7 (South Channel) has a relatively moderate rate of lateral channel migration and bank erosion (2.3 percent unstable both banks and 11.9 percent undercut both banks) due to the lack of woody vegetation along the riparian buffer zone (30-meter riparian buffer zone along both banks). Due to the lack of woody vegetation to maintain bank stability, this river segment is interpreted to be in an **At Risk Condition**.

River segment RM 55.6 to RM 56.2 has a relatively low rate of lateral channel migration and bank erosion (4.1 percent unstable both banks and 2.1 percent undercut both banks) due to bank protection (31 rock spurs and 100 feet riprap). Due to constraints on lateral channel migration, this river segment is interpreted to be in an **At Risk Condition.**

Overall, the bank stability/channel migration specific indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: VERTICAL CHANNEL STABILITY

Criteria: The criteria for vertical channel stability were agreed upon by the assessment team as a relative condition of the specific indicator.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel	Dynamics	Vertical Channel Stability	No measurable trend of aggradation or incision and no visible change in channel planform.	Measurable trend of aggradation or incision that has the potential to but not yet caused disconnection of the floodplain or a visible change in channel planform (e.g., single thread to braided).	Enough incision that the floodplain and off-channel habitat areas have been disconnected; or, enough aggradation that a visible change in channel planform has occurred (e.g., single thread to braided).

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**55.6-56.2**	**56.2-58.0**	**57.0-57.7**
Habitat Reach	**7**	**8-North Channel**	**8-South Channel**
Valley Form	7-Broad, trough-like with side slopes <30%	8-Narrow flat-floored floor width 100-300 feet wide with side slopes >30%	8-Narrow flat-floored floor width 100-300 feet wide with side slopes >30%
Surveyed Length	3,068 feet	9,308 feet	5,926 feet
Side Channel Length	325 feet	419 feet	550 feet
Mapped Channel Length	3,405 feet	8,976 feet	4,858 feet
Min. Elevation	3,678 feet	3,693 feet	3,691 feet
Max. Elevation	3,693 feet	3,749 feet	3,713 feet
Cubic Feet per Second (cfs)	31.12 cfs	28.81 cfs	ND
Avg. Wetted Width	33.4 feet	21.6 feet	16.70 feet
Avg. Bankfull Depth	1.53 feet	1.87 feet	1.22 feet
Avg. Bankfull Max. Depth	2.00 feet	2.10 feet	1.35 feet
Avg. Bankfull Width	42.5 feet	26.0 feet	21.0 feet
Avg. Floodprone Width	160 feet	521 feet	54 feet
Valley Width	843 feet	827 feet	817 feet
Valley Length	2,731 feet	8,448 feet	3,852 feet
Mapped Gradient	0.4%	0.6%	0.5%
Mapped Sinuosity	1.2	1.1	1.3
Avg. Bankfull W/D Ratio	21.3	12.4	15.6
Avg. Entrenchment Ratio	3.8	20.0	2.6
Rosgen Stream Class	C	C	C
Dominant Substrate	Gravel	Cobbles	Gravel

Data: Initial Site Assessment - Channel unit mapping summary (Appendix C).

Channel Unit	Number	Acres	Percentage
Pool	29	1.8051	21
Rapid	7	0.2891	3
Riffle	84	2.9645	35
Run	81	3.5619	41
Totals	201	8.6206	100

Data: Initial Site Assessment - Channel unit mapping by inner zone subreaches (Appendix C).

River Mile	55.6-56.2	56.2-57.0 (North)	57.0-57.7 (North)	57.7-58.0 (North)	57.0-57.7 (South)
Total Acres	2.093	2.043	1.341	0.745	2.329
Percent Pools	5%	20%	37%	40%	22%
Percent Rapids	0%	6%	12%	0%	0%
Percent Riffles	43%	32%	31%	39%	29%
Percent Runs	52%	42%	20%	21%	49%

Data: Two-dimensional hydraulic model results (Reclamation 2009).

River Mile	55.6-56.2	56.2-57.0 (North)	57.0-57.7 (North)	57.7-58.0 (North)	57.0-57.7 (South)
2-year Flow/Floodplain Connectivity	Good	Poor	Poor	Good	Good
10-year Flow/Floodplain Connectivity	Good	Poor	Poor	Good	Good
100-year Flow/Floodplain Connectivity	Good	Poor	Poor	Good	Good

Good – stream accesses floodplain and disperses energy
Fair – stream accesses floodplain, but stream energy remains focused in the main channel
Poor – stream does not effectively access floodplain and stream energy is focused in the main channel

Interpretation:

River Mile	55.6-56.2	56.2-57.0 (North)	57.0-57.7 (North)	57.7-58.0 (North)	57.0-57.7 (South)
Condition	Adequate Condition	Unacceptable Risk Condition	At Risk Condition	Adequate Condition	Adequate Condition

Narrative:

Vertical channel stability can be affected by channel bed armoring (coarsening), an influx of sediment, channel confinement, and channel gradient, etc. In river segment RM 56.2 to RM 58.0 (North Channel), the stream has been channelized through mine tailings. The channel gradient is about 0.6 percent with an average width/depth ratio of 12.4 and average entrenchment ratio of 20.0. The dominant substrate is cobbles and this river segment has the highest concentration of rapids (about 10 percent). Floodplain connectivity is poor in that the 100-year flood is contained in many parts of the channel. This river segment is predominantly a transport section and the vertical stability is interpreted to be in an **At Risk Condition**.

River segment RM 57.0 to RM 57.7 (South Channel), the channel gradient is about 0.5 percent with an average width/depth ratio of 2.6 and average entrenchment ratio of 2.6. The dominant substrate is gravel and the dominant channel units are runs (49 percent) and riffles (29 percent). Floodplain connectivity is good in that the 2-year flood is able to access the floodplain. This river segment is predominantly a transition section due to the flow split between the North and South Channels and is interpreted to be in an **Adequate Condition**.

River segment RM 55.6 to RM 56.2 the channel gradient is about 0.4 percent with an average width/depth ratio of 21.3 and average entrenchment ratio of 3.8. The dominant substrate is gravel and the dominant channel units are runs (52 percent) and riffles (43 percent). Floodplain connectivity is good in that the 2-year flood is able to access the floodplain. This river segment has a confined valley near RM 56.2 that transitions to an unconfined valley. This river segment is predominantly a transition section and is interpreted to be in an **Adequate Condition**.

Overall, the vertical channel stability specific indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: VEGETATION CONDITION (STRUCTURE)

Criteria: The criteria for riparian vegetation structure were agreed upon by the assessment team as a “relative” indication to the functionality of the specific indicator.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Riparian/Upland Vegetation	Vegetation Condition	Vegetation Structure	>80% species composition, seral stage, and structural complexity are consistent with potential native community.	50-80% species composition, seral stage, and structural complexity are consistent with potential native community.	<50% species composition, seral stage, and structural complexity are consistent with potential native community.

Data: U.S. Forest Service Stream Survey (Appendix B).

Understory Cover:	Left Bank (Percent)	Right Bank (Percent)
Woody Shrub Cover	5.68	5.00
Grass/Forb Cover	11.44	11.44
Ground Cover:		
Woody Cover	0.61	0.76
Grass/Forb Cover	62.12	66.21
Barren/Rock Cover	26.44	21.06

Data: U.S. Forest Service Stream Survey (Appendix B).

	Left Bank Plots				Right Bank Plots			
Species	**0 m**	**3 m**	**6 m**	**9 m**	**0 m**	**3 m**	**6 m**	**9 m**
Annual Forb	0.00	0.00	0.45	0.04	0.00	0.00	0.44	1.20
Alopecurus pratensis	1.08	5.40	4.55	4.64	0.00	13.44	5.88	0.28
Bromus tectorum	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00
Carex aquatilis	1.08	0.97	0.00	0.00	0.00	0.00	0.00	0.00
Carex lasiocarpa	0.00	0.32	1.45	0.18	0.41	0.00	0.00	0.00
Carex lenticularis	75.41	0.81	0.45	0.63	33.38	1.31	0.00	0.00
Carex nebrascensis	0.00	0.00	0.00	0.00	0.81	0.57	0.00	0.00
Carex spp.	4.32	3.79	0.45	3.75	10.68	5.74	17.63	2.69
Carex utriculata	0.95	3.63	1.73	1.16	0.68	0.57	0.44	2.13
Cirsium arvense	0.00	2.18	0.00	0.63	0.00	2.54	0.26	0.83

	Left Bank Plots				Right Bank Plots			
Species	**0 m**	**3 m**	**6 m**	**9 m**	**0 m**	**3 m**	**6 m**	**9 m**
Crataegus douglasii	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Deschampsia cespitosa	1.22	1.29	1.36	0.00	0.00	2.21	0.88	1.39
Eleocharis	0.00	0.00	0.00	0.00	0.68	0.16	0.00	0.00
Equisetum	0.00	2.18	0.00	0.00	0.00	0.16	0.35	0.28
forb	7.57	19.35	21.27	16.61	3.51	11.64	13.86	11.11
Festuca spp.	0.00	0.00	0.18	1.43	0.00	0.00	0.44	0.00
Juncus arcticus	0.00	1.37	0.00	0.89	0.68	1.89	0.00	0.00
Juncus spp.	2.03	2.58	4.45	0.80	6.49	2.54	1.32	2.04
Phalaroides arundinacea	0.68	0.56	0.00	0.00	0.00	2.30	1.14	0.28
Calamagrostis rubescens	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00
Planting mat	0.00	0.00	6.55	78.75	0.00	0.00	6.32	106.67
Poa spp.	0.00	0.97	2.64	1.88	0.00	0.82	8.86	2.59
Rock	0.00	0.00	1.64	0.00	0.00	1.48	1.58	1.67
Rumex crispus	0.00	0.00	1.36	0.00	0.00	0.00	0.00	0.00
Rosa woodsii	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.19
Salix spp.	0.00	0.00	0.00	0.00	0.00	0.57	0.44	1.39
Scirpus microcarpus	4.59	0.65	1.09	0.80	8.92	4.59	0.44	0.46
Symphoricarpos spp.	0.00	0.00	1.27	0.71	0.00	0.00	0.00	0.28

	Left Bank Plots				Right Bank Plots			
Species	**0 m**	**3 m**	**6 m**	**9 m**	**0 m**	**3 m**	**6 m**	**9 m**
Thinopyrum	0.00	4.35	4.64	5.00	0.00	2.46	9.74	4.35
Trisetum	0.00	0.00	0.64	0.00	0.00	0.00	0.44	0.00
Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67

Data: U.S. Forest Service Stream Survey (Appendix B).

Invasive and Noxious Species Present	
Common Name	**Scientific Name**
Canadian thistle	*Cirsium arvense*
Reed Canary grass	*Phalaroides arundinacea*
Cheatgrass	*Bromus tectorum*

Data: U.S. Forest Service Stream Survey (Appendix B).

Density of Species Within Belt Transects			
Species	**Count**	**Density/m²**	**Species Density (%)**
Alnus incana	47	1.57	6.1
Amleanchier alnifolia	2	0.07	0.3
Betula spp.	7	0.23	0.9
Cornus stolonifera	14	0.47	1.8
Crataegus douglasii	40	1.33	5.2
Junipercus occidentalis	1	0.03	0.1
Pinus ponderosa	10	0.33	1.3
Populus trichocarpa	8	0.27	1.0
Prunus virginiana	10	0.33	1.3
Ribes spp.	15	0.50	1.9
Rosa woodsii	73	2.43	9.5
Salix boothii	47	1.57	6.1
Salix drummundiana	1	0.03	0.1
Salix eriocephela	47	1.57	6.1
Salix exigua	191	6.37	24.8
Salix geyeriana	10	0.33	1.3
Salix lemmonii	1	0.03	0.1
Salix lucida	4	0.13	0.5
Salix melanopsis	60	2.00	7.8
Symphoricarpos spp.	182	6.07	23.6

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	55.6-56.2	56.2-58.0	57.0-57.7
Habitat Reach	**7**	**8-North**	**8-South**
Riparian Classes	grassland/forbs	grassland/forbs	grassland/forbs
Understory	grassland/forbs	grassland/forbs	grassland/forbs
Overstory	alder	alder	ponderosa pine grassland/forbs alder

Interpretation:

River Mile	55.6-56.2	56.2-58.0	57.0-57.7
Habitat Reach	**7**	**8-North**	**8-South**
Successional Class	At Risk Condition	At Risk Condition	At Risk Condition

Narrative:
Throughout the Oxbow reach area, the successional class is predominantly in a shrub/seedling condition with less than 10 percent of the floodplain in a sapling/pole condition. Although much of the Oxbow reach may have been a wet meadow environment, the successional class along the stream riparian buffer zone (30-meter width along both banks) would be expected to have a higher percentage in the small-to-large tree condition (i.e. alders, cottonwoods, pine). Currently most of the woody riparian vegetation is from CREP plantings that are in a shrub/seedling condition. Overall, the vegetation condition (structure) specific indicator for the Oxbow reach is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: VEGETATION CONDITION (DISTURBANCE)

Criteria: The criteria for riparian vegetation disturbance were agreed upon by the assessment team as a “relative” indication to the functionality of the specific indicator.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Riparian/Upland Vegetation	Vegetation Condition	Vegetation Disturbance (Natural/Human)	>80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; <20% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); <2 mi/mi^2 road density in the floodplain.	50-80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; 20-50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); 2-3 mi/mi^2 road density in the floodplain.	<50% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; >50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); >3 mi/mi^2 road density in the floodplain.

Data: Tributary Assessment (Reclamation 2008).

Tributary Assessment Reach	Tree/Shrub Percent Change (based on 1939 and 2006 aerial photographs)
MF 07	0.0%
MF 08	-16.1%

Narrative:
Over 20 percent of the Oxbow reach has been disturbed by dredge mining, livestock grazing, and timber harvests. Over 16 percent of the trees and shrubs have been lost based on 1939 and 2006 aerial photograph comparisons. There is a low percentage of large-to-mature trees in the riparian buffer zone (30-meter width along both banks) available for recruitment by the stream. Currently most of the woody riparian vegetation is from CREP plantings that are in a shrub/seedling condition. Overall, the vegetation condition (disturbance) specific indicator for the Oxbow reach is interpreted to be in an **Unacceptable Risk Condition**.

GENERAL INDICATOR: VEGETATION CONDITION (CANOPY COVER)

Criteria: The criteria for riparian vegetation canopy cover were agreed upon by the assessment team as a “relative” indication to the functionality of the specific indicator.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Riparian/Upland Vegetation	Vegetation Condition	Canopy Cover	Trees and shrubs within one site potential tree height distance have >80% canopy cover that provides thermal shading to the river.	Trees and shrubs within one site potential tree height distance have 50-80% canopy cover that provides thermal shading to the river.	Trees and shrubs within one site potential tree height distance have <50% canopy cover that provides thermal shading to the river.

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	55.6-58.0
Center	0.66%
Left	1.79%
Right	7.97%

Data: Tributary Assessment (Reclamation 2008).

Tributary Assessment Reach	Percent of Stream Shaded
MF 07	3.9%
MF 08	8.0%

Narrative:
Canopy cover of the stream channel was less than 1 percent, while the left and right bank had higher percentages at 2 percent and 8 percent cover, respectively. The canopy layer was made up of predominantly small trees (8 percent cover, less than 0.3 m DBH) and less than 1 percent big trees (greater than 0.3 m DBH). Based on the densitometer summary and the predominant successional class (shrub/seedling condition), the vegetation condition (canopy cover) specific indicator is interpreted to be in an ***Unacceptable Risk Condition***.

REFERENCES

Hahn 2000	Hahn and Associates, Inc. (Robert Ede, Senior Project Manager). *Phase II Environmental Site Assessment Report: Oxbow Ranch, Middle Fork of the John Day River Property, Grant County, Oregon*. Hahn and Associates, Inc., Portland, Oregon. December 20, 2000.
Hillman and Giorgi 2002	Hillman and Giorgi. 2002. Monitoring protocols: Effectiveness monitoring of physical/environmental indicators in tributary habitats. Prepared for Bonneville Power Administration: BioAnalysts, Inc., Boise, Idaho, 104 p.
Montgomery and Buffington 1993	Montgomery and Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Washington State Timber/Fish/Wildlife Agreement, TFW-SH10-93-002, Department of Natural Resources, Olympia, WA.
Reclamation 2008	Bureau of Reclamation. 2008. *Middle Fork and Upper John Day River Tributary Assessments, Grant County, Oregon*. U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center (Denver, Colorado) and the Pacific Northwest Regional Office (Boise, Idaho). 114 p. + Appendices.
Reclamation 2009	Bureau of Reclamation. 2008. *Geomorphology and Hydraulic Model Analysis of the Oxbow Conservation Area, Middle Fork John Day River, Grant County, Oregon*. U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center, Denver, Colorado. 123 p. + Appendices.
USFWS 1998	U.S. Fish and Wildlife Service. 1998. Matrix of physical/environmental pathways and indicators for east-side streams: in Hillman and Giogi, 2002, Appendix C.

APPENDIX B

2008 Stream Survey

MIDDLE FORK JOHN DAY RIVER

2008 Stream Survey Report
Malheur National Forest
Blue Mountain Ranger District

Prepared by: United States Forest Service, Stream Survey
La Grande Ranger District- Wallowa-Whitman National Forest
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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Chapter 1: Stream Survey

OVERVIEW

Dates Surveyed: July 8th – July 28th, 2008
Survey Type: Region 6 Stream Inventory Methodology, Version 2.8, Level II
Mouth Location: 044º 54.9600' N, 119º 18.0412' W
Headwater Location: 044º 35.0795' N, 118º 25.7258' W
USGS Quadrangle: Susanville, Boulder Butte, Bates and Austin
Watershed (4th field): Middle Fork John Day
Subwatershed (6th field): Coyote Creek/Balance Creek, Granite Boulder Creek, Little Boulder Creek/Deerhorn, Vinegar Creek and Mill Creek
Tributary To: North Fork John Day River
NFS Watershed No.: 170702030205, 170702030203, 170702030202, 170702030201, 170702030106
Stream Class at Mouth: I
Distance Surveyed: 20.6 miles (mainstem channel)
Stream Length: 75 miles (approximate)
Surveyors: Christine Maxwell, Matthew Nightengale and Tara Thomas

SUMMARY

The Middle Fork John Day River runs approximately 75 miles from the headwaters at over 8,100 feet in elevation until it empties in to North Fork John Day River at an elevation just less than 2,200 feet. The section of river surveyed in July of 2008 was a mix of National Forest Land, Nature Conservancy Land (Dunstan Homestead Preserve), Forrest and Oxbow Property (Confederated Tribes of the Warm Springs) as well as private land. The survey began at the confluence with Camp Creek and was surveyed until approximately one mile upstream of where State Highway 7 crosses the river. The Middle Fork John Day River is home to spring Chinook salmon (*Oncorhynchus tshawytscha)*, summer steelhead (*Oncorhynchus mykiss),* resident redband trout (*Oncorhynchus mykiss)* and some bull trout (*Salvelinus confluentus)* populations. Having no dams or fish hatcheries the John Day River system is imperative and need be preserved for native fish migration, spawning and rearing. The John Day River is one of the longest free flowing rivers in the continental United States.

Numerous flows were taken on the section of river surveyed that ranged from 4.19 cubic feet per second to 47.26 cubic feet per second (ignoring an outlier). A flow was measured at the beginning of each reach, and a few additional ones were taken upstream of significant tributaries. Flows were measured with a Marsh McBirney Flowmate and sites were marked on the GPS.

This survey was not conducted continuously from reach one through twenty due to two sections being of higher priority than others. Habitat reach breaks were established at geomorphic reaches identified by Reclamation in the Middle Fork and Upper John Day River Tributary Assessments (May 2008). Additional habitat reach breaks were established within the geomorphic reaches when required. The survey crew used maps and changes in geomorphology to duplicate the reach breaks and there was a small deviation from those that the Reclamation determined. See Appendix G for survey maps. The Forrest Property section was conducted first followed by starting at the downstream end of the Oxbow Property (reach five) and continuing upstream to the bottom of the Forrest Property (reach eleven). Next, reaches one through four were completed and then reaches fifteen through twenty. The out of order reaches are the reason why the sequence order (SO) numbers are not continuous throughout the survey. Within reach eight there is a channel running parallel to the Middle Fork John Day River that appears to just be a tributary, but is contributed to by the mainstem river and is known as the south channel, while the main channel is known as the north channel. This section of channel was additionally surveyed. Furthermore, part of reach two that was on private property was not surveyed because permission was not granted from the land owner to do so.

This was a Level II survey conducted along the Pacific Northwest Stream Inventory Program protocol. Many parameters were added to the basic Level II protocol for this survey. Reach one is at the downstream end and reach twenty is at the uppermost end of the survey. Bank orientation in the data is all facing downstream, unless otherwise noted. GPS coordinates were saved for numerous points throughout the survey including the start and end of reaches, measured habitat units, pools greater then three feet deep, side channels, large pieces of wood and Wolman Pebble Counts. Some of the coordinates did not save properly and were therefore entered manually using other habitat units to approximate their location. The GPS points for the start of reach thirteen and reach fourteen were not saved and therefore were manually entered into the GIS layer as well as measured units at SO 3 and SO 4 within reach 12 (see Appendix G).

The Middle Fork John Day River stream survey runs through four sixth level hydrologic unit codes (HUC). Level one (i.e. 17) is the region level and level six (i.e. 05) is the subwatershed level. Starting at the downstream end, Camp Creek to just downstream of Ragged Creek is within the HUC 17,07,02,03,02,05. From there upstream to Vincent Creek the HUC is 17,07,02,03,02,02. Vincent Creek through Bridge Creek has a HUC of 17,07,02,03,02,01 and Bridge Creek through the end of the survey is within the 17,07,02,03,01,06 HUC boundary.

BASIN DESCRIPTION

Watershed and Flow Regime

General Characteristics

- **Location:** Surveyed section of Middle Fork John Day River is located due north of Prairie City, Oregon, and runs along County Highway 20.

- **Stream Order:** Strahler method (Handbook 2008)

    - Sixth order from the confluence with Camp Creek upstream to Big Boulder Creek.
    - Fifth order from Big Boulder Creek to Vinegar Creek.
    - Fourth order from Vinegar Creek through the end of the survey (reach twenty).

- **Flow:** Many discharge measurements were taken throughout the surveyed area with a Marsh McBirney flow meter. The accuracy of the Marsh McBirney Flo-Mate Model 2000 is ± 2% of the reading (Marsh-McBirney 1990).

Table 1.1. Discharge locations, readings, dates and times.

Location – at start of reach unless otherwise noted	**Ft^3/Second**	**Date**	**Time**
Reach 1	35.20	07/30/2008	0757
Reach 2	40.25	07/30/2008	0839
Reach 3	47.26	07/30/2008	0913
Reach 4	47.18	07/30/2008	0945
Reach 5	34.85	07/30/2008	1022
Reach 5 – upstream of confluence w/ Sunshine Creek	68.97	07/10/2008	1521
Reach 6	31.64	07/30/2008	1048
Reach 7	31.12	07/30/2008	1325
Reach 8 – north channel	28.81	07/30/2008	1404
Reach 9	22.78	07/30/2008	1434
Reach 10	25.77	07/30/2008	1450
Reach 11	21.21	07/30/2008	1513
Reach 12	22.06	07/24/2008	1335
Reach 12 – upstream of confluence w/ Deerhorn Creek	36.65	07/07/2008	1450
Reach 13	21.62	07/24/2008	1305
Reach 13 – upstream of confluence w/ Vincent Creek	36.11	07/07/2008	1415
Reach 13 – upstream of confluence w/ Vinegar Creek	29.44	07/07/2008	1200
Reach 14	14.90	07/24/2008	1211
Reach 14 – upstream of confluence w/ Davis Creek	25.93	07/07/2008	1324
Reach 14 – upstream of confluence w/ Bridge Creek	20.78	07/07/2008	1130
Reach 15	13.02	07/24/2008	1100
Reach 16	5.84	07/30/2008	1549

Reach 17	5.17	07/30/2008	1611
Reach 18	5.31	07/30/2008	1642
Reach 19	4.39	07/30/2008	1620
Reach 20	4.19	07/30/2008	1541

- **Note:** The discharge for reach 5 above Sunshine Creek is an outlier and it is unknown why the total discharge is so high.
- There was active restoration being done on Granite Boulder Creek during part of the survey in which they were holding back water that could have affected some of the discharge readings.

- **Elevation and General Gradient:** The survey began at 3,448 feet in elevation and ended at 4,173 feet, making the gradient for the entire survey 0.7%.

- **Sinuosity:** The sinuosity for the length of the survey was 1.06.

  - Elevation, gradient and sinuosity were all determined using Maptech® Pro computer program features.

<u>Interim Riparian Management Objectives</u>

- Interim Riparian Management Objective (RMOs) applies to all watershed with anadromous fish bearing stream. For general habitat conditions to be considered good for anadromous fish the following objectives must be met or exceeded (USDA 1995).

Table 1.2. Summary of interim riparian management objectives (RMOs) (USDA 1995).

Habitat Feature	**Interim Objectives**								
Pool Frequency (kf) (all systems)	Varies by channel width, see below.								
Wetted Width in Feet	10	20	25	50	75	100	125	150	200
Number of Pools Per Mile	96	56	47	26	23	18	14	12	9
Water Temperature (sf) (all systems)	Compliance with state water quality standards, or maximum <68ºF/20ºC								
Large Woody Debris (sf) (forested systems)	East of Cascade Crest in Oregon, Washington and Idaho. >20 pieces per mile; >12 inch diameter; >35 foot length.								
Bank Stability (sf) (non-forested systems)	>80 percent stable								
Lower Bank Angle (sf) (non-forested systems)	>75 percent of banks with <90 degree angle (i.e. undercut)								
Width/Depth Ratio (sf) (all systems)	<10; mean wetted width divided by mean depth								

kf = key feature sf = supporting feature

Reach Summaries

- **Definition of Stream Classification:** The Blue Mountain Stream Survey Program (Wallowa-Whitman, Malheur and Umatilla National Forests) uses the three-class system.
    - o **Classification I =** municipal watershed and/or fish-bearing stream (perennial or intermittent).
    - o **Classification III =** non fish-bearing, perennial streams
    - o **Classification IV** = non fish-bearing, intermittent streams

- All of the reaches in the Middle Fork John Day River stream survey were of stream class I.

Tributaries

- **Access to Fish out of the Mainstem:** Forty six tributaries entered Middle Fork John Day River throughout the survey, but not all provide access to fish.

Table 1.3. Tributaries encountered on Middle Fork John Day River.

Tributary Name/ Number	Reach	SO	% Flow Contribu-tion*	Tributary Temperature ºC**	Downstream Bank Orientation	% Gradient At Mouth+
1 – Camp Creek	1	2	15	14	LB	6
2 – Cress Creek	1	10	1	16	RB	10
3 – Coyote Creek	2	41	1	16	RB	6
4 – Big Boulder Creek	4	95	30	20	RB	6
1 - Sunshine Creek	5	12	5	15	LB	6
2	6	36	1	20	RB	10
3 – Rugged Creek	6	46	1	18	LB	5
4	7	61	1	15	RB	5
5 – Beaver Creek	7	69	5	15	RB	6
6	7	72	5	15	RB	5
7	7	76	1	16	LB	5
8	8	80	1	18	LB	5
9 - Ruby Creek	8	82	10	20	LB	6
10	8	95	10	21	LB	5
11	8	98	1	20	LB	6
12	8	111	25	21	LB	5
13 – Granite Boulder Cr.	8	123	45	17	RB	5
14 – Butte Creek	8	137	1	17	LB	6
15 – Windlass Creek	10	204	1	19	RB	5
16	10	243	1	12	LB	10
17	10	247	10	14	LB	5
18	11	258	5	16	LB	6
19 - Murdock Creek	11	293	1	16	RB	6

20 – Little Boulder Creek	11	304	10	15	RB	7
21 – Deerhorn Creek	11	316	10	17	LB	5
1	13	109	5	24	LB	5
2 – Vincent Creek (split entrance)	13	118	5	19	LB	5
3 – Vincent Creek (split entrance)	13	120	10	21	RB	5
4	13	123	5	21	LB	6
5 – Vinegar Creek	13	151	30	20	RB	7
6 – Davis Creek	14	174	10	12	LB	10
7	14	190	1	19	RB	10
8	14	192	1	19	RB	10
9	14	196	5	19	RB	5
10 – Bridge Creek	14	203	30	21	LB	6
1	15	13	1	15	LB	5
2	15	14	1	17	LB	7
3 – Clear Creek	16	17	50	20	LB	6
4	16	20	5	20	LB	7
5	16	30	1	20	LB	5
6	16	42	1	20	LB	5
7	16	51	1	20	LB	5
8	16	54	2	20	LB	5
9	17	86	2	24	RB	5
10 – Mill Creek	17	89	1	16	LB	6
11	17	90	1	14	RB	5

* = percent flow contribution is an estimate of the tributaries contribution to the Middle Fork John Day River
** = temperature was measured with a handheld thermometer
$^{+}$ = gradient was measured with a clinometer

- No discharge was taken on reach 8 – south channel.

<u>Special Cases</u>

- Two culverts were encountered throughout the survey.

Table 1.4. Special case units on Middle Fork John Day River.

Reach #	Sequence Order #	Channel Unit Type	Type of Struc-ture	Length of Structure (ft)	Diameter (ft)	% Gradient	Jump Distance	Spill Pool Depth	Height (ft)
15	6	ARTIF	Open arch	83	17	2	0	0	11
19	129	ARTIF	Open arch	100	18	4	0	0	10

- There were no baffles present in the two culverts (they had open bottoms) and they were not migration barriers.

IN-CHANNEL HABITAT

Temperature

- The temperature was taken at the start of every day and at every measured unit. Temperature readings were taken with a handheld thermometer and were submerged for at least one minute to ensure an accurate reading.

- The range of temperatures recorded throughout the Middle Fork John Day River survey was from 13ºC to 24ºC.

Table 1.4. Average and maximum temperature readings by reach.

Reach	Average Temp ºC	Maximum Temp ºC	Date(s) Surveyed	Time Range Readings Collected In	Number of Readings
1	15.5	16.0	07/22/2008	0803-1004	6
2	16.0	16.0	07/22/2008	1248-1400	2
3	14.5	18.0	07/22/2008 – 07/23/2008	0809-1513	3
4	16.2	21.0	07/23/2008 – 07/24/2008	0925-1609	4
5	17.0	19.0	07/14/2008	1047-1400	3
6	20.0	20.0	07/14/2008	1534-1548	2
7	15.7	16.0	07/15/2008	1011-1038	2
8 – North	19.3	20.0	07/15/2008	1253-1530	4
8 – South	19.0	20.0	07/23/2008	1148-1440	5
9	16.7	17.0	07/16/2008	0900-1322	6
10	16.0	21.0	07/16/2008 – 07/17/2008	0851-1037	3
11	16.8	17.0	07/17/2008 – 07/18/2008	1135-1524	5
12	14.1	16.0	07/08/2008	0730-1051	7
13	19.2	24.0	07/08/2008 – 07/09/2008	1242-1633	13
14	16.0	19.0	07/10/2008	0840-1230	4
15	17.0	18.0	07/24/2008	1127-1238	3
16	18.0	20.0	07/24/2008 – 07/25/2008	1020-1234	9
17	20.7	21.0	07/25/2008	1342-1413	3
18	21.0	21.0	07/25/2008	1436-1528	4
19	22.0	22.0	07/25/2008	1608-1614	2
20	23.0	23.0	07/25/2008	1710-1758	4

- From reach one through Clear Creek (reach fifteen) the Middle Fork John Day River has a designated fish use of core coldwater habitat by the State of Oregon Department of Environmental Quality (Sturdevant 2008). This means that the water is expected to maintain temperatures usually considered optimal for salmon and steelhead rearing, or that are suitable for bull trout migration. Temperature are optimally not supposed to exceed 16.0ºC in this habitat, but in this survey the maximum temperature reached at least 16ºC for reaches one through fifteen, and in most circumstances exceeded that value (see Table 1.4).

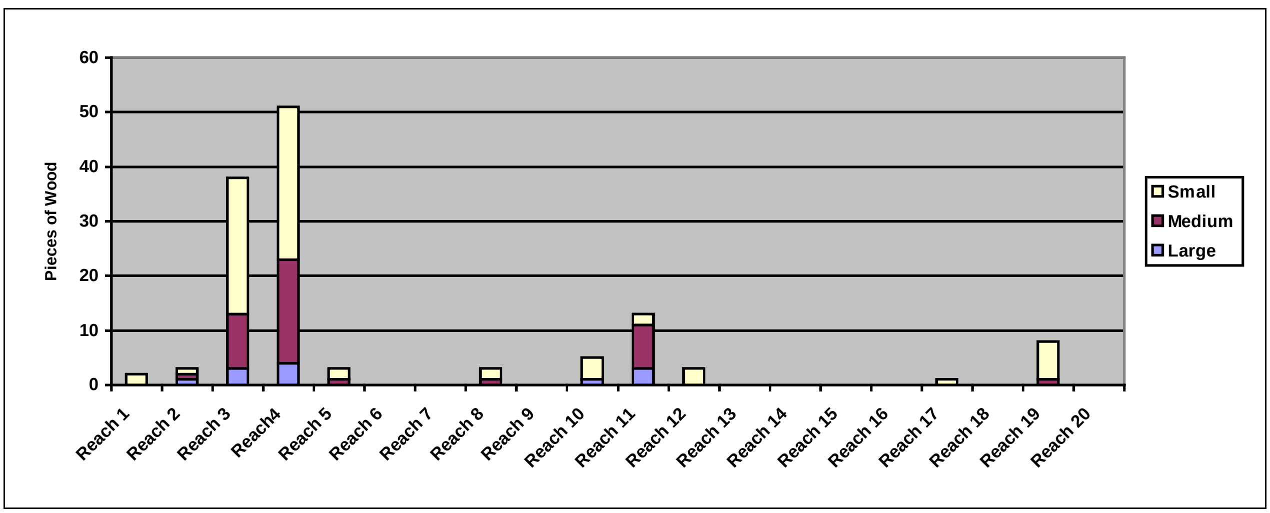
- Clear Creek through the end of the survey is designated by the state water quality standards as bull trout spawning and juvenile rearing, which has optimal temperatures below 12ºC (Sturdevant 2008). Reaches sixteen through twenty exceeded this parameter (see Table 1.4).

<u>Woody Debris</u>

- Woody debris size categories for the east side of the Cascade Mountains can be found in the table below.

Table 1.5. Definitions of woody debris size categories (Handbook 2008).

Size	Diameter	Length
Small	>6 inches at 20 feet from large end	>20 feet or 2X bankfull width
Medium	>12 inches at 35 feet from large end	>35 feet or 2X bankfull width
Large	>20 inches at 35 feet from large end	>35 feet or 2X bankfull width



Graph 1.1. Wood distribution by reach.

- The wood found in Middle Fork John Day River did not meet the criteria for the RMO's. To meet the RMO's for wood there needed to be greater then twenty pieces of medium and large sized wood combined per mile of stream. See Wood Summary in Chapter 2.

- Of the countable wood found throughout this survey, 59% of the wood was small sized, 32% was medium and 9% was large.

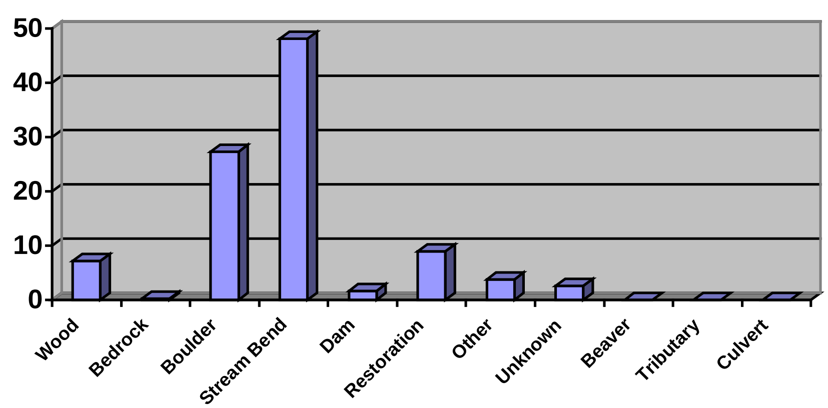
Pools

- A pool, or slow water unit, is defined as a portion of the stream that usually has reduced surface turbulence and has an average depth greater than fast water units when observed during low flow conditions. There is always a hydraulic control on the downstream end of a pool, better known as the pool tail crest. This hydraulic control functions as a dam which will retain water in the pool even after streamflow has ceased (Handbook 2008).

- **Pool Quality:** The average residual pool depth, which is the difference between the maximum pool depth and the maximum depth along the pool tail crest, for this survey was 1.72 feet. This is the depth of water that would be persisting if water stopped flowing out of the pool.

- **Pool Forming Forces:** For each pool the major pool forming forces were noted, oftentimes with more then one factor playing a part (Graph 1.2).

- The pool per mile criteria varies by channel width, but the RMOs were not met for pool frequency. See Table 1.2 and the Pool Summary in Chapter 2.



Graph 1.2. Average percent total of pool formation factors for survey.

Pebble Counts

- For each reach two Wolman Pebble Counts were performed, the first being approximately 1/3 and a second 2/3 of the way through each reach. The site chosen should be fast water and representative of what is perceived to be normal conditions for fast water units already observed.

- The procedure for performing a pebble count is that you randomly select at least one hundred pebbles (without bias) from the streambed along a transect that traverses the stream from the edge of the bankfull channel on one bank to that on the opposite bank. The first particle touched is measured and tallied for each sample. (Handbook 2008)

- The D16, D50 and D84 were determined for each reach. At bankfull flow particles smaller then the D50 (50^{th} percentile) will be mobile. Substrate larger then the D84 (84^{th} percentile) are considered immobile during bankfull flow (Handbook 2008). See Appendix 1A for these values.

- Graphs representing each reach's pebble counts can be found in Appendix 1A.

- Some of the coordinates did not save properly on the GPS and we therefore had to insert them into the GIS layer manually based on their proximity to other habitats with GPS coordinates. Those that did not save accurately were:
    - Reach 6 – wolman #1
    - Reach 8 (North Channel) – wolman #2
    - Reach 9 – wolman #2
    - Reach 12 – wolman #1
    - Reach 14 – wolman #1
    - Reach 19 – wolman #2 (the sequence order number was not noted for this particular pebble count, therefore there is no reference to plot it's approximate location)

<u>Percent Substrate Composition</u>

- The percent substrate composition is a visual estimate of the make up of the substrate on measured units of the wetted channel. Size class categories are: sand (<2 mm), gravel (2-64 mm), cobble (64-256 mm) boulder (256-4096 mm) and bedrock (>4096 mm). All estimates were rounded to 10 percent and the streambed substrate is to total 100 percent for each unit (Handbook 2008).

Table 1.6. Average percent substrate composition per reach.

Reach	**Sand** <2 mm	**Gravel** 2-64 mm	**Cobble** 64-256 mm	**Boulder** 256-4096 mm	**Bedrock** >4096 mm
1	18.3	35	37.5	9.2	0
2	20	35	35	10	0
3	20	43.3	30	6.7	0
4	16.7	40	33.3	10	0

5	10	28	44.7	17.3	0
6	12.5	35	42.5	10	0
7	10	25	45	20	0
8 – North	16.7	20	33.3	30	0
8 – South	24	37	34	5	0
9	11.7	38.3	41.5	8.5	0
10	11.25	36.25	35	17.5	0
11	16	30	31.6	22.4	0
12	14.2	44.2	40	1.7	0
13	13.1	37.8	44.9	4.2	0
14	11.25	46.25	40	2.5	0
15	16.7	23.3	33.3	26.7	0
16	26.7	58.9	14.3	0.1	0
17	13.3	50	30	6.7	0
18	10	37.5	49.75	10.25	0
19	10	40	32.5	17.5	0
20	17.5	63.75	18.25	0.5	0

Special Habitats

- **Side Channels:** A side channel is a secondary channel that flows roughly parallel to the mainstem channel with an island that will not be breached during bankfull condition between the two. Oftentimes woody plants and/or a well developed soil layer and vegetation are in indicator that an island is stable (Handbook 2008).

- Side channels comprised 7.4% of the total habitat units in Middle Fork John Day River stream survey. See the Percent Area Habitat Summary in Chapter 2 for more detailed information by reach.

RIPARIAN HABITATS

Riparian Vegetation

- The riparian vegetation was noted on measured habitat units for the inner riparian zone only (100 feet on both banks). The class is broken down by diameter at breast height (dbh) and the classes are as follows (Handbook 2008):
    - NV = No Vegatation (bare rock/soil, dbh not applicable)
    - GF = Grassland/Forb Condition (dbh not applicable)
    - SS = Shrub/Seedling Condition (1.0 – 4.9 in. dbh)
    - SP = Sapling/Pole Condition (5.0 – 8.9 in. dbh)
    - ST = Small Trees Condition (9.0 – 20.9 in. dbh)
    - LT = Large Trees Condition (21 – 31.9 in. dbh)

- MT = Mature Trees Condition (>32 in. dbh)

- The overstory vegetation is defined by the species that from an overhead view occupies the most overstory area along both banks. It is an average of both banks' condition.

- The understory is denoted by which species are growing in this lower vegetative layer. It too is an average of both banks' condition.

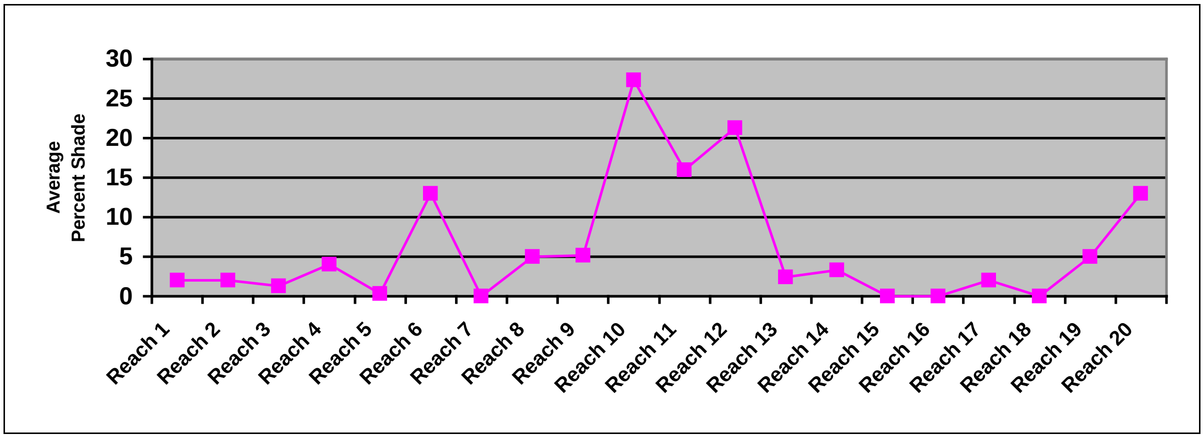
Table 1.7. Riparian vegetation classes and species observed.

Reach	Riparian Class	Overstory	Understory
1	▪ shrub/seedling ▪ grassland/forbs	▪ willow (*Salix s.)* ▪ hawthorn (*Crataegus sp.)* ▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ cottonwood (*Poplus sp.)* ▪ hawthorn (*Crataegus sp.)* ▪ willow (*Salix sp.)* ▪ grassland/forbs
2	▪ grassland/forbs	▪ grassland/forbs	▪ cottonwood (*Poplus sp.)* ▪ lodgepole pine (*Pinus contorta)*
3	▪ grassland/forbs ▪ shrub/seedling	▪ hawthorn (*Crataegus sp.)* ▪ grassland/forbs	▪ cottonwood (*Poplus sp.)* ▪ lodgepole pine (*Pinus contorta)*
4	▪ small tree ▪ grassland/forbs	▪ lodgepole pine (*Pinus contorta)* ▪ grassland/forbs ▪ ponderosa pine (*Pinus ponderosa)*	▪ alder (*Alnus sp.)*
5	▪ shrub/seedling ▪ grassland/forbs	▪ alder (*Alnus sp.)* ▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ alder (*Alnus sp.)*
6	▪ small tree	▪ lodgepole pine (*Pinus contorta)* ▪ ponderosa pine (*Pinus ponderosa)*	▪ hawthorn (*Crataegus sp.)*
7	▪ grassland/forbs	▪ grassland/forbs	▪ alder (*Alnus sp.)*
8 – North	▪ grassland/forbs	▪ grassland/forbs	▪ alder (*Alnus sp.)*
8 – South	▪ grassland/forbs	▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs ▪ alder (*Alnus sp.)*
9	▪ grassland/forbs ▪ shrub/seedling	▪ grassland/forbs ▪ alder (*Alnus sp.)*	▪ alder (*Alnus sp.)* ▪ grassland/forbs ▪ lodgepole pine (*Pinus*

			contorta)
10	▪ small tree ▪ shrub/seedling	▪ lodgepole pine (*Pinus contorta)* ▪ alder (*Alnus sp.)* ▪ Englemann spruce (*Picea engelmannii)*	▪ alder (*Alnus sp.)* ▪ ponderosa pine (*Pinus ponderosa)*
11	▪ small tree ▪ shrub/seedling	▪ lodgepole pine (*Pinus contorta)* ▪ alder (*Alnus sp.)*	▪ alder (*Alnus sp.)* ▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs
12	▪ grassland/forbs ▪ shrub/seedling	▪ grassland/forbs ▪ ponderosa pine (*Pinus ponderosa)*	▪ grassland/forbs ▪ alder (*Alnus sp.)* ▪ ponderosa pine (*Pinus ponderosa)* ▪ lodgepole pine (*Pinus contorta)*
13	▪ grassland/forbs	▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs ▪ alder (*Alnus sp.)* ▪ sagebrush (*Artesmisia sp.)*
14	▪ grassland/forbs	▪ grassland/forbs	▪ alder (*Alnus sp.)* ▪ grassland/forbs
15	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs
16	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs ▪ ponderosa pine (*Pinus ponderosa)*
17	▪ small tree ▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs	▪ alder (*Alnus sp.)* ▪ grassland/forbs
18	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs
19	▪ small tree	▪ ponderosa pine (*Pinus ponderosa)*	▪ alder (*Alnus sp.)*
20	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs ▪ alder (*Alnus sp.)*

<u>Solar Radiation</u>

- Solar radiation was taken at every measured unit with a solar pathfinder to determine the percent of shade and was normalized for the latitude in which it was used and the month of July. The surveyor stood in the middle of the channel while assessing the shade.



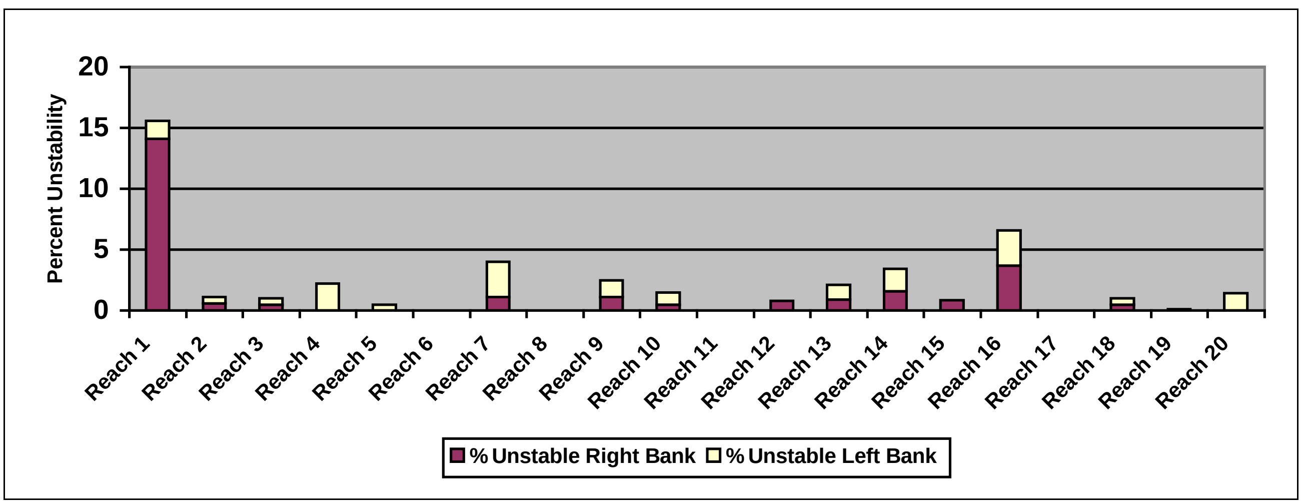
Graph 1.3. Average percent solar radiation for each reach.

MANAGEMENT ACTIVITIES / IMPACTS

<u>Bank Stability</u>

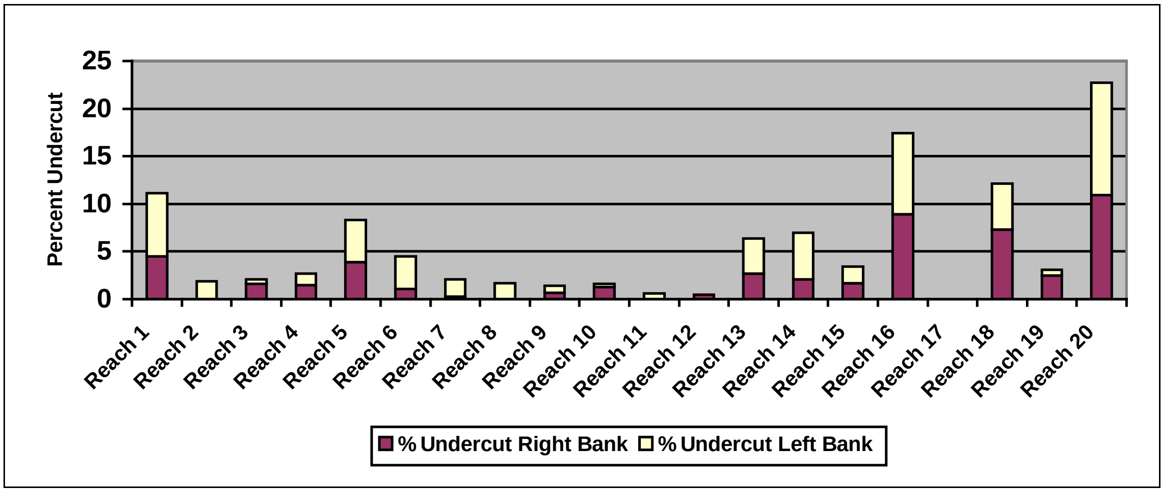
- The banks on Middle Fork John Day met the RMOs for bank stability, being more then 80% stable (Graph 1.4).

- For more detailed information by reach see the Unstable and Undercut Bank Summary in Chapter 2.



Graph 1.4. Percent of unstable banks observed by reach.

- The RMOs were met for undercut banks (lower bank angle) being greater then 75% stable (Graph 1.5).



Graph 1.5. Percent of undercut banks found on Middle Fork John Day River.

Roads

- County Highway 20 runs along Middle Fork John Day River for the first 16 reaches of the survey, then it crosses the river and State Highway 7 runs close by partway through reach 19. Highway 7 crosses the river and it is followed by a private road for the remainder of the survey.

- There were very few road crossings that had culverts rather then bridges, but those culverts were located in reach 15 at SO 6 and in reach 19 at SO 129. They were both open arch culverts.

Mining

- Historically parts of the Middle Fork John Day River were dredged for gold. This dredging in the 1940's straightened the channel and has prohibited the river from reaching the floodplain at high flows, in turn increasing sediment transport capacity and the water velocity (Reclamation 2008).

Stream Enhancement Projects

- Stream restoration projects have been and are in the process of being completed on this section of the Middle Fork John Day River. Restoration has been done on The Nature Conservancy land and on land owned by the Confederated Tribes of the Warm Springs (Oxbow Property and Forrest Property). These projects are done to enhance fish habitat as well as restore typical channel processes to the river. Changes in land use and roads have impacted the river (Reclamation 2008).

- The Dunstan Homestead Preserve (The Nature Conservancy land), near Boulder Creek Ranch, improved 2.5 miles of the river in the summer of 2007.

Log structures were installed, vegetation was planted and rock barbs were removed from the river. (The Nature Conservancy 2007)

<u>Grazing</u>

- Grazing was present on portions of the survey. Within the Oxbow and Forrest Properties there were cattle access points to the river for water, but for the most part they were kept out of the river and off the banks. Unrestricted grazing occurs in other reaches of this survey and cattle have free access to the river (Reclamation 2008).

CHAPTER 2: STREAM SURVEY SUMMARY REPORTS

Hydrology Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030205, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 7/08/2008-7/28/2008

Reach	Valley Form	Mapped Gradient	Mapped Sinuosity	Average Bankfull Width/Depth Ratio	Average Entrench-ment Ratio	Rosgen Stream Class	Remarks
1	6	0.9	1.3	26.9	2.3	C	Survey began at the confluence with Camp Creek and reach 1 ended at the private property boundary.
2	5	1.0	1.2	12.0	1.3	C	Reach broken because channel became more confined; ended at a tributary on the right bank.
3	5	0.3	1.0	28.3	4.5	C	Reach ended due to channel becoming more confined.
4	6	0.7	1.2	38.1	1.3	F	Reach ended due to channel becoming less confined.
5	7	0.5	1.1	41.3	2.5	C	Reach 5 ended due to channel becoming more confined. Lower portion of reach is on National Forest Property and upper end is on Oxbow property.
6	7	0.7	1.1	56.9	1.3	F	Reach 6 ended due to channel becoming less confined and also ended at Rugged Creek confluence. Reach is entirely within Oxbow Property boundary.
7	7	0.4	1.2	21.3	3.8	C	Reach ends at a tributary on the left bank and entire reach is within Oxbow Property.
8 - North	8	0.6	1.1	12.4	20.0	C	Reach is entirely within Oxbow Property.
9	6	0.5	1.2	14.2	2.6	C	Reach 9 was broken due to the channel becoming more confined. The bottom portion of the reach is in Oxbow Property and the upper portion is on National Forest Property.
10	6	0.6	1.1	22.4	2.0	F	Reach was broken due to the channel becoming even more confined.
11	5	1.2	1.1	18.0	2.3	C	Reach 11 was broken due to channel becoming less confined and also ends at the confluence with Deerhorn Creek.
12	6	0.7	1.1	20.0	4.8	C	Reach 12 was broken because the channel became unconfined; the upper end of the reach is in Forrest Property boundary
13	9	0.5	1.1	21.0	2.2	C	Reach entirely w/ in Forrest Property boudary and is broken where the channel becomes moderately confined.
14	8	0.4	1.1	12.0	8.0	C	Bottom portion of reach in Forrest Property boundary
15	7	0.7	1.0	13.0	1.7	F	Reach 15 broken due to the channel becoming less confined.
16	8	0.7	1.2	15.8	6.4	C	Reach broke due to channel becoming more confined, at confluence w/ Clear Creek
17	7	0.8	1.1	8.4	27.7	C	Valley floor opens up where reach ends.
18	9	1.0	1.1	12.9	16.8	C	Reach ended at a fence just short of where the trees starts to appear and channel becomes more confined
19	7	1.5	1.1	0.0	0.0	C	Reach ends where the valley floor opens up.
20	7	0.5	1.1	12.4	3.8	C	Survey ended at the upstream end of private property.
Average		**0.7**	**1.1**	**20.4**	**5.8**		
8 - South	8	0.5	1.3	15.6	2.6	C	This is a side channel that runs parallel to reach 8 for just less then 1 mile. It was surveyed from where it entered M. Fk. John Day River to where it exited the river.

Hydrology Summary (continued)

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 07/08/2008-07/28/2008

Reach	Surveyed Length in Feet	Side Channel Length in Feet	Mapped Channel Length in Feet	Mapped Minimum Elevation in Feet	Mapped Maximum Elevation in Feet	Stream Order	Discharge Cubic Feet per Second	Average Corrected Wetted Width	Average Bankfull Depth in Feet	Average Bankfull Max Depth in Feet	Average Bankfull Width in feet	Average Floodprone Width in Feet	Mapped Valley Width in Feet	Mapped Valley Length in Feet
1	2,734	400	1,272	3,448	3,460	6	35.20	39.2	1.18	2.25	60.5	140	1,007	988
2	6,251	130	5,560	3,503	3,559	6	40.25	33.8	2.63	3.00	36.0	46	974	4,764
3	7,323	160	8,057	3,559	3,586	6	47.26	35.8	1.58	1.75	49.5	225	393	7,867
4	6,910	300	7,054	3,586	3,631	6	47.18	41.5	1.43	1.60	61.0	81	489	5,982
5	5,905	720	5,914	3,631	3,663	5	34.85	41.3	1.25	1.35	55.8	142	414	5,280
6	2,377	130	2,277	3,663	3,678	5	31.64	44.2	1.17	1.30	74.0	94	288	2,106
7	3,068	325	3,405	3,678	3,693	5	31.12	33.4	1.53	2.00	42.5	160	843	2,731
8 - North	9,308	419	8,976	3,693	3,749	5	28.81	21.6	1.87	2.10	26.0	521	827	8,448
9	5,747	100	5,182	3,749	3,774	5	22.78	24.1	1.39	2.20	31.3	83	551	4,488
10	8,758	240	8,488	3,774	3,825	5	25.77	28.5	1.50	1.73	38.7	76	396	7,920
11	9,244	1,730	8,606	3,825	3,931	5	21.21	28.6	1.56	2.13	38.3	89	276	7,920
12	5,514	0	4,907	3,931	3,965	5	22.09	26.9	1.73	1.90	38.0	183	505	4,346
13	15,297	900	14,256	3,965	4,034	5	21.62	22.9	1.27	1.70	35.7	80	941	12,672
14	6,561	96	6,019	4,034	4,058	4	14.90	20.7	1.43	1.75	21.0	168	359	5,650
15	1,756	0	1,646	4,058	4,069	4	13.02	17.8	1.83	2.15	28.0	48	683	1,577
16	4,368	180	4,120	4,069	4,096	4	5.84	14.4	1.21	1.48	23.3	149	835	3,593
17	1,630	40	1,357	4,096	4,107	4	5.17	14.4	1.70	1.80	15.0	415	431	1,263
18	1,840	200	1,972	4,107	4,127	4	5.31	12.7	1.28	1.40	18.0	303	973	1,785
19	2,591	427	2,587	4,127	4,166	4	4.39	14.4	0.00	0.00	0.0	0	309	2,405
20	1,748	100	1,370	4,166	4,173	4	4.19	10.9	1.33	1.65	20.5	78	330	1,260
Total / Average	**108,930**	**6,597**	**103,025**				**23.13**	**26.4**	**1.44**	**1.76**	**35.7**	**154**	**591.2**	**93,045**
8 - South	5,926	550	4,858	3,691	3,713	5		16.70	1.22	1.35	21.0	54	817	3,852

Percent Habitat Area Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 07/08/2008-07/28/2008

Reach	% Slow Water	Number of Slow Water Units	% Fast Water	Number of Fast Water Units	Fast Water/Slow Water Ratio	% Side Channel	Number of Side Channel Units	% Special Habitat	Number of Special Habitats	% Tributary	Number of Tributaries
1	40.0	6	40.0	6	1.00	6.7	1	0.0	0	13.3	2
2	38.5	10	53.8	14	1.40	3.8	1	0.0	0	3.8	1
3	46.2	18	48.7	19	1.06	5.1	2	0.0	0	0.0	0
4	40.6	13	50.0	16	1.23	6.3	2	0.0	0	3.1	1
5	30.0	9	60.0	18	2.00	6.7	2	0.0	0	3.3	1
6	18.8	3	56.2	9	3.00	12.5	2	0.0	0	12.5	2
7	43.3	13	3.0	9	0.69	13.3	4	0.0	0	13.3	4
8 -North	34.8	23	43.9	29	1.26	10.6	7	0.0	0	10.6	7
9	45.1	23	52.9	27	1.17	2.0	1	0.0	0	0.0	0
10	31.0	18	58.6	34	1.89	5.2	3	0.0	0	5.2	3
11	29.2	19	43.1	28	1.47	21.5	14	0.0	0	6.2	4
12	48.5	16	51.5	17	1.06	0.0	0	0.0	0	0.0	0
13	52.3	68	40.0	52	0.76	3.8	5	0.0	0	3.8	5
14	38.1	16	47.6	20	1.25	2.4	1	0.0	0	11.9	5
15	33.3	5	46.7	7	1.40	0.0	0	6.7	1	13.3	2
16	48.2	26	37.0	20	0.77	3.7	2	0.0	0	11.1	6
17	52.9	9	35.3	6	0.67	5.9	1	0.0	0	5.9	1
18	39.1	9	43.5	10	1.11	8.7	2	0.0	0	8.7	2
19	32.1	9	35.7	10	1.11	28.6	8	3.6	1	0.0	0
20	54.5	12	40.9	9	0.75	4.5	1	0.0	0	0.0	0
Total / Average	**39.8**	**325**	**44.4**	**360**		**7.6**	**59**	**0.5**	**2**	**6.3**	**46**
8 - South	48	33	35	24	0.75	16	11	0	0	1	1

Slow water (pool) = A habitat unit with a hydraulic control, usually with reduced surface turbulence and has an average depth greater than riffles when viewed during low flow conditions.

Fast Water = A habitat unit without a hydraulic control, usually with relatively fast velocity and usually relatively shallow.

Side Channel = A lateral (i.e., secondary) channel with an axis of flow roughly parallel to the mainstem channel. This secondary channel transports water from an upstream confluence with the mainstem channel to a downstream confluence with the mainstem channel.

Special Habitats = A category for other habitats, waterfalls, chutes, culverts, marshes, braids, dry sections, man-made dams and structures.

Tributary = A secondary channel system that occupies a distinct drainage basin and has a unique headwater origin. The drainage basin of a tributary is a portion of the larger drainage basin of the mainstem channel.

Wood Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

Protocol Name: R6 Eastside AI

LLID: 1193015449167

Date: 07/08/2008-07/28/2008

			Number of Pieces of Wood per Mile				
Reach	Miles		Large	Medium	Small	Total	Frequency of Large Pieces of Wood*
1	0.52		0	0	3.8	3.8	0
2	1.18		0.9	0.9	0.9	2.5	0.03
3	1.39		2.2	7.2	18	27.3	0.08
4	1.31		3.1	14.5	21.4	38.9	0.02
5	1.12		0	0.9	1.8	2.7	0
6	0.45		0	0	0	0	0
7	0.58		0	0	0	0	0
8 - North	1.76		0	0.57	1.1	1.7	0
9	1.09		0.9	0	3.6	5	0.003
10	1.66		0	0	0	0	0
11	1.75		0.6	0	2.4	3	0.003
12	1.04		1.7	4.6	1.1	7.4	0.009
13	2.9		0	0	2.9	2.9	0
14	1.24		0	0	0	0	0
15	0.33		0	0	0	0	0
16	0.83		0	0	0	0	0
17	0.31		0	0	1	1	0
18	0.35		0	0	0	0	0
19	0.49		0	1	7	8	0
20	0.33		0	0	0	0	0
Total	**20.63**	**Average**	**9.4**	**29.7**	**65**	**104.2**	**0.00725**
8 - South	1.12		0.9	0	3.6	4.5	0.047

* Frequency of Wood = Number of Large Pieces of Wood/(Corrected Channel Length/Average Corrected Wetted Channel Width).

Pool Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

Protocol Name: R6 Eastside AI

LLID: 1193015449167

Date: 07/08/2008-07/28/2008

									Percentage of Pools Formed By										
Reach	Miles		Number of Pools	Number of Pools/Surveyed Mile of Stream	Frequency of Pools*	Number of Pools > 3 feet Deep/Surveyed Mile of Stream	Frequency of Pools > 3 Feet Deep *	Average Residual Pool Depth**	Beaver	Wood	Bedrock	Boulder	Stream Bend	Tributary	Culvert	Dam	Restoration	Other	Unknown
1	0.52		6	11.5	0.086	3.85	0.029	1.66				27	36				9	18	9
2	1.18		10	8.5	0.054	6.78	0.043	2.18				33	33				33		
3	1.39		18	12.9	0.088	3.6	0.024	1.61		24		27	18				30		
4	1.31		13	9.9	0.078	3.05	0.024	1.82		38		44	19						
5	1.12		9	8	0.063	0	0	1.36				36	55						9
6	0.45		3	6.7	0.056	2.2	0.019	1.73				25	75						
7	0.58		13	22.4	0.142	8.62	0.054	1.76		3		32	32				32		
8 - North	1.76		23	13.1	0.053	8.52	0.035	2.33		15		11	52			2		15	7
9	1.09		23	21.1	0.096	1.83	0.008	1.4		8		23	65					4	
10	1.66		18	10.8	0.059	0.6	0.003	1.24		5		32	58						5
11	1.75		19	10.9	0.059	2.29	0.012	1.17				76	5			14			5
12	1.04		16	15.4	0.078	2.88	0.015	1.77		5.5	5.5	28	39				22		
13	2.9		68	23.4	0.078	16.9	0.073	2.35				34	32			1	32	1	
14	1.24		16	12.9	0.05	0.81	0.003	1.65		3		27	36			9	21	3	
15	0.33		5	15.2	0.051	3.03	0.01	1.72				37.5	25					25	12.5
16	0.83		26	31.3	0.086	3.61	0.01	1.77					96						4
17	0.31		9	29	0.08	0	0	1.18		10		20	60					10	
18	0.35		9	25.7	0.062	0	0	1.04					100						
19	0.49		9	18.4	0.05	0	0	0.76		25		33	33			8			
20	0.33		12	36.4	0.075	0	0	1.11		8			92						
Total/ Average	**5**		**14.2**	**14.26**	**0.082**	**4.234**	**0.0232**	**1.716**	**0**	**13**	**5.5**	**32**	**48**	**0**	**0**	**6.8**	**26**	**11**	**7.4**
8 - South	1.12		33	29.5	0.093	11.6	0.037	0.037		7		2	70			2		2	16

* Frequency of Pools = Number of Pools/(Corrected Channel Length/Average Corrected Wetted Channel Width).

** Residual Pool Depth = Maximum Depth – Depth at Pools Tail Crest

Unstable and Undercut Bank Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 07/08/2008-07/28/2008

Reach		Miles	% Unstable Right Bank	% Unstable Left Bank	% Unstable Both Banks		% Undercut Right Bank	% Undercut Left Bank	% Undercut Both Banks
1		0.52	14.1	1.5	15.5		4.5	6.6	11.0
2		1.18	0.6	0.5	1.0		0.0	1.9	1.9
3		1.39	0.5	0.5	1.1		1.6	0.5	2.0
4		1.31	0.0	2.2	2.2		1.5	1.2	2.7
5		1.12	0.0	0.5	0.5		3.9	4.4	8.3
6		0.45	0.0	0.0	0.0		1.1	3.4	4.5
7		0.58	1.1	2.9	4.1		0.3	1.8	2.1
8 - North		1.76	0.0	0.0	0.0		0.0	1.7	1.7
9		1.09	1.1	1.4	2.5		0.7	0.7	1.4
10		1.66	0.5	1.0	1.5		1.3	0.3	1.7
11		1.75	0.0	0.0	0.0		0.0	0.6	0.6
12		1.04	0.8	0.0	0.8		0.5	0.0	0.5
13		2.90	0.9	1.2	2.1		2.7	3.7	6.4
14		1.24	1.6	1.8	3.0		2.1	4.9	7.0
15		0.33	0.9	0.0	0.9		1.7	1.7	3.4
16		0.83	3.7	2.9	6.5		8.9	8.5	17.4
17		0.31	0.0	0.0	0.0		0.0	0.0	0.0
18		0.35	0.5	0.5	1.1		7.3	4.8	12.1
19		0.49	0.1	0.0	0.1		2.5	0.6	3.1
20		0.33	0.0	1.4	1.4		10.9	11.8	22.7
Total/Average		**20.63**	**1.3**	**0.9**	**2.2**		**2.6**	**3.0**	**5.5**
8 - South		1.12	1.2	1.1	2.3		5.1	6.8	11.9

Count of Special Habitat Units

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

Protocol Name: R6 Eastside AI

LLID: 1193015449167

Date: 07/08/2008-07/28/2008

Reach	Number of Waterfalls	Maximum Height of Waterfalls	Number of Chutes	Number of Braids	Number of Marshes	Number of Dams	Number of Dry Channels	Total Length of Dry Channels	Number of Culverts
1	0		0	0	0	0	0	0	0
2	0		0	0	0	0	0	0	0
3	0		0	0	0	0	0	0	0
4	0		0	0	0	0	0	0	0
5	0		0	0	0	0	0	0	0
6	0		0	0	0	0	0	0	0
7	0		0	0	0	0	0	0	0
8 - North	0		0	0	0	0	0	0	0
9	0		0	0	0	0	0	0	0
10	0		0	0	0	0	0	0	0
11	0		0	0	0	0	0	0	0
12	0		0	0	0	0	0	0	0
13	0		0	0	0	0	0	0	0
14	0		0	0	0	0	0	0	0
15	0		0	0	0	0	0	0	1
16	0		0	0	0	0	0	0	0
17	0		0	0	0	0	0	0	0
18	0		0	0	0	0	0	0	0
19	0		0	0	0	0	0	0	1
20	0		0	0	0	0	0	0	0
Total	**0**		**0**	**0**	**0**	**0**	**0**	**0**	**2**
8 - South	0		0	2	0	0	0	0	0

CHAPTER 3: RIPARIAN VEGETATION CONDITION

SUMMARY

<u>Forrest Property-</u>

Riparian vegetation data on the Forrest Property was surveyed from July 28, 2008 to July 30, 2008. The survey was done at three representative vegetation reaches delineated by dominant species present and channel geomorphology features. Reach delineation is shown in Maps 2 in Appendix G. A total of 1.2 stream miles were surveyed.

Riparian vegetation structure composed of 3% understory shrub cover with no cover from big or small trees. The dominant woody riparian shrubs were *Salix eriocephala* and *Alnus incana.* The ground cover was composed of approximately 65% grass/forb cover. For detailed summary of the riparian vegetation structure by reach, see Riparian Vegetation Structure Section, Tables 3.4-3.11.

Riparian vegetation disturbance was assessed based on the human influences present and proximity to the channel. The dominant influences consisted of planting strips (40 locations), road (14 locations), and hardened riprap (13 locations). A detailed summary of the disturbance presence per reach and proximity to the channel are in the Riparian Vegetation Disturbance Section, Graph 3.6.

Riparian vegetation canopy cover was assessed through densitometer readings, characterization, and cover of big tree and small tree. Channel canopy cover was 0.03%, while left bank was 0% and right bank 0%.

<u>Oxbow Property-</u>

Riparian vegetation data on the Oxbow Property was surveyed from July 21, 2008 to July 23, 2008. The survey was done at three representative vegetation reaches delineated by dominant species present and channel geomorphology features. Reach delineation is shown in Maps 4 in Appendix G. A total of 1.3 stream miles were surveyed.

Riparian vegetation structure composed of 0-9% cover of deciduous big and small type trees, with approximately 5% understory shrub cover. The dominant woody riparian shrubs were *Salix exigua* and *Symphoricarpos spp.* The ground cover was composed of approximately 70% grass/forb cover. For detailed summary of the riparian vegetation structure by reach, see Riparian Vegetation Structure Section, Tables 3.12- 3.23.

Riparian vegetation disturbance was assessed based on the human influences present and proximity to the channel. The dominant influences consisted of planting strips (39 locations), mine tailings (20 locations), and fence (13 locations). A detailed summary of the disturbance presence per reach and proximity to the channel are in the Riparian Vegetation Disturbance Section, Tables 3.7.

Riparian vegetation canopy cover was assessed through densitometer readings, characterization, and cover of big tree and small tree. Channel canopy cover was 0.66%, while left bank was 1.79% and right bank 7.97%.

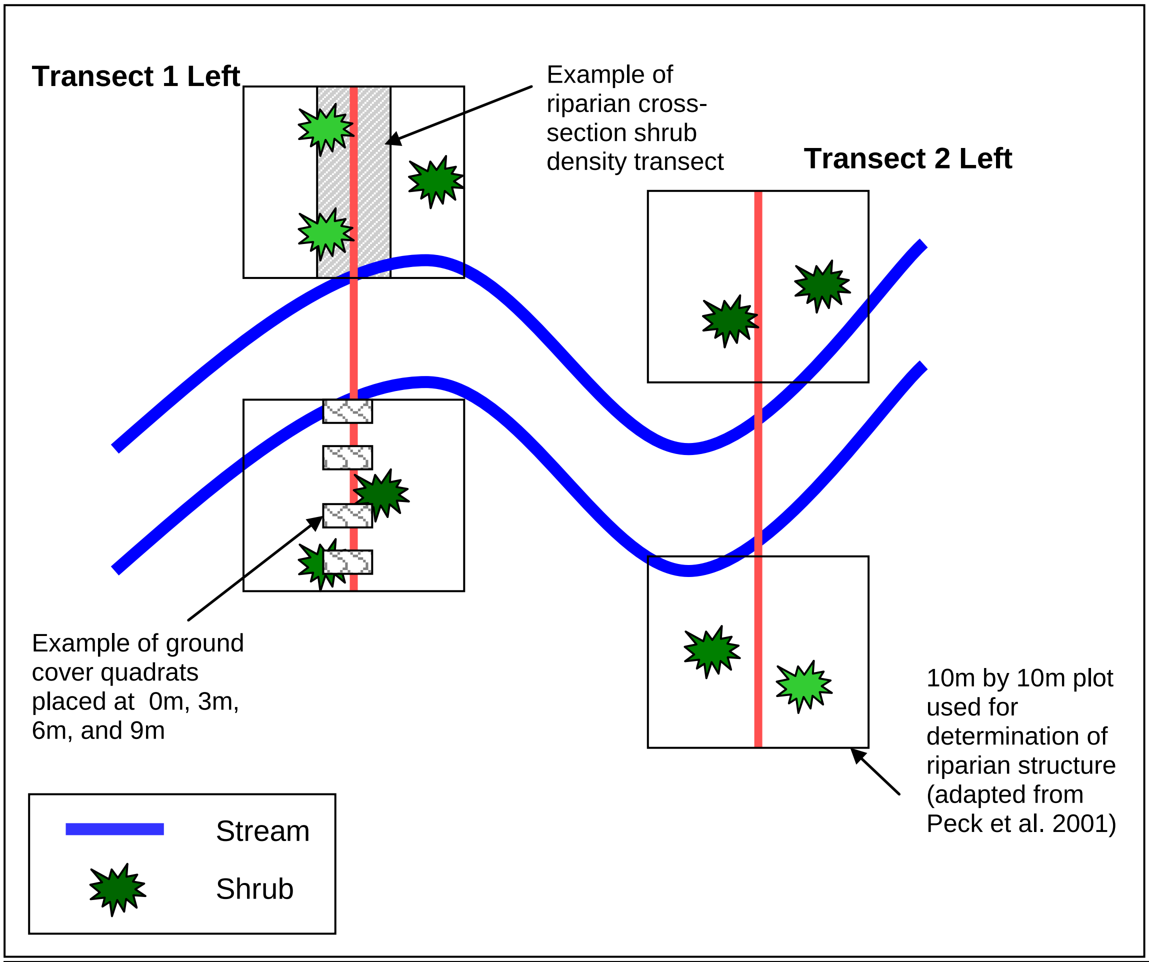
METHODS

Field Survey Design

Riparian condition data collection was completed over two consecutive weeks from July 21st to July 31st, 2008. Field sampling setup followed protocol described by Peck et al. (2001). Three riparian condition assessments were completed on each piece of the Forrest and Oxbow Properties. These assessments were considered a reach. The reach delineation was made based on changes in vegetative structure, geomorphology, and human impacts, such as mining or roads. (Geomorphic delineation was done by Reclamation 2008). Measurements of riparian condition were sampled along 11 channel transects (perpendicular to the direction of the valley bottom) placed 50 meters apart, resulting in 33 transects per stream property. Measurements were made on both left and right bank to reduce the variation caused by difference in fluvial surfaces. Left and right bank were determined facing downstream.

Each of the 33 channel transects was paired with vegetation cover transects, vegetation belt transects, and vegetation plots for the purpose of corresponding analysis. Vegetation cover transects stretched the length of water's edge to 10 meters on left and right bank. Measurements of understory cover were taken along each of the vegetation cover transects at 0, 3, 6, and 9 meters. The vegetation belt transect stretched from water's edge to 10 meters placed over the vegetation cover transect. Overstory shrub species density was sampled in the vegetation belt transects. Riparian vegetation structure, disturbance, and canopy cover outlined by Peck et al. (2001) were measured within a 10 meter by 10 meter plot placed over the vegetation and channel transect. Graph 3.1 displays the difference between the channel, vegetation cover, vegetation belt transects, and vegetation plots.

Forrest and Oxbow properties were planted in the spring of 2006 by a contractor for the Warm Springs Tribe with funding and oversight from the NRCS CREP program. These plantings were encountered within the vegetation survey. The planting mat and species were recorded as "planting mat" within the understory cover plots and shrub species were recorded within understory cover and density as a planted species. The CREP planting were considered a human influence and recorded as a vegetation disturbance.



Graph 3.1: Model of field sampling with two transects. Transects are depicted as lines stretching 10 meters each side of the stream.

<u>Riparian Vegetation Structure</u>

Canopy, Understory, and Ground Layers

Riparian structure was assessed following Peck et al. (2001) protocol. Type and amount of riparian vegetation at three layers: a canopy, an understory, and ground cover layer were measured at each vegetation plot. Vegetation type for each layer was recorded followed by an estimate of aerial cover. The cover classes are list in Table 3.1. Type of each riparian vegetation layer is listed in Table 3.2. Appendix F contains the codes and associated species name or vegetation type used for data entry and observation.

Table 3.1- Cover Classes (adapted from Daubenmire 1959)	
Class	**Percent Cover**
0	Absent
1	1-10%
2	10-25%
3	25-50%
4	50-75%
5	75-90%
6	90% >

Table 3.2- Riparian Vegetation Types
Canopy Layer
None
Mixed
Broadleaf Evergreen
Coniferous
Deciduous
Understory Layer
Woody Shrub and Sapling
Forbs, Grasses, Sedge, and Rush
Ground Cover Layer
Woody Shrub and Sapling
Forbs, Grasses, Sedge, and Rush
Bareground, Rock, and Barren

Woody Riparian Shrub Density

Woody riparian species density was measured within the 33, 3-meter belt transects, per stream property. Individual plants rooted within the belt transect were recorded by species with the exception of the clonal species *S. exigua* and *S. melanopis* where individual stems were recorded. It was characteristic of many of the species to form clumps, so an individual plant was counted based on the distance of separation between the plant bases. Plant base separations greater than 10 cm (approximant width of observer's hand) were considered a separate individual.

Species density was counted within the 10 meter length starting at water's edge. Species counts were divided by the area (30 m^2) for density calculations. Species density was calculated for each channel transect, each vegetation assessment reach, and each stream property. Density classes were established for the purpose of analysis (Table 3.3).

Table 3.3- Shrub Density Classes	
Class	**Density**
0	Absent
1	0.0-0.1
2	0.1-0.5
3	0.5-1
4	1-5
5	5-10
6	10+

Understory Cover

Understory plant community composition was assessed using plant population measuring techniques adapted from of United States Forest Service-PIBO (Coles-Ritchie 2006). Understory foliar cover was measured using a 50 cm x 20 cm quadrant frame of Daubenmire (1959) along the 22 vegetation cover transects per stream. The tape stretched from 0 to 10 m, along which a reading of cover was taken at 0 m, 3 m, 6 m, and 9 m. Foliar cover was recorded as the vegetation cover of the dominant and sub-dominant species for each plot. Data were summarized with species cover to determine the species weighted average cover for each vegetation reach and stream.

Riparian Vegetation Disturbance

Riparian disturbance was measured following the protocol of Peck et al. (2001). Presence and proximity of various types of human land-use activities disturbances present in the riparian area were assessed. The list of human influences proposed by Peck et al. (2001) was expanded for the survey to include human influences present on the Forrest and Oxbow Properties. Human influences included:

- Bridge
- Buildings
- Gravel Pit
- Grazing (current activity)
- Hayfield
- Inlet/outlet pipes
- Landfill/trash
- Logging operations
- Mine tailings
- Pasture
- Park/lawn
- Pavement
- Plantings (planting strip mats)
- Railroad (including old grades)
- Restoration (current excavation)
- Roads (paved and gravel)
- Rock weirs
- Row crops
- Utility (telephone, electrical, etc.)
- Walls/dikes

The proximity classes were determined by relationship to the riparian area transects (Peck et al. 2001). These classes included: present at or on stream bank, present between the bank and 10m from the bank, and present between 10m and 30m from the bank.

Riparian Vegetation Canopy Cover

Canopy cover was measured with a spherical convex densitometer Model A following the protocols established by Kelley and Krueger (2005) and Peck et al. (2001). Densitometer readings were taken at the center of the channel, left bank, and right bank on the 33 vegetation transects per stream property. Left and right bank canopy cover readings provided an estimate of canopy cover within the bank and riparian area. At each location, four densitometer readings were taken facing north, south, east, and west. The four readings were averaged providing one value of canopy cover for each location, for a total of 33 center, 33 left, and 33 right readings per stream. The average canopy cover, at center and along the banks, was calculated from the 33-densitometer readings per stream.

RIPARIAN VEGETATION STRUCTURE

Forrest Property Summary

The understory (0.5 to 5 m height) on the Forrest Property was determined with semi-quantitative visual assessment to be less than 5% shrub and herbaceous aerial cover, respectively (Tables 3.4 and 3.5). The ground layer structure was predominantly composed of herbaceous cover less than 0.5 m in height (Tables 3.6, 3.7, and 3.8). The canopy layer was not present on this channel reach within the surveyed plots. The densiometer value for the stream was less than 1% cover. The following tables and graphs display the quantitative summaries for this channel reach of the Middle Fork John Day River. The values used to make the reach summary graphs are displayed in Appendix B.

Riparian vegetation cover was also quantified in cover plots at 0, 3, 6, and 9 meters from the channel. The *Alopecurus pratensis* and forb were the most common species within the plots, followed by *Juncus spp., Carex spp,* and *Scirpus microcarpus.* Planting mats comprised 23% of the cover within all the plots, but were only present at 3, 6, and 9 meters from the channel. Table 3.9 displays the percent cover of each understory species within the cover plots.

The density of the woody species within the surveyed transects was less than 2 plants/ m^2. The dominant species were *Alnus incana, Salix boothii,* and *Salix eriocephela.* Table 3.11 displays the woody density and the percent of the total density for each species, while Appendix C shows the woody species density summarized for left and right bank and amount of density from planted woody shrubs. In addition, Appendix C includes the woody species density by reach.

Throughout the survey, invasive and noxious species were noted when present within or in between transects. Species that were present along the three reach of the Upper John Day River are displayed in Table 3.10. *Iris pseudacorus* was observed along the banks in stream survey reach 13 and 14. The species currently is not documented Grant County and only in few locations with Eastern Oregon, yet surveyor identification stated its presence within the Forrest Property.

From the surveyed transects, the Forrest Property of the Middle Fork John Day River exhibited species that are part of the Meadow Foxtail plant association (Crowe and Clausnitzer 1997). This plant community is often a result of seeded meadows (1997). The dominant species present within the riparian area surveyed were considered obligate wetland or facultative wetland species (USDA, NRCS 2008). Appendix F displays the wetland indicator rating for each species, which provides an indication of the species riparian characteristics. This rating is the based on the probabilities of the species occurring in wetlands versus non-wetland (USDA, NRCS 2008).

There were few overstory or establishing shrub species excluding the planted shrubby species (Table 3.11). Plantings introduced a diversity of woody species including: *Alnus incana, Betula spp., Crataegus douglasii, Populus trichocarpa, Pinus ponderosa, Prunus virginiana, Ribes spp., Rosa woodsii,* and *Symphoricarpos spp.* On the three reaches the planted shrub species were the majority of the overall woody species density for the reach (Appendix C). It was observed the health of the plantings depended on location to the stream channel, where riparian species were more vigorous when planted near the stream channel and facultative species had higher vigor when farther from the stream channel.

The overall riparian vegetation condition displayed characteristics of the desired indicators for a Proper Functioning channel. This observation is based on the vegetation component of proper functioning condition streams (Prichard et al. 1998). First, the species or rock bank cover was adequate to dissipate and protect the banks from energy of a flowing stream (Table 3.7 and 3.8). Second, vegetation displayed high vigor and diverse age distribution. The presence of meadow foxtail species impacted the diversity of riparian understory herbaceous species, where sedges and rushes were not the dominant ground cover species. The streambank vegetation was not strongly comprised of species with bank stabilizing root masses and did not provide current sources of coarse or large woody material (Tables 3.9 and 3.11). These two characteristics may be considered less than desirable for the functionality of a healthy riparian system.

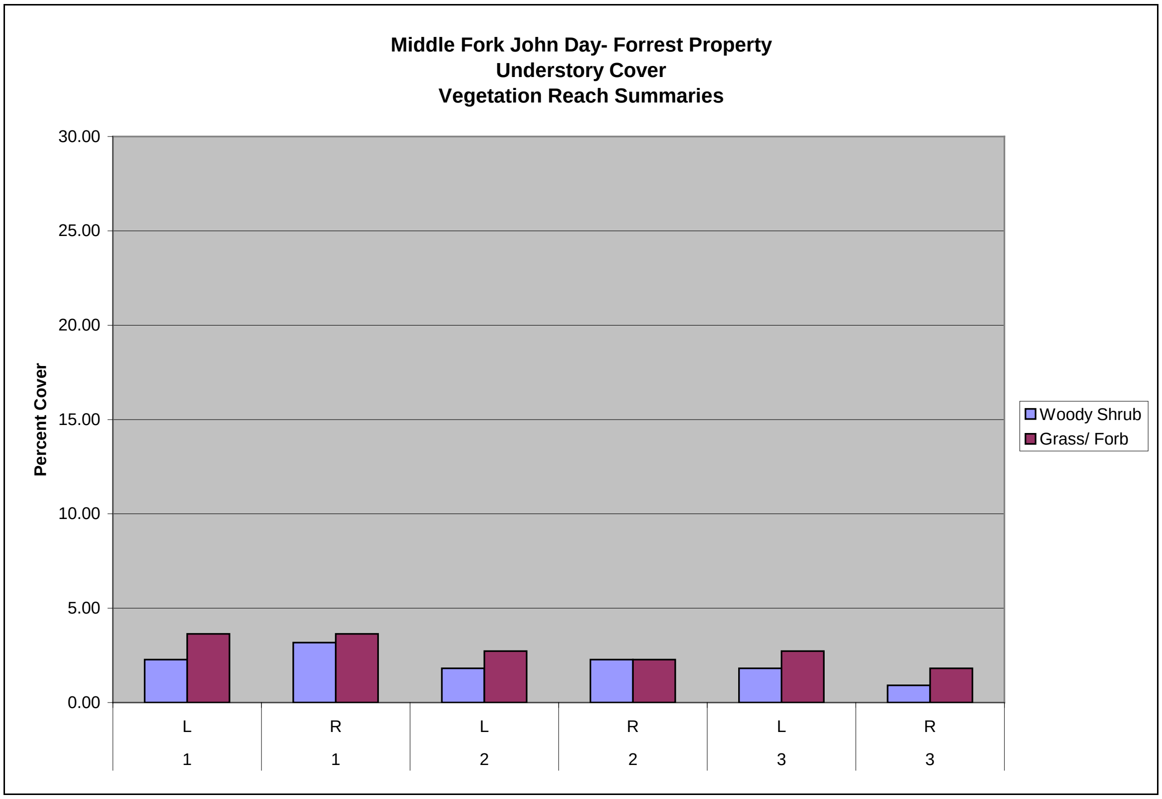
Understory Cover

Table 3.4 Woody Shurb Understory Cover- Stream Summary

Stream	Bank	Cover
FP	L	3.03
FP	R	3.26

Table 3.5 Grass/Forb Understory Cover- Stream Summary

Stream	Bank	Cover
FP	L	3.03
FP	R	2.58



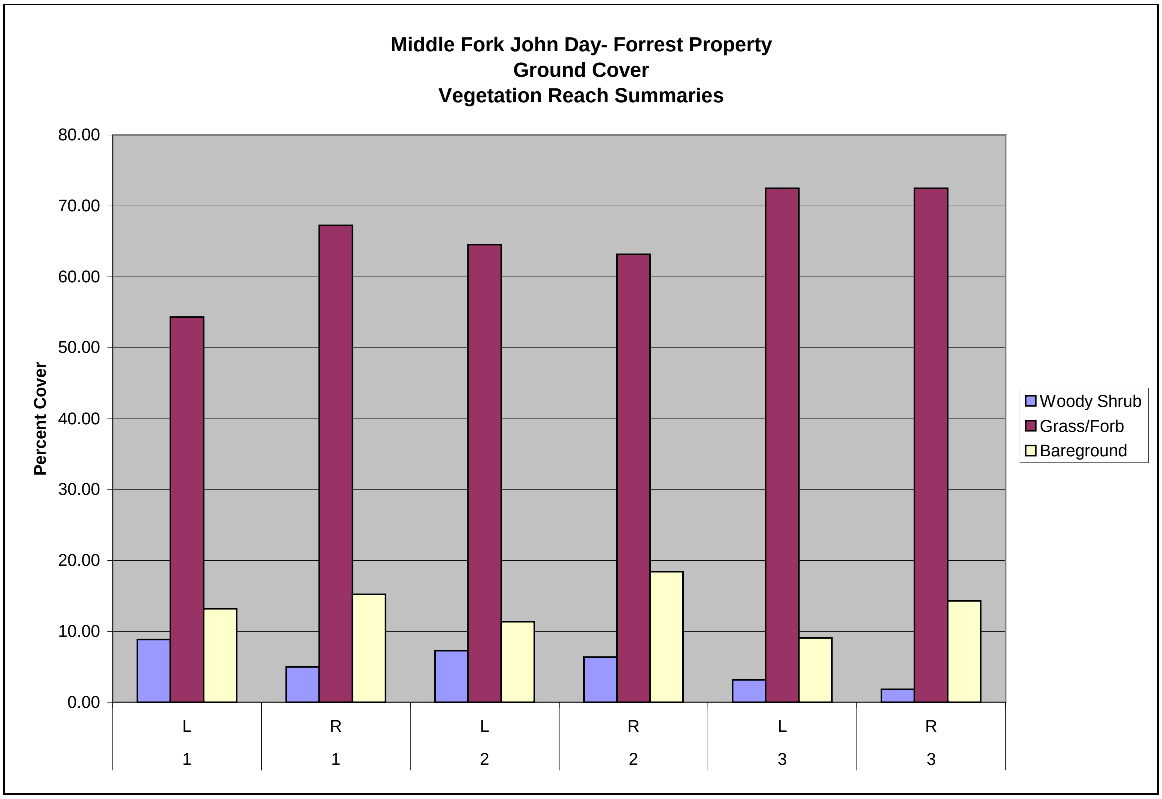
Graph 3.2: Percent understory cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Ground Cover

Table 3.6 Woody Ground Cover- Stream Summary		
Stream	**Bank**	**GrWoody_Cover**
FP	L	5.38
FP	R	1.97

Table 3.7 Grass/Forb Ground Cover- Stream Summary		
Stream	**Bank**	**GF_Cover**
FP	L	63.79
FP	R	67.65

Table 3.8 Barren/Rock Ground Cover- Stream Summary		
Stream	**Bank**	**BG_Cover**
FP	L	11.21
FP	R	15.98



Graph 3.3: Percent ground cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Understory Species Cover

Table 3.9- Understory Species Percent Cover - Within Cover Plots Middle Fork John Day-Forrest Property									
		L				**R**			
Species	**CODE**	**0**	**3**	**6**	**9**	**0**	**3**	**6**	**9**
annual Forb	AF	0.00	0.00	0.09	0.76	0.00	0.00	0.00	0.00
Alnus incana	ALIN	0.00	0.65	0.00	0.00	0.00	1.37	0.43	0.43
Alopecurus pratensis	ALPR	10.16	9.76	22.54	9.24	1.02	5.48	23.71	9.05
barren	BARREN	0.00	0.00	1.58	1.53	0.00	1.45	1.55	0.00
Bromus tectorum	BRTE	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.26
Carex aquatilis	CAAQ	0.32	0.00	0.00	0.00	1.25	0.00	0.00	0.00
Calamagrostis canadensis	CACA4	0.00	0.81	0.00	0.00	0.00	0.00	0.26	0.00
Carex lasiocarpa	CALA11	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.00
Carex lenticularis	CALE8	0.56	0.00	0.00	0.00	1.02	0.00	0.00	0.00
Carex nebrascensis	CANE	2.42	0.00	0.00	0.42	5.86	4.03	1.29	0.60
Carex spp.	CAREX	3.15	5.65	0.00	1.95	6.33	3.06	3.79	9.57
Carex utriculata	CAUT	0.00	0.00	0.96	0.00	0.00	0.65	0.00	0.00
Cirsium arvense	CIAR4	0.00	0.56	0.70	0.42	0.00	0.40	0.86	1.64
Deschampsia cespitosa	DECE	0.00	0.00	0.96	0.25	0.00	0.00	0.00	0.00
Eleocharis	ELEOC	7.98	0.65	0.00	0.00	4.14	0.81	0.00	0.00
Equisetum	EQUIS	0.81	0.24	0.09	0.59	0.63	0.48	0.52	0.00
forb	F	13.39	18.31	13.07	6.10	4.84	10.89	11.29	6.90
Festuca spp.	FESTU	0.00	0.81	0.79	0.00	0.00	0.00	0.00	0.43
Juncus arcticus	JUARL	0.89	1.37	1.05	0.00	0.47	1.94	0.00	0.00
Juncus spp	JUNCU	7.10	10.97	5.79	5.93	7.19	2.10	3.10	2.76
Phalaroides arundinacea	PHAR3	0.00	0.00	1.14	0.00	0.00	1.21	0.00	0.00
Pinus ponderosa	PIPO	0.00	0.00	1.49	0.00	0.00	0.00	0.00	0.00
planting mat	plmat	0.00	5.81	39.47	24.41	0.00	5.81	13.97	24.83
Poa spp.	POA	0.24	0.97	1.84	2.37	0.00	1.37	0.78	0.69
Prunus virginiana	PRVI	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00
rock	ROCK	0.00	5.81	0.00	0.00	0.00	0.00	1.55	6.21
Salix spp.	SA	0.00	0.00	0.00	0.00	0.00	0.24	0.60	0.00
Scirpus microcarpus	SCMI2	10.24	0.24	0.79	0.76	7.97	3.63	0.95	2.84
Symphoricarpos spp.	SYMPH	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Thinopyrum	THINO	0.00	3.55	1.14	1.78	0.00	0.24	0.00	3.28
Trisetum	TRISE	0.00	0.48	0.26	0.00	0.00	0.00	0.00	0.43

Table 3.10: Middle Fork John Day River- Forrest Property Observed Invasive and Noxious Species	
Common Name	**Scientific Name**
Canada thistle	*Cirsium arvense*
Reed Canary grass	*Phalaroides arundinacea*
Cheatgrass	*Bromus tectorum*
Yellow Flag iris	*Iris pseudacorus*

Shrub Density

Table 3.11. Middle Fork John Day- Forrest Property Density of species within belt transects				
Species	**Code**	**Count**	**Density/m^2**	**Percent Species Density**
Alnus incana	ALIN	56	1.87	29.9
Artemisia tridentata	ARTR	4	0.13	2.1
Betula spp.	BETUL	5	0.17	2.7
Ceanothus spp.	CEANO	1	0.03	0.5
Crataegus douglasii	CRDO2	2	0.07	1.1
Pinus contorta	PICO	1	0.03	0.5
Pinus ponderosa	PIPO	11	0.37	5.9
Populus trichocarpa	POBAT	5	0.17	2.7
Prunus virginiana	PRVI	6	0.20	3.2
Ribes spp.	RIBES	9	0.30	4.8
Rosa woodsii	ROWO	12	0.40	6.4
Salix boothii	SABO2	15	0.50	8.0
Salix eriocephela	SAER	31	1.03	16.6
Salix exigua	SAEX	11	0.37	5.9
Salix geyeriana	SAGE2	1	0.03	0.5
Salix lucida	SALUL	8	0.27	4.3
Salix melanopsis	SAME2	6	0.20	3.2
Symphoricarpos spp.	SYMPH	3	0.10	1.6

Oxbow Property Summary

The understory (0.5 to 5 m height) on the Oxbow Property was determined with semi-quantitative visual assessment to be approximately 5% shrub cover and 11% herbaceous aerial cover (Tables 3.12 and 3.13). The vegetation structure was predominantly composed of herbaceous ground cover less than 0.5 m in height (Tables 3.14, 3.15, and 3.16). The canopy layer was determined to be approximately 10% deciduous big and small tree with less than 1% conifer big tree. The densiometer value for the stream was less than 1% cover. The Canopy Cover Section (page 45) provides more detail on the canopy layer. The following tables and graphs display the quantitative summaries for this channel reach of the Middle Fork John Day River. The values used to make the reach summary graphs are displayed in Appendix B.

Riparian vegetation cover was also quantified in cover plots at 0, 3, 6, and 9 meters from the channel. The *Carex lenticularis* and forb were the most common species within the plots, followed by *Alopecurus pratensis, Carex spp,* and wheatgrass. Planting mats comprised 30% of the cover within all the plots, but were only present at 6 and 9 meters from the channel. Table 3.17 displays the percent cover of each understory species within the cover plots.

The density of the woody species within the surveyed transects was less than 6 plants/ m^2. The dominant species were *Salix exigua, Symphoricarpos* *spp.,* and *Rosa woodsii.* Table 3.19 displays the woody density and the percent of the total density for each species, while Appendix C shows the woody species density summarized for left and right bank and amount of density from planted woody shrubs. In addition, Appendix C includes the woody species density by reach.

Throughout the survey, invasive and noxious species were noted when present within or in between transects. Species that were present along the three reach of the Upper John Day River are displayed in Table 3.18.

From the surveyed transects, the Oxbow Property of the Middle Fork John Day River exhibited species that are part of the several different plant associations, yet the dominant species present were not specifically described as a plant association by Crowe and Clausnitzer (1997). The dominant species present within the riparian area surveyed were considered obligate wetland or facultative wetland species (USDA, NRCS 2008). Appendix F displays the wetland indicator rating for each species, which provides an indication of the species riparian characteristics. This rating is the based on the probabilities of the species occurring in wetlands versus non-wetland (USDA, NRCS 2008).

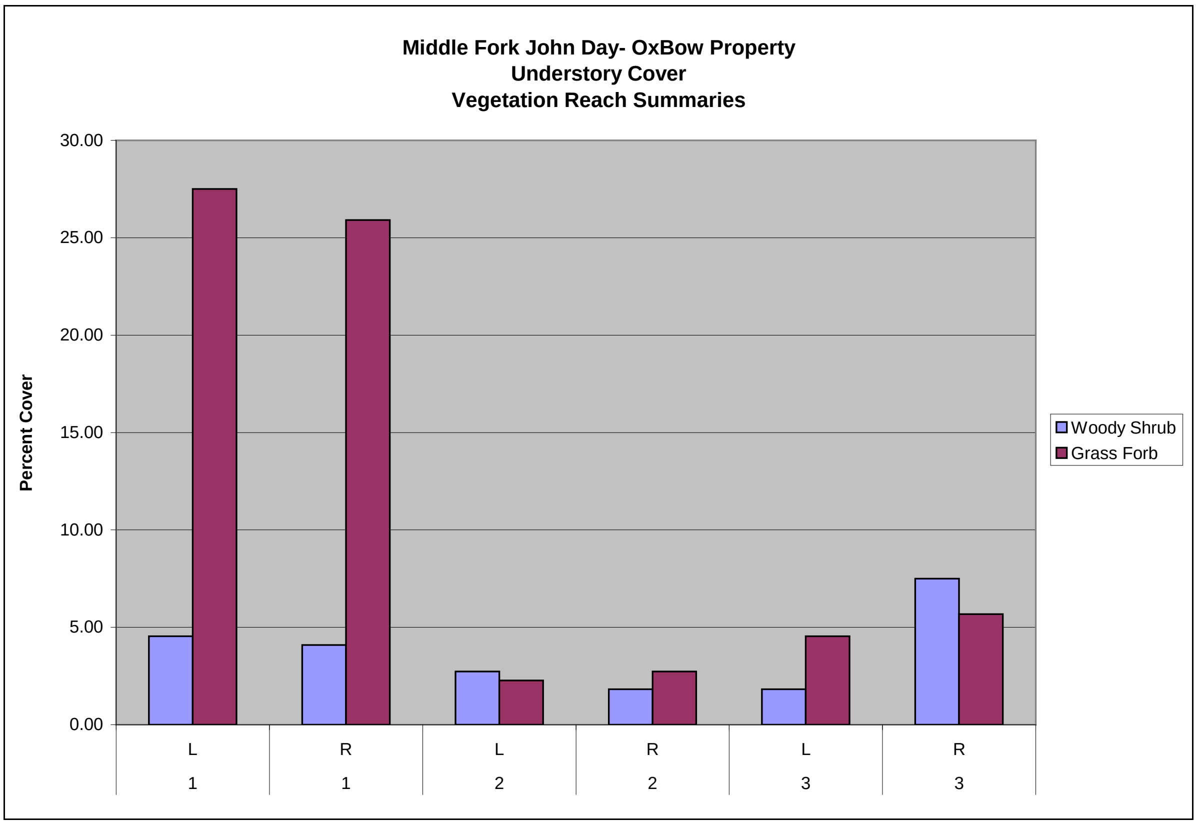
Plantings introduced a diversity of woody species including: *Alnus incana, Crataegus douglasii, Populus trichocarpa, Prunus virginiana, Pinus ponderosa, Ribes spp., Rosa woodsii, Salix boothii, Salix melanopis,* and *Symphoricarpos spp.* It was observed the health of the plantings depended on location to the stream channel, where riparian species were more vigorous when planted near the stream channel and facultative species had higher vigor when farther from the stream channel. The planted species were less than 50% of the average woody species density for the Oxbow Property (Appendix C). Non-planted species were riparian species that exhibited bank stabilization and riparian woody diversity. The dense transects with numerous woody shrubs were transects in Reach 3 with young and mature *Alnus incana, Cornus stolonifera,* and *Salix eriocephala,* and transects over depositional bars establishing with *Salix exigua and Salix melanopsis* (Appendix C).

The overall riparian vegetation condition displayed characteristics of the desired indicators for a Proper Functioning channel. This observation is based on the vegetation component of proper functioning condition streams (Prichard et al. 1998). First, the species bank cover was adequate to dissipate and protect the banks from energy of a flowing stream (Table 3.15 and 3.16). Second, vegetation displayed high vigor and diverse age distribution. Third, the streambank vegetation was comprised of species with bank stabilizing root masses (Table 3.17). Specifially, the dominance of *Carex spp*. within the riparian area exhibit high density of root mass and bank cover. The high diversity of riparian herbaceous species and woody riparian species indicated ecosystem stability and riparian soil moisture characteristics.

Understory Cover

Table 3.12: Woody Shurb Understory Cover- Stream Summary		
Stream	**Bank**	**Woody_Cover**
OB	L	5.68
OB	R	5.00

Table 3.13: Grass/Forb Understory Cover- Stream Summary		
Stream	**Bank**	**GF_Cover**
OB	L	11.44
OB	R	11.44



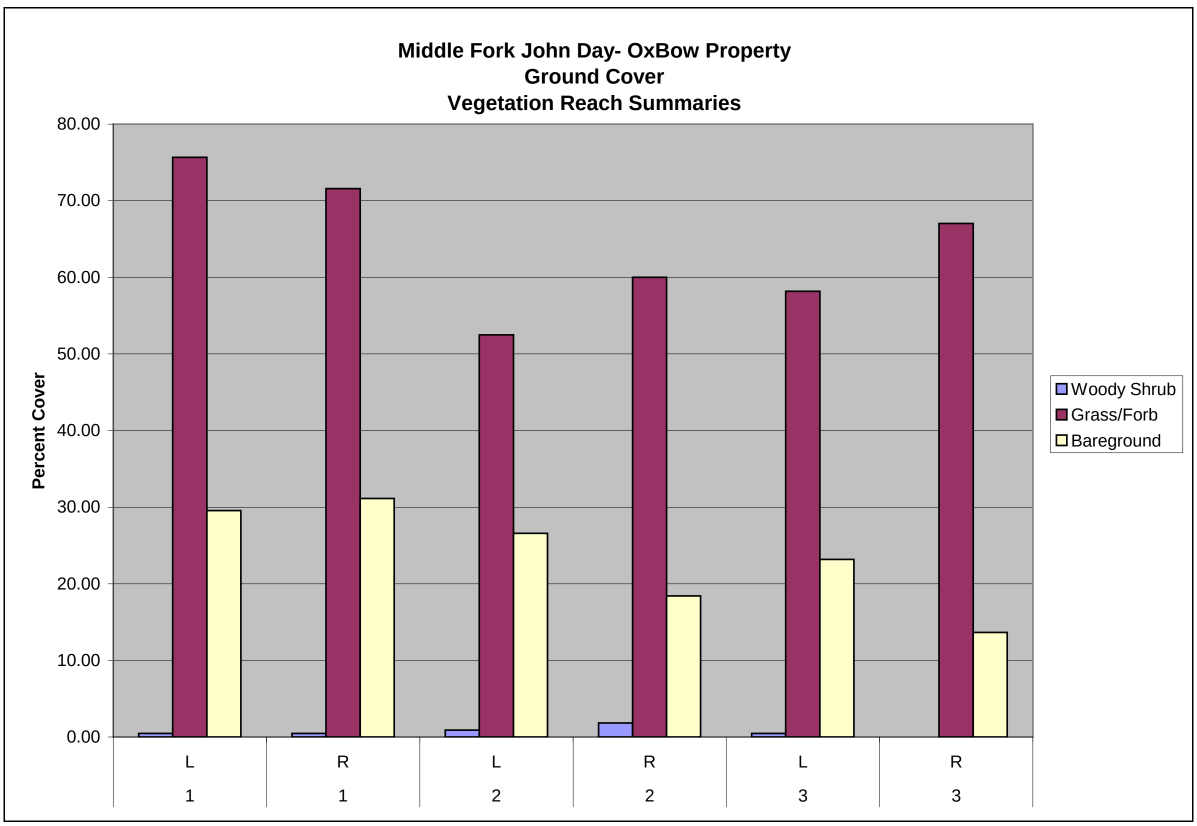
Graph 3.4: Percent understory cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Ground Cover

Table 3.14: Woody Ground Cover- Stream Summary		
Stream	**Bank**	**GrWoody_Cover**
OB	L	0.61
OB	R	0.76

Table 3.15: Grass/Forb Ground Cover- Stream Summary		
Stream	**Bank**	**GF_Cover**
OB	L	62.12
OB	R	66.21

Table 3.16: Barren/Rock Ground Cover- Stream Summary		
Stream	**Bank**	**BG_Cover**
OB	L	26.44
OB	R	21.06



Graph 3.5: Percent ground cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Understory Species Cover

Table 3.17: Understory Species Percent Cover - Within Cover Plots									
Oxbow Property									
		L				R			
Species	**CODE**	**0**	**3**	**6**	**9**	**0**	**3**	**6**	**9**
annual Forb	AF	0.00	0.00	0.45	0.04	0.00	0.00	0.44	1.20
Alopecurus pratensis	ALPR	1.08	5.40	4.55	4.64	0.00	13.44	5.88	0.28
Bromus tectorum	BRTE	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00
Carex aquatilis	CAAQ	1.08	0.97	0.00	0.00	0.00	0.00	0.00	0.00
Carex lasiocarpa	CALA11	0.00	0.32	1.45	0.18	0.41	0.00	0.00	0.00
Carex lenticularis	CALE8	75.41	0.81	0.45	0.63	33.38	1.31	0.00	0.00
Carex nebrascensis	CANE	0.00	0.00	0.00	0.00	0.81	0.57	0.00	0.00
Carex spp.	CAREX	4.32	3.79	0.45	3.75	10.68	5.74	17.63	2.69
Carex utriculata	CAUT	0.95	3.63	1.73	1.16	0.68	0.57	0.44	2.13
Cirsium arvense	CIAR4	0.00	2.18	0.00	0.63	0.00	2.54	0.26	0.83
Crataegus douglasii	CRDO2	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Deschampsia cespitosa	DECE	1.22	1.29	1.36	0.00	0.00	2.21	0.88	1.39
Eleocharis	ELEOC	0.00	0.00	0.00	0.00	0.68	0.16	0.00	0.00
Equisetum	EQUIS	0.00	2.18	0.00	0.00	0.00	0.16	0.35	0.28
forb	F	7.57	19.35	21.27	16.61	3.51	11.64	13.86	11.11
Festuca spp.	FESTU	0.00	0.00	0.18	1.43	0.00	0.00	0.44	0.00
Juncus arcticus	JUARL	0.00	1.37	0.00	0.89	0.68	1.89	0.00	0.00
Juncus spp	JUNCU	2.03	2.58	4.45	0.80	6.49	2.54	1.32	2.04
Phalaroides arundinacea	PHAR3	0.68	0.56	0.00	0.00	0.00	2.30	1.14	0.28
Calamagrostis rubescens	Pine grass	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00
planting mat	plmat	0.00	0.00	6.55	78.75	0.00	0.00	6.32	106.67
Poa spp.	POA	0.00	0.97	2.64	1.88	0.00	0.82	8.86	2.59
rock	ROCK	0.00	0.00	1.64	0.00	0.00	1.48	1.58	1.67
Rumex crispus	RUCR	0.00	0.00	1.36	0.00	0.00	0.00	0.00	0.00
Rosa woodsii	ROWO	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.19
Salix spp.	SA	0.00	0.00	0.00	0.00	0.00	0.57	0.44	1.39
Scirpus microcarpus	SCMI2	4.59	0.65	1.09	0.80	8.92	4.59	0.44	0.46
Symphoricarpos spp.	SYMPH	0.00	0.00	1.27	0.71	0.00	0.00	0.00	0.28
Thinopyrum	THINO	0.00	4.35	4.64	5.00	0.00	2.46	9.74	4.35
Trisetum	TRISE	0.00	0.00	0.64	0.00	0.00	0.00	0.44	0.00
water	WATER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67

Table 3.18: Middle Fork John Day River- Oxbow Property Observed Invasive and Noxious Species	
Common Name	**Scientific Name**
Canada thistle	*Cirsium arvense*
Reed Canary grass	*Phalaroides arundinacea*
Cheatgrass	*Bromus tectorum*

Shrub Density

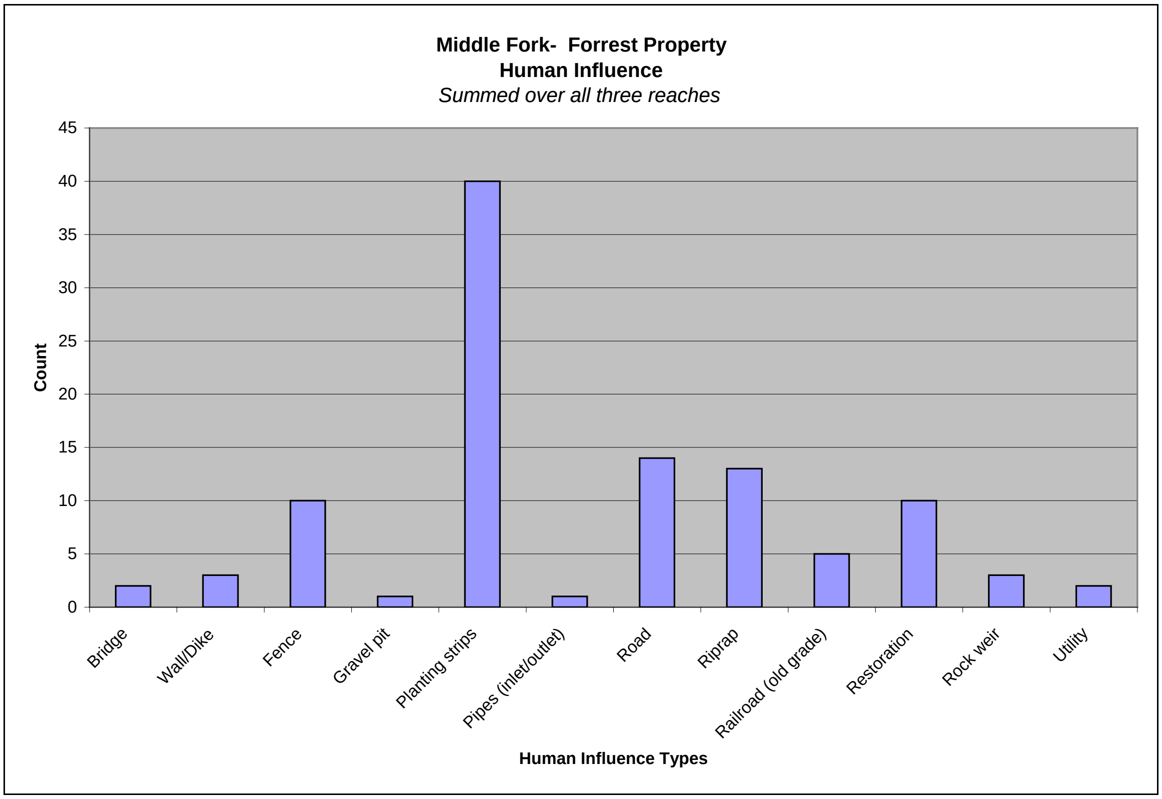
Table 3.19: Middle Fork John Day- Oxbow Property Density of species within belt transects				
Species	**Code**	**Count**	**Density/m^2**	**Percent Species Density**
Alnus incana	ALIN	47	1.57	6.1
Amleanchier alnifolia	AMALA	2	0.07	0.3
Betula spp.	BETUL	7	0.23	0.9
Cornus stolonifera	COSES	14	0.47	1.8
Crataegus douglasii	CRDO2	40	1.33	5.2
Junipercus occidentalis	JUOC	1	0.03	0.1
Pinus ponderosa	PIPO	10	0.33	1.3
Populus trichocarpa	POBAT	8	0.27	1.0
Prunus virginiana	PRVI	10	0.33	1.3
Ribes spp.	RIBES	15	0.50	1.9
Rosa woodsii	ROWO	73	2.43	9.5
Salix boothii	SABO2	47	1.57	6.1
Salix drummundiana	SADR	1	0.03	0.1
Salix eriocephela	SAER	47	1.57	6.1
Salix exigua	SAEX	191	6.37	24.8
Salix geyeriana	SAGE2	10	0.33	1.3
Salix lemmonii	SALE	1	0.03	0.1
Salix lucida	SALUL	4	0.13	0.5
Salix melanopsis	SAME2	60	2.00	7.8
Symphoricarpos spp.	SYMPH	182	6.07	23.6

RIPARIAN VEGETATION DISTURBANCE

<u>Forrest Property Summary</u>

Human influence within the riparian zone was determined by visual assessment of presence, type, and proximity to the stream channel. Planting strips had the highest occurrence within the vegetation transects, followed by road and riprap disturbances (Graph 3.6). The road influences were only present in Reach 1 and Reach 2, while riprap was present in Reach 2 and Reach 3 (Appendix D). Rock weirs and riprap were human influences to the bank, while other influences were close (within the 10 x 10m plot) or were present (outside plot area).

Planting strips created a disturbance to the riparian area, first restricting of vegetation under the black mats, and second disturbing the soil, where early seral vegetation species were observed to establish in failed plantings. The paved road was a disturbance to the riparian area, by constraining the active channel and effective riparian zone. Both the rock weirs and riprap are often considered a human disturbances present to ameliorate bank degradation and create stream habitat.

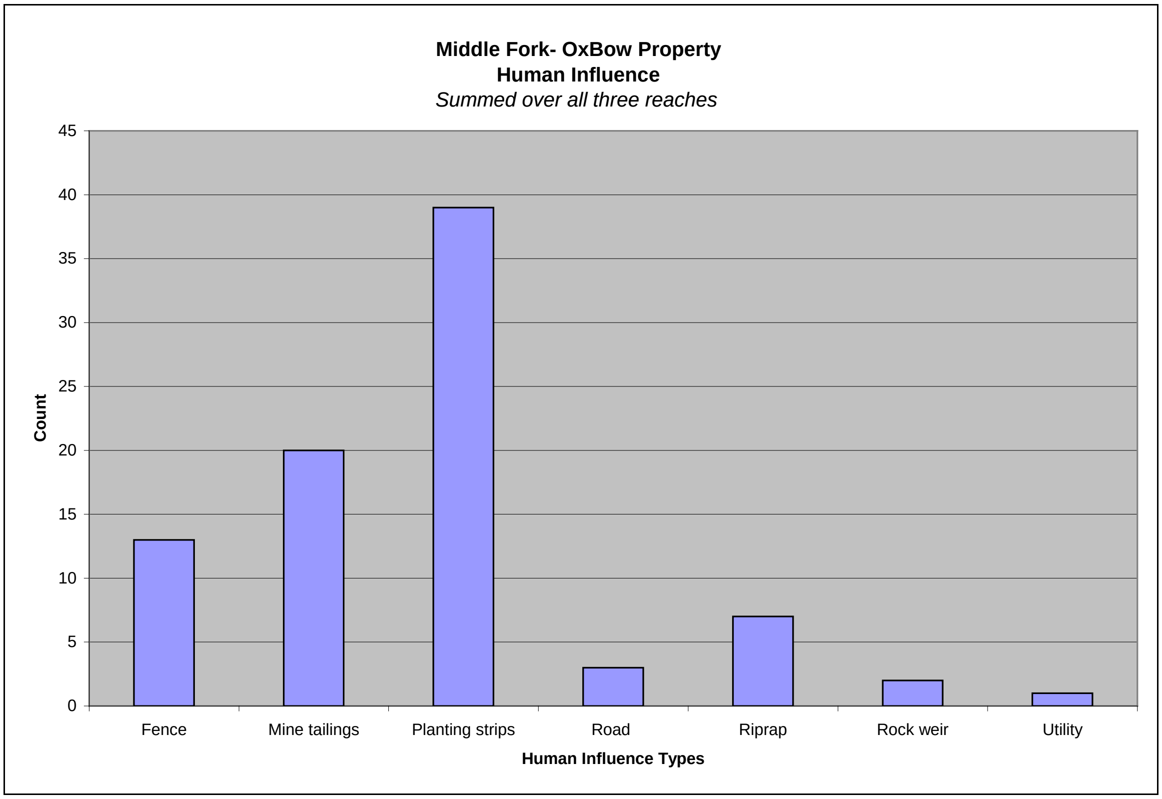


Graph 3.6: Human influence counts on Middle Fork John Day- Forrest Property, summarized over all three reaches.

<u>Oxbow Property Summary</u>

Planting strips had the highest occurrence within the vegetation transects, followed by mine tailings and fence disturbances (Graph 3.7). The mine tailing influences were only present in Reach 2 and Reach 3, while riprap and planting strips were present throughout (Appendix D). Riprap was the human influences to the bank, while other influences were close (within the 10 x 10m plot) or were present (outside plot area).

Planting strips created a disturbance to the riparian area, first restricting of vegetation under the black mats, and second disturbing the soil, where early seral vegetation species were observed to establish in failed plantings. The mine tailings were a disturbance to the riparian area and stream, constraining the active channel and effective riparian zone, while restricting vegetation growth. Riprap is often a human disturbances present to ameliorate bank degradation and create stream habitat, while the fence is often present to restrict cattle from the riparian area.



Graph 3.7: Human influence counts on Middle Fork John Day- Forrest Property, summarized over all three reaches.

RIPARIAN VEGETATION CANOPY COVER

Forrest Property Summary

As mentioned in vegetation structure canopy cover of the stream channel was less than 1% cover (Table 3.20). The low level of canopy cover was verified in the vegetation transects, where the canopy layer was not present.

Table 3.20 Densitometer Summary-Canopy Cover			
Forrest Property			
	Center	*Left*	*Right*
Upper John Day	8.19	15.38	19.00
MF John Day	0.03	0.00	0.00
OxBow Property			
OxBow	0.66	1.79	7.97

OxbowProperty Summary

Canopy cover of the stream channel was less than 1% cover, while the left and right bank had higher percent cover 2% and 8% cover (Table 3.21). The canopy layer was made up of predominately small trees (8% cover, less than 0.3

m DBH) and less than 1% big trees (greater than 0.3 m DBH). Graph 3.8 displays the big tree and small tree canopy cover for each bank, summarized in Tables 3.22 and 3.23.

Table 3.21: Densiometer Summary-Canopy Cover

	Center	*Left*	*Right*
Forrest Property			
Upper John Day	8.19	15.38	19.00
MF John Day	0.03	0.00	0.00
OxBow Property			
OxBow	0.66	1.79	7.97

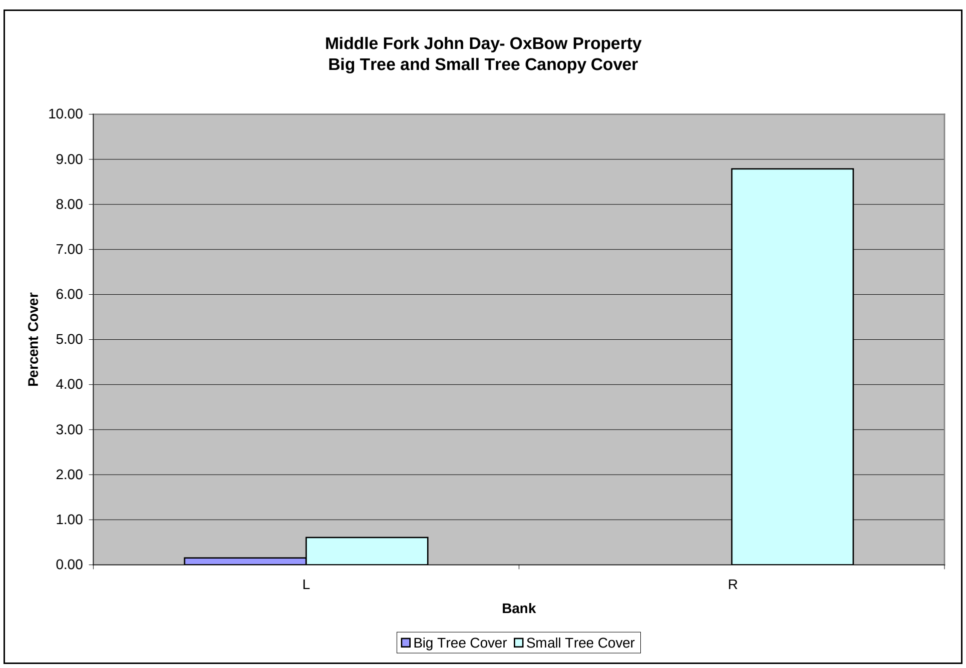
Canopy Cover

Table 3.22: Big Tree Canopy Cover- Stream Summary
(ST, small tree, BT, Big Tree)

Stream	Bank	BT_type	BT_Cover
OB	L	C	0.15

Table 3.23: Small Tree Canopy Cover- Stream Summary
(ST, small tree, BT, Big Tree)

Stream	Bank	ST_type	ST_Cover
OB	L	D	0.61
OB	R	D	8.79



Graph 3.8: Canopy cover on left (L) and right (R) bank summarized the Forrest Property- Middle Fork John Day.

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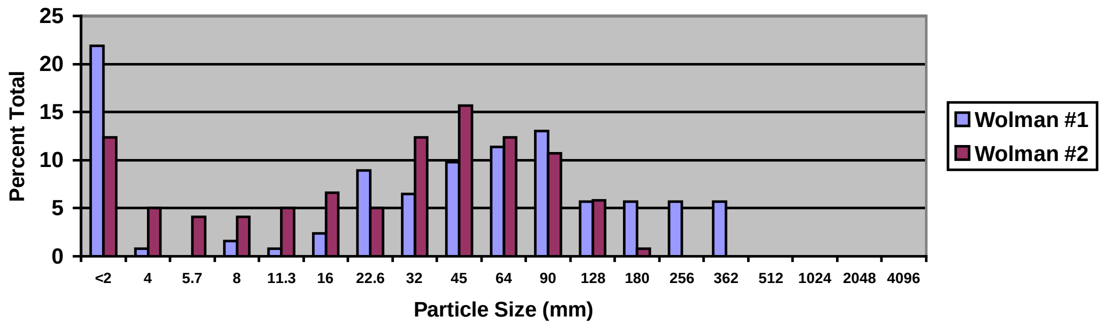
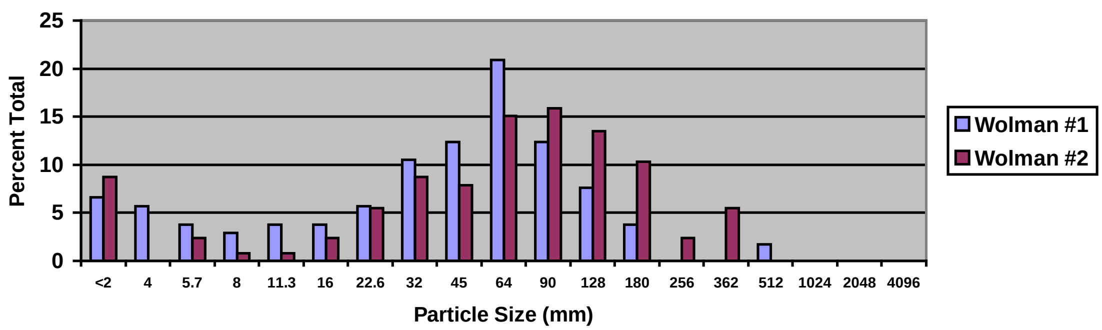
APPENDICES

APPENDIX A: Wolman Pebble Count Graph by Reach

Reach 1
D16 – <2 mm
D50 – 32-45 mm
D84 – 64-90 mm

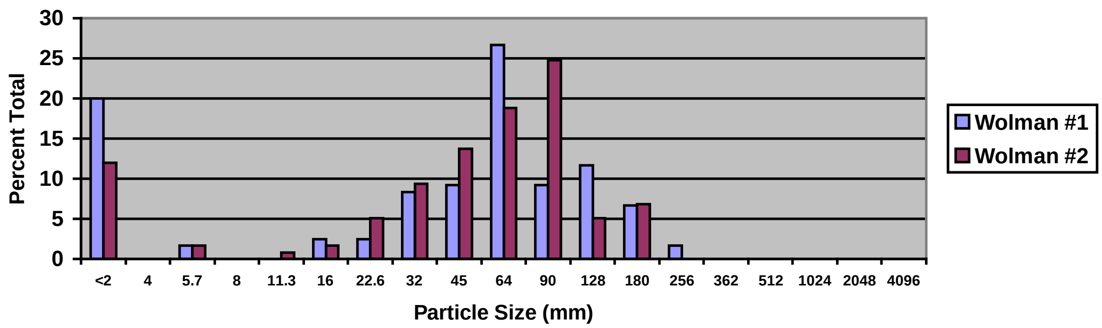


Reach 2
D16 – 2-4 mm
D50 – 45-64 mm
D84 – 90-128 mm

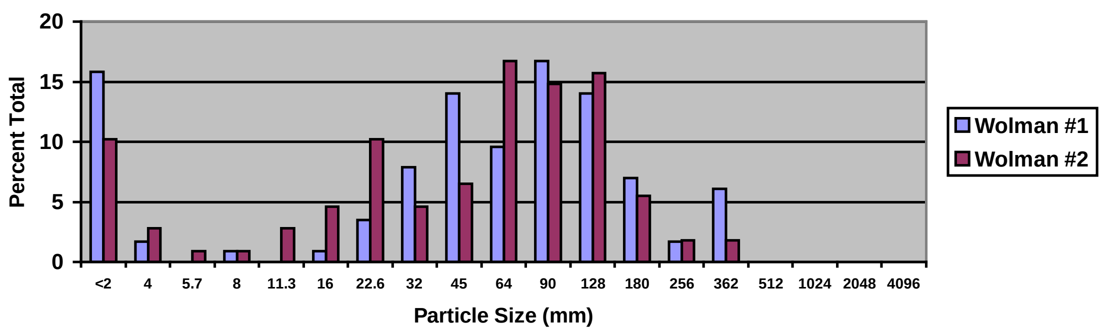


APPENDIX A (Continued)

Reach 3
D16 – <2 mm
D50 – 45-64 mm
D84 – 64-90 mm

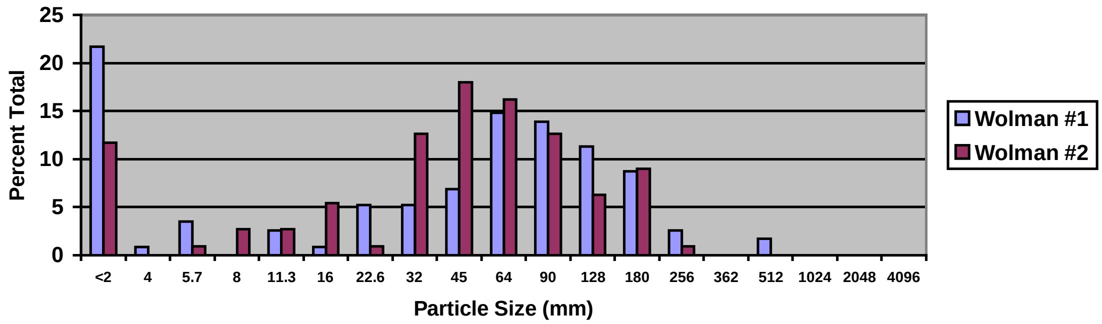


Reach 4
D16 – 5.7-8 mm
D50 – 45-64 mm
D84 – 90-128 mm

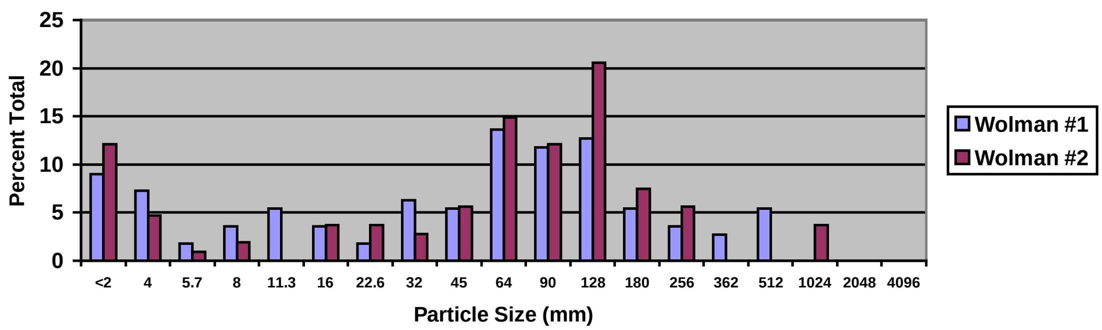


APPENDIX A (Continued)

Reach 5
D16 – <2 mm
D50 – 32-45 mm
D84 – 90-128 mm

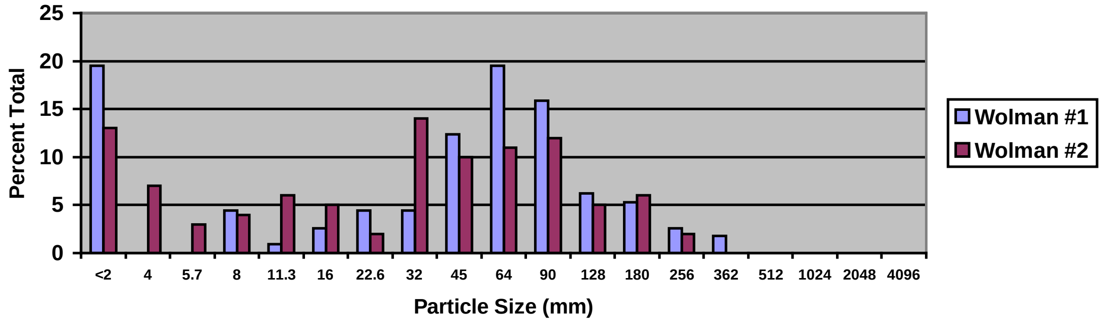


Reach 6
D16 – 2-4 mm
D50 – 45-64 mm
D84 – 128-180 mm

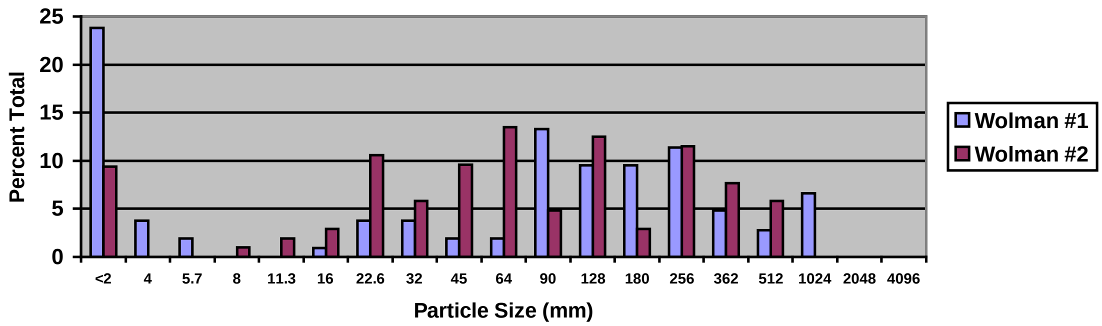


APPENDIX A (Continued)

Reach 7
D16 – <2 mm
D50 – 32-45 mm
D84 – 64-90 mm

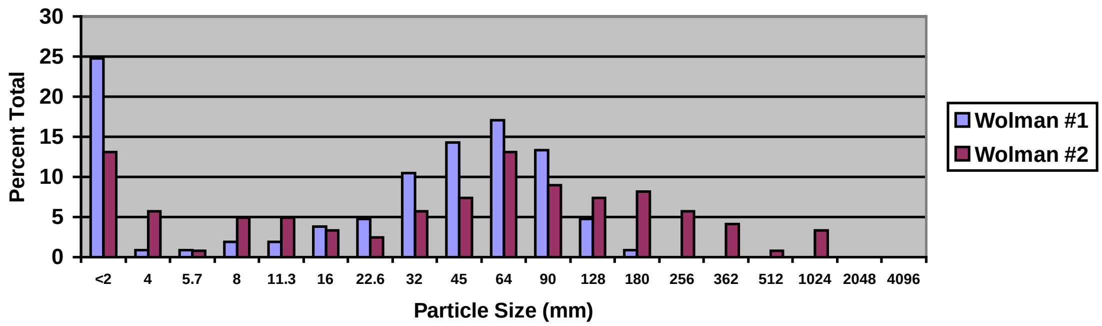


Reach 8 – North Channel
D16 – <2 mm
D50 – 64-90 mm
D84 – 180-256 mm

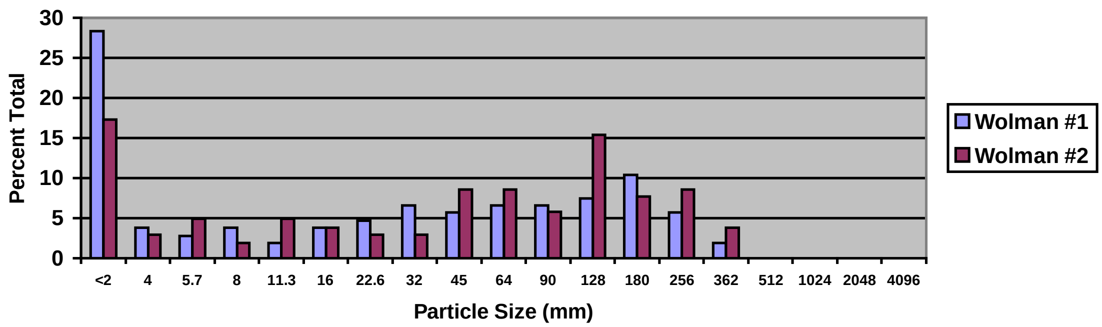


APPENDIX A (Continued)

Reach 9
D16 – <2 mm
D50 – 32-45 mm
D84 – 90-128 mm

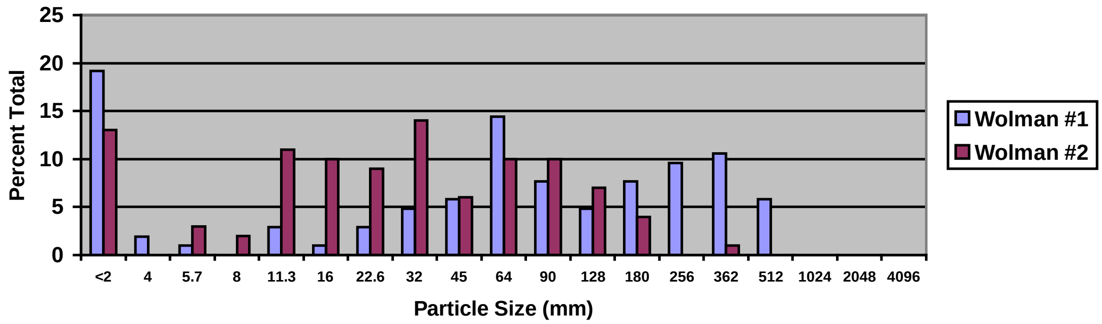


Reach 10
D16 – <2 mm
D50 – 32-45 mm
D84 – 128-180 mm

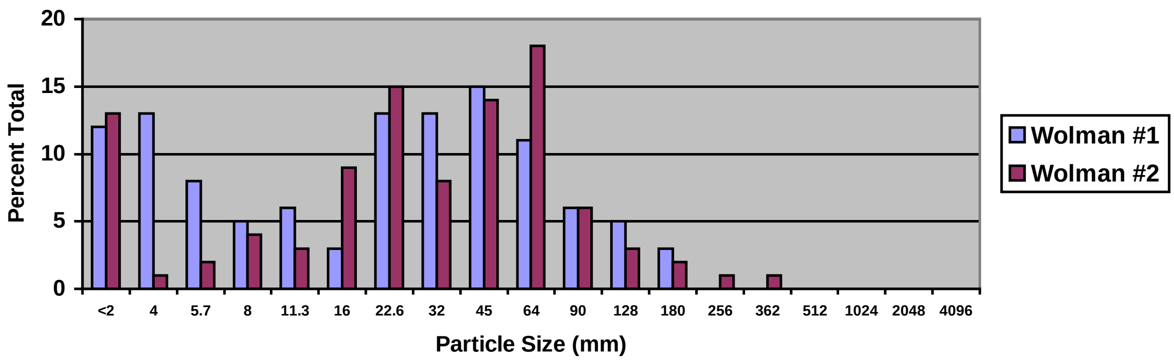


APPENDIX A (Continued)

Reach 11
D16 – <2 mm
D50 – 32-45 mm
D84 – 128-180 mm

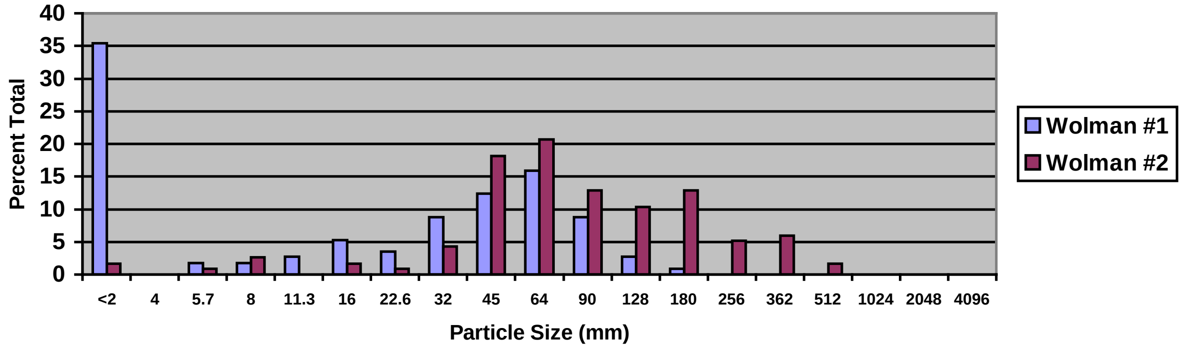


Reach 12
D16 – 2-4 mm
D50 – 16-22.6 mm
D84 – 45-64 mm

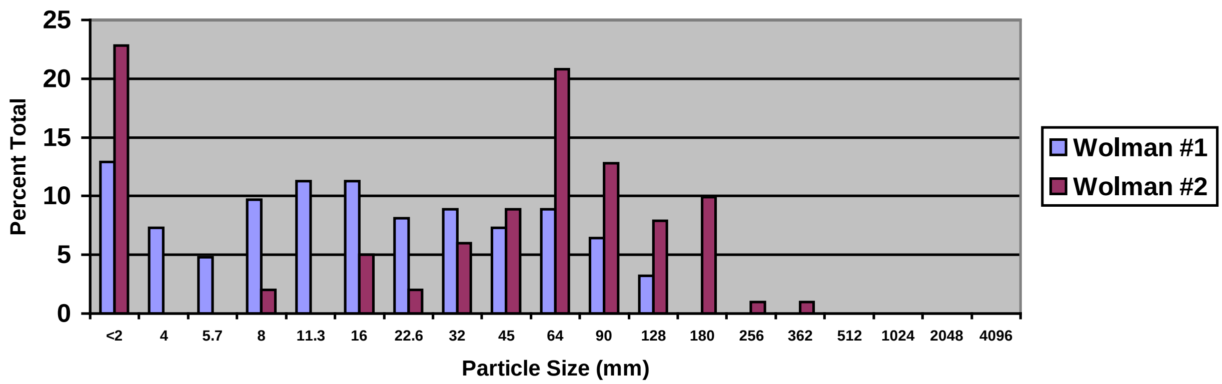


APPENDIX A (Continued)

Reach 13
D16 – <2 mm
D50 – 32-45 mm
D84 – 90-128 mm

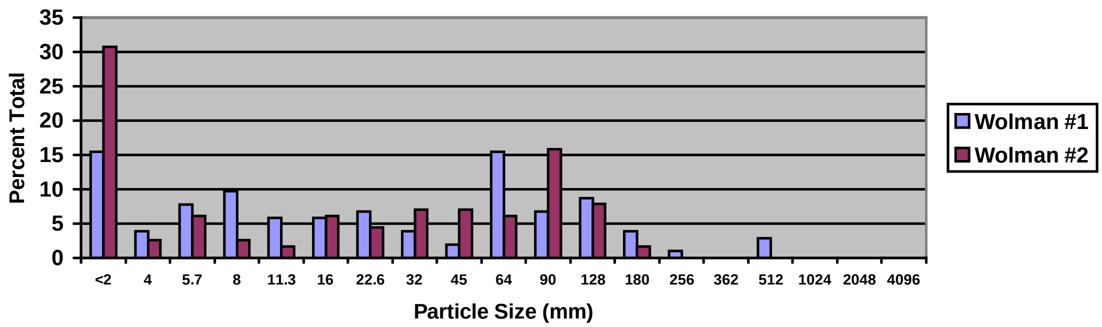


Reach 14
D16 – <2 mm
D50 – 22.6-32 mm
D84 – 64-90 mm

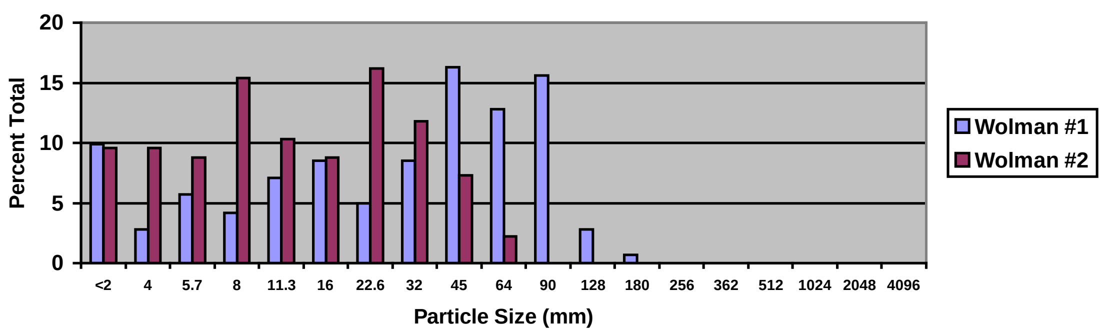


APPENDIX A (Continued)

Reach 15
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 64-90 mm

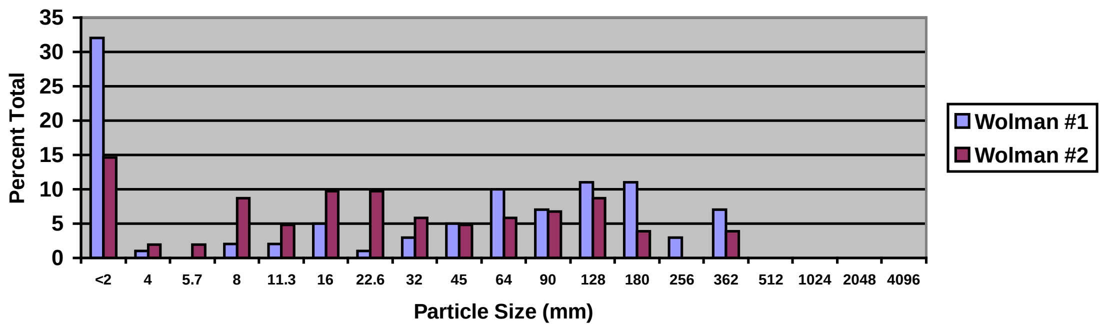


Reach 16
D16 – 4-5.7 mm
D50 – 11.3-16 mm
D84 – 45-64 mm

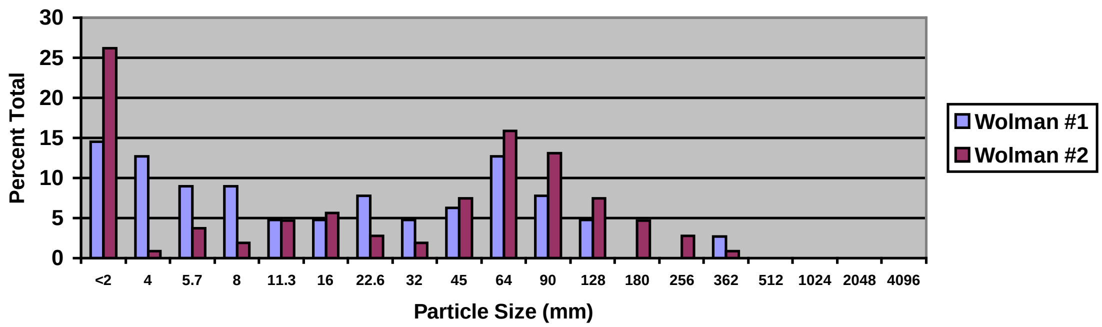


APPENDIX A (Continued)

Reach 17
D16 – <2 mm
D50 – 22.6-32 mm
D84 – 128-180 mm

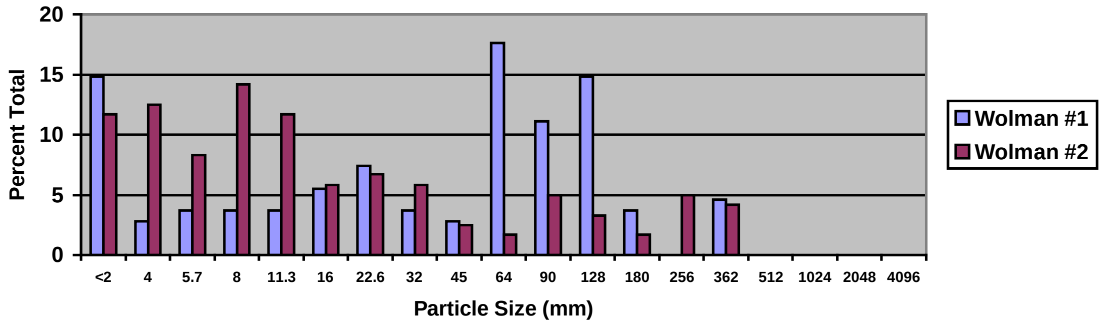


Reach 18
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 64-90 mm

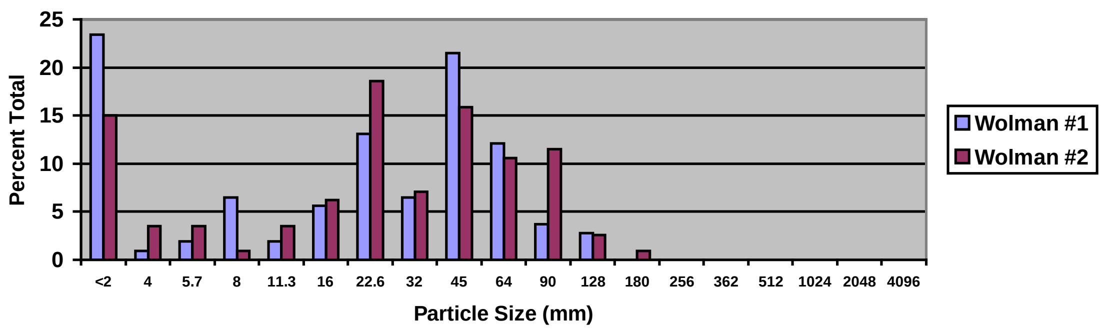


APPENDIX A (Continued)

Reach 19
D16 – 2-4 mm
D50 – 16-22.6 mm
D84 – 90-128 mm

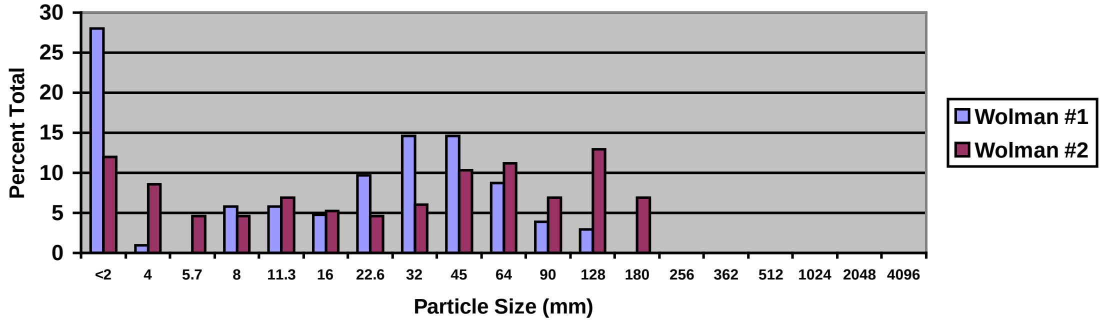


Reach 20
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 45-64 mm



APPENDIX A (Continued)

Reach 8 – South Channel
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 64-90 mm



APPENDIX B: Understory and Ground Cover Summaries by Reach

Woody Shurb Understory Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**Woody_Cover**
FP	1	L	2.27
FP	1	R	3.18
FP	2	L	1.82
FP	2	R	2.27
FP	3	L	1.82
FP	3	R	0.91

Grass/Forb Understory Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**GrFo_Cover**
FP	1	L	3.64
FP	1	R	3.64
FP	2	L	2.73
FP	2	R	2.27
FP	3	L	2.73
FP	3	R	1.82

Woody Ground Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**GrWoody_Cover**
FP	1	L	8.86
FP	1	R	5.00
FP	2	L	7.27
FP	2	R	6.36
FP	3	L	3.18
FP	3	R	1.82

Grass/Forb Ground Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**GrFo_Cover**
FP	1	L	54.32
FP	1	R	67.27
FP	2	L	64.55
FP	2	R	63.18
FP	3	L	72.50
FP	3	R	72.50

Barren/Rock Ground Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**BG_Cover**
FP	1	L	13.18
FP	1	R	15.23
FP	2	L	11.36
FP	2	R	18.41
FP	3	L	9.09
FP	3	R	14.32

APPENDIX C: Woody Species Density

Woody Species Density- Overall Stream Summary Forrest Property						
Bank	L	R	***MIN***	***MAX***	***AVERAGE***	***Planting Average***
ALIN	0.83	1.03	0.83	1.03	0.93	0.133
AMALA	0.00	0.00	0.00	0.00	0.00	0.000
ARTR	0.00	0.13	0.00	0.13	0.07	0.000
BETUL	0.10	0.07	0.07	0.10	0.08	0.083
CEANO	0.03	0.00	0.00	0.03	0.02	0.000
COSES	0.00	0.00	0.00	0.00	0.00	0.000
CRDO2	0.07	0.00	0.00	0.07	0.03	0.067
JUOC	0.00	0.00	0.00	0.00	0.00	0.000
PICO	0.03	0.00	0.00	0.03	0.02	0.000
PIPO	0.20	0.17	0.17	0.20	0.18	0.167
POBAT	0.10	0.07	0.07	0.10	0.08	0.083
PRVI	0.10	0.10	0.10	0.10	0.10	0.100
RIBES	0.20	0.10	0.10	0.20	0.15	0.150
ROWO	0.10	0.30	0.10	0.30	0.20	0.083
SAAM2	0.00	0.00	0.00	0.00	0.00	0.000
SABO2	0.13	0.37	0.13	0.37	0.25	0.000
SADR	0.00	0.00	0.00	0.00	0.00	0.000
SAER	0.17	0.87	0.17	0.87	0.52	0.000
SAEX	0.30	0.07	0.07	0.30	0.18	0.000
SAGE2	0.03	0.00	0.00	0.03	0.02	0.000
SALE	0.00	0.00	0.00	0.00	0.00	0.000
SALU2	0.00	0.27	0.00	0.27	0.13	0.000
SAME2	0.10	0.10	0.10	0.10	0.10	0.000
Salix spp.	0.00	0.00	0.00	0.00	0.00	0.000
SYMPH	0.07	0.03	0.03	0.07	0.05	0.050
		TOTALS	**0.00**	**1.03**	**0.12**	**0.104**

Woody Species Density- Overall Stream Summary						
Stream	**Oxbow Property**					
Bank	**L**	**R**	***MIN***	***MAX***	***AVERAGE***	***Planting Average***
ALIN	0.73	0.83	0.73	0.83	0.78	0.17
AMALA	0.07	0.00	0.00	0.07	0.03	0.00
ARTR	0.00	0.00	0.00	0.00	0.00	0.00
BETUL	0.07	0.17	0.07	0.17	0.12	0.07
CEANO	0.00	0.00	0.00	0.00	0.00	0.00
COSES	0.20	0.27	0.20	0.27	0.23	0.00
CRDO2	1.00	0.33	0.33	1.00	0.67	0.13
JUOC	0.03	0.00	0.00	0.03	0.02	0.00
PICO	0.00	0.00	0.00	0.00	0.00	0.00
PIPO	0.17	0.17	0.17	0.17	0.17	0.13
POBAT	0.13	0.13	0.13	0.13	0.13	0.10

PRVI	0.27	0.07	0.07	0.27	0.17	0.27
RIBES	0.20	0.30	0.20	0.30	0.25	0.17
ROWO	0.97	1.47	0.97	1.47	1.22	0.13
SAAM2	0.00	0.00	0.00	0.00	0.00	0.00
SABO2	0.33	1.23	0.33	1.23	0.78	0.10
SADR	0.00	0.03	0.00	0.03	0.02	0.00
SAER	0.53	1.03	0.53	1.03	0.78	0.00
SAEX	1.57	4.80	1.57	4.80	3.18	0.00
SAGE2	0.33	0.00	0.00	0.33	0.17	0.00
SALE	0.03	0.00	0.00	0.03	0.02	0.00
SALU2	0.07	0.07	0.07	0.07	0.07	0.00
SAME2	0.47	1.53	0.47	1.53	1.00	0.03
Salix spp.	0.00	0.00	0.00	0.00	0.00	0.00
SYMPH	5.77	0.30	0.30	5.77	3.03	0.17
		TOTALS	**0.00**	**5.77**	**0.51**	**0.13**

WOODY RIPARIAN DENSITY- REACH SUMMARY

Stream	FP						OB						UJD					
VegReach	1		2		3		1		2		3		1		2		3	
Bank	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
ALIN	0.53	0.13	0.03	0.77	0.27	0.13	0.33	0.13	0.07	0.13	0.33	0.57	0.40	0.10	0.33	0.60	0.30	0.30
AMALA											0.07							
ARTR				0.13														
BETUL	0.03	0.07	0.03		0.03		0.03	0.13	0.03	0.03								
CEANO			0.03															
COSES									0.07	0.10	0.13	0.17	0.03	0.07				
CRDO2	0.03				0.03		0.80	0.17		0.03	0.20	0.13	0.03	0.03				0.13
JUOC									0.03									
PICO	0.03																	
PIPO	0.10	0.03	0.07		0.03	0.13	0.10	0.17			0.07							
POBAT	0.03		0.03	0.03	0.03	0.03	0.07		0.07	0.07		0.07	0.77	1.53	3.97	9.17	4.83	8.37
PRVI	0.03	0.10	0.03		0.03		0.13	0.03	0.10		0.03	0.03						
RIBES	0.10		0.03	0.03	0.07	0.07	0.03	0.17	0.13	0.07	0.03	0.07						
ROWO	0.07	0.23		0.03	0.03	0.03	0.07	0.10	0.07	0.03	0.83	1.33	0.43	0.93	0.03	0.03	0.30	0.53
SAAM2													0.13	0.10	0.13	0.33	0.13	0.03
SABO2	0.03	0.10	0.07	0.03	0.03	0.23	0.13	0.10	0.20	0.10		1.03	0.03				0.43	0.03
SADR										0.03								
SAER	0.03	0.83	0.13			0.03	0.40	0.37	0.10	0.30	0.03	0.37	0.17		0.30	0.70	1.47	0.40
SAEX	0.07		0.23			0.07	1.10	1.37	0.17	3.43	0.30		1.27	0.03	0.03	0.17	0.80	0.60
SAGE2			0.03								0.33		0.13					
SALE							0.03											
Salix spp													0.17					
SALU2		0.07		0.20				0.03	0.07			0.03	0.47	0.10	0.23	1.03	1.20	0.80
SAME2		0.10	0.07		0.03			0.03	0.47	1.50								0.10
SYMPH	0.03				0.03	0.03	0.13	0.07		0.03	5.63	0.20	0.27					

APPENDIX D: Human Influence Summary Tables by Reach

Reach 1

Middle Fork- Forrest Property					
Stream	**VegReach**	**Reach**	**Type**	**Prox.**	**Count**
FP	1	15	Bridge	C	0
FP	1	15	Bridge	P	2
FP	1	15	Bridge	B	0
FP	1	15	Fence	C	0
FP	1	15	Fence	P	4
FP	1	15	Fence	B	0
FP	1	15	Gravel pit	C	0
FP	1	15	Gravel pit	P	1
FP	1	15	Gravel pit	B	0
FP	1	15	Planting strips	C	10
FP	1	15	Planting strips	P	4
FP	1	15	Planting strips	B	0
FP	1	15	Restoration	C	7
FP	1	15	Restoration	P	3
FP	1	15	Restoration	B	0
FP	1	15	Road	C	0
FP	1	15	Road	P	7
FP	1	15	Road	B	0
FP	1	15	Utility	C	0
FP	1	15	Utility	P	1
FP	1	15	Utility	B	0
FP	1	15	Wall/Dike	C	0
FP	1	15	Wall/Dike	P	1
FP	1	15	Wall/Dike	B	0

APPENDIX D (Continued)

Reach 2

Middle Fork- Forrest Property					
Stream	**VegReach**	**Reach**	**Type**	**Prox.**	**Count**
FP	2	14	Fence	C	2
FP	2	14	Fence	P	3
FP	2	14	Fence	B	0
FP	2	14	Pipes (inlet/outlet)	C	0
FP	2	14	Pipes (inlet/outlet)	P	1
FP	2	14	Pipes (inlet/outlet)	B	0
FP	2	14	Planting strips	C	6
FP	2	14	Planting strips	P	7
FP	2	14	Planting strips	B	0
FP	2	14	Railroad (old grade)	C	1
FP	2	14	Railroad (old grade)	P	0
FP	2	14	Railroad (old grade)	B	0
FP	2	14	Riprap	C	4
FP	2	14	Riprap	P	1
FP	2	14	Riprap	B	5
FP	2	14	Road	C	1
FP	2	14	Road	P	6
FP	2	14	Road	B	0
FP	2	14	Rock weir	C	0
FP	2	14	Rock weir	P	0
FP	2	14	Rock weir	B	2
FP	2	14	Utility	C	0
FP	2	14	Utility	P	1
FP	2	14	Utility	B	0
FP	2	14	Wall/Dike	C	0
FP	2	14	Wall/Dike	P	2
FP	2	14	Wall/Dike	B	0

APPENDIX D (Continued)

Reach 3

Middle Fork- Forrest Property					
Stream	**VegReach**	**Reach**	**Type**	**Prox.**	**Count**
FP	3	14	Fence	C	1
FP	3	14	Fence	P	0
FP	3	14	Fence	B	0
FP	3	14	Planting strips	C	6
FP	3	14	Planting strips	P	7
FP	3	14	Planting strips	B	0
FP	3	14	Railroad (old grade)	C	3
FP	3	14	Railroad (old grade)	P	1
FP	3	14	Railroad (old grade)	B	0
FP	3	14	Riprap	C	0
FP	3	14	Riprap	P	1
FP	3	14	Riprap	B	2
FP	3	14	Rock weir	C	0
FP	3	14	Rock weir	P	0
FP	3	14	Rock weir	B	1
FP	3	14	Wall/Dike	C	0
FP	3	14	Wall/Dike	P	0
FP	3	14	Wall/Dike	B	0

APPENDIX E: Oxbow Property Canopy Cover Summarized by Reach

Big Tree Canopy Cover- Vegetation Reach Summary				
Stream	**VegReach**	**Bank**	**BT_type**	**BT_Cover**
OB	3	L	C	0.45

Small Tree Canopy Cover- Vegetation Reach Summary				
Stream	**VegReach**	**Bank**	**ST_type**	**ST_Cover**
OB	1	R	D	1.59
OB	3	L	D	1.82
OB	3	R	D	24.77

APPENDIX F: Vegetation Key

Human Influence	
Wall/Dike/Revetment/Dam	DIKE
Riprap	RP
Building	BD
Pavement/Lot	PV
Road	RD
Railroad	RR
Pipes(inlet/outlet)	PP
Landfill/Trash	LD
Park/Lawn	PARK
Row Crops	CROP
Pasture	PS
Hayfield	HAY
Logging Operations	LOG
Mine tailings	MINE
Rock Weirs	RW
Plantings	PL
Utility	U
Bridge	BG
Gravel Pit	GP
Restoration	RS
Grazing	GR

Riparian Vegetation Type	
None	N
Mixed	M
Broadleaf Evergreen	E
Coniferous	C
Deciduous	D

Name	CODE	Wetland Rating
Annual forb	AF	FAC
Thinleaf Alder	ALIN	FACW
meadow foxtail	ALPR	FACW
Serviceberry	AMALA	FAC
Sage brush	ARTR	UPL
Water Birch	BETUL	FACW
Bareground	BG	
cheatgrass	BRTE	UPL
water sedge	CAAQ	FACW
Bluejointed Reed Grass	CACA4	FACW+
woolyfruit sedge	CALA11	OBL

Name	CODE	Wetland Rating
lakeshore sedge	CALE8	FACW+
Carex spp.	CAREX	FACW
bladder sedge	CAUT	OBL
ceanothus	CEANO	UPL
Canada thistle	CIAR4	FACU+
Red-Osier Dogwood	COSES	FACW
Hawthorn	CRDO2	FACW
tufted hairgrass	DECE	FACW
Spike rush	ELEOC	OBL
Horsetail	EQUIS	FAC
Forb	F	FACW-
Fescue spp.	FESTU	FACW
Baltic Rush	JUARL	OBL
Juncus spp.	JUNCU	OBL
Western Juniper	JUOC	UPL
Reed Canary grass	PHAR3	FACW
lodgepole pine	PICO	FAC-
Ponderosa Pine	PIPO	FACU-
Planting mat	plmat	
Poa spp.	POA	FACU+
Black Cottonwood	POBAT	FACW
chokecherry	PRVI	FACW
Ribes spp.	RIBES	FAC
Rock	ROCK	
Wild Rose	ROWO	FACU
Curly dock	RUCR	FAC
Salix spp.	SA	FACW
peachleaf willow	SAAM	FACW
Booth's willow	SABO2	OBL
Drummund's willow	SADR	FACW
Mackenzie's willow	SAER	OBL
Coyote willow	SAEX	OBL
Geyer's willow	SAGE2	FACW
Lemmon's willow	SALE	FACW-
Pacific willow	SALUL	FACW
Dusky willow	SAME2	OBL
Panicle Bulrush	SCMI2	OBL
snowberry	SYMPH	FAC
wheatgrass	THINO	FACU-
Oatgrass	TRISE	UPL

Wetland Indicator Categories

Indicator Code	Wetland Type	Comment
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.

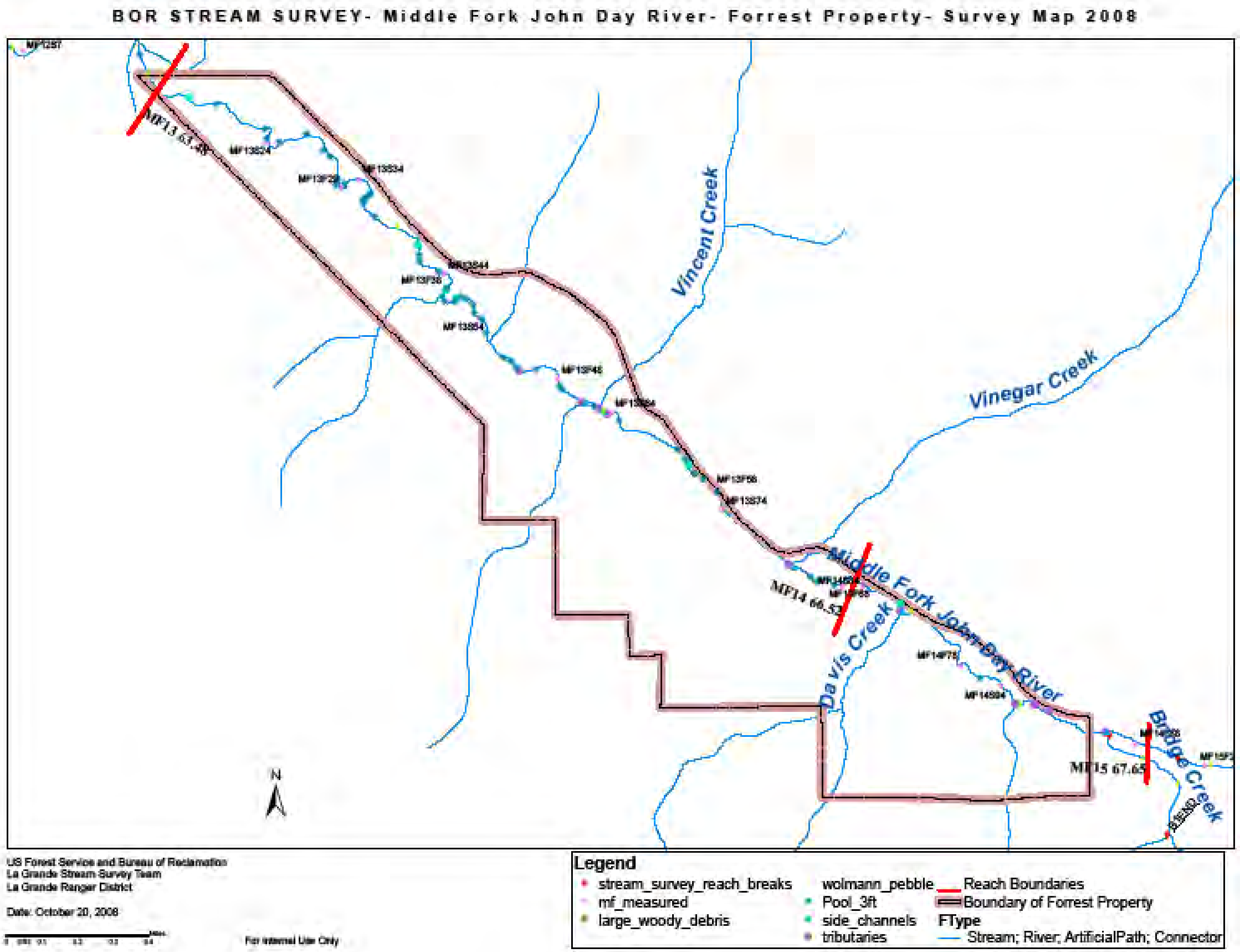
A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

Wetland Indicator Categories Table and explanation from:

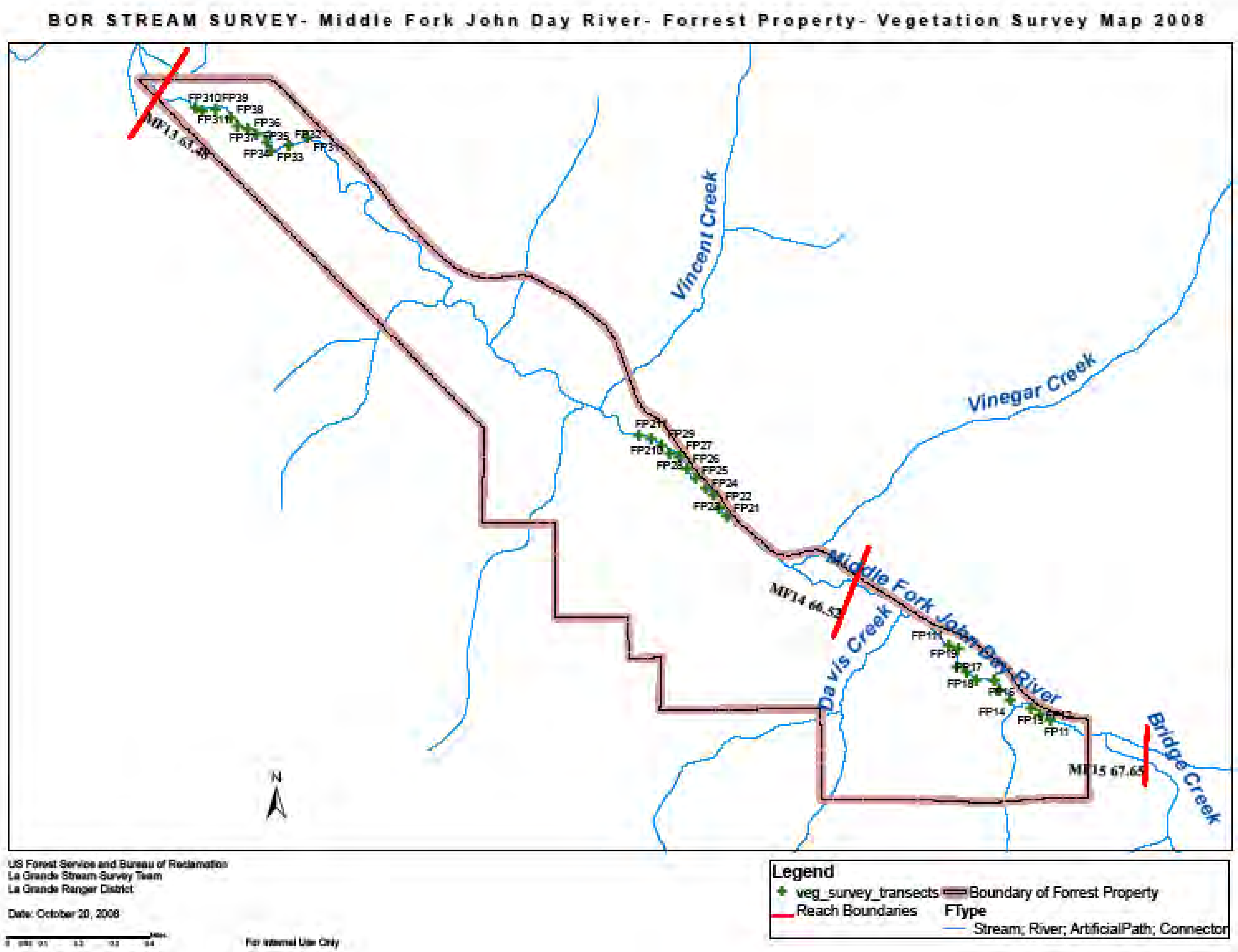
USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 28 October 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

APPENDIX G- Maps

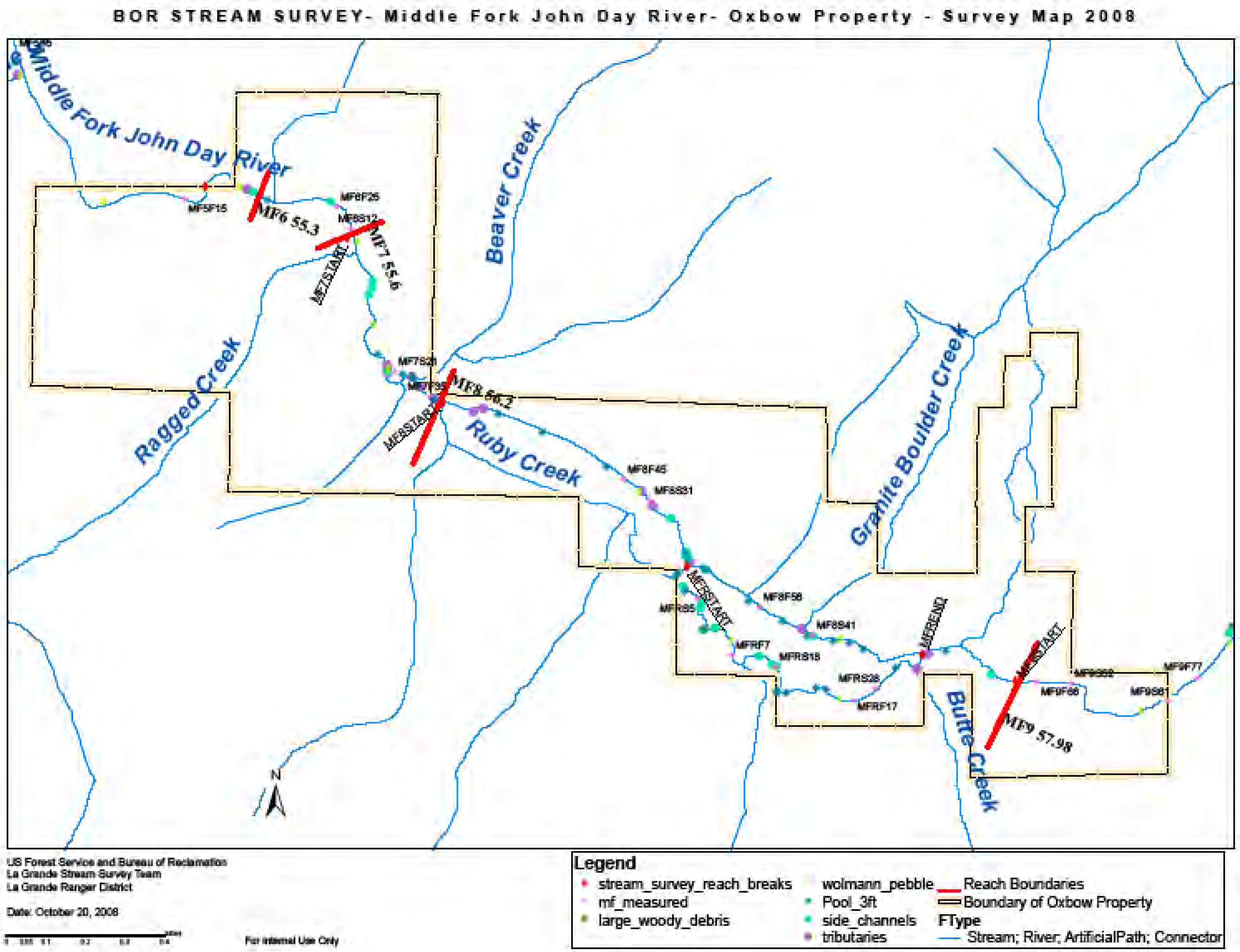
Map 1


BOR STREAM SURVEY- Middle Fork John Day River- Forrest Property- Survey Map 2008
Vincent Creek
Vinegar Creek
Middle Fork John Day River
Davis Creek
Bridge Creek
MF13 63.45
MF14 66.53
MF15 67.65
N
US Forest Service and Bureau of Reclamation
La Grande Stream Survey Team
La Grande Ranger District
Date: October 20, 2008
For Internal Use Only
Legend
stream_survey_reach_breaks
mf_measured
large_woody_debris
wolmann_pebble
Pool_3ft
side_channels
tributaries
Reach Boundaries
Boundary of Forrest Property
FType
Stream; River; ArtificialPath; Connector

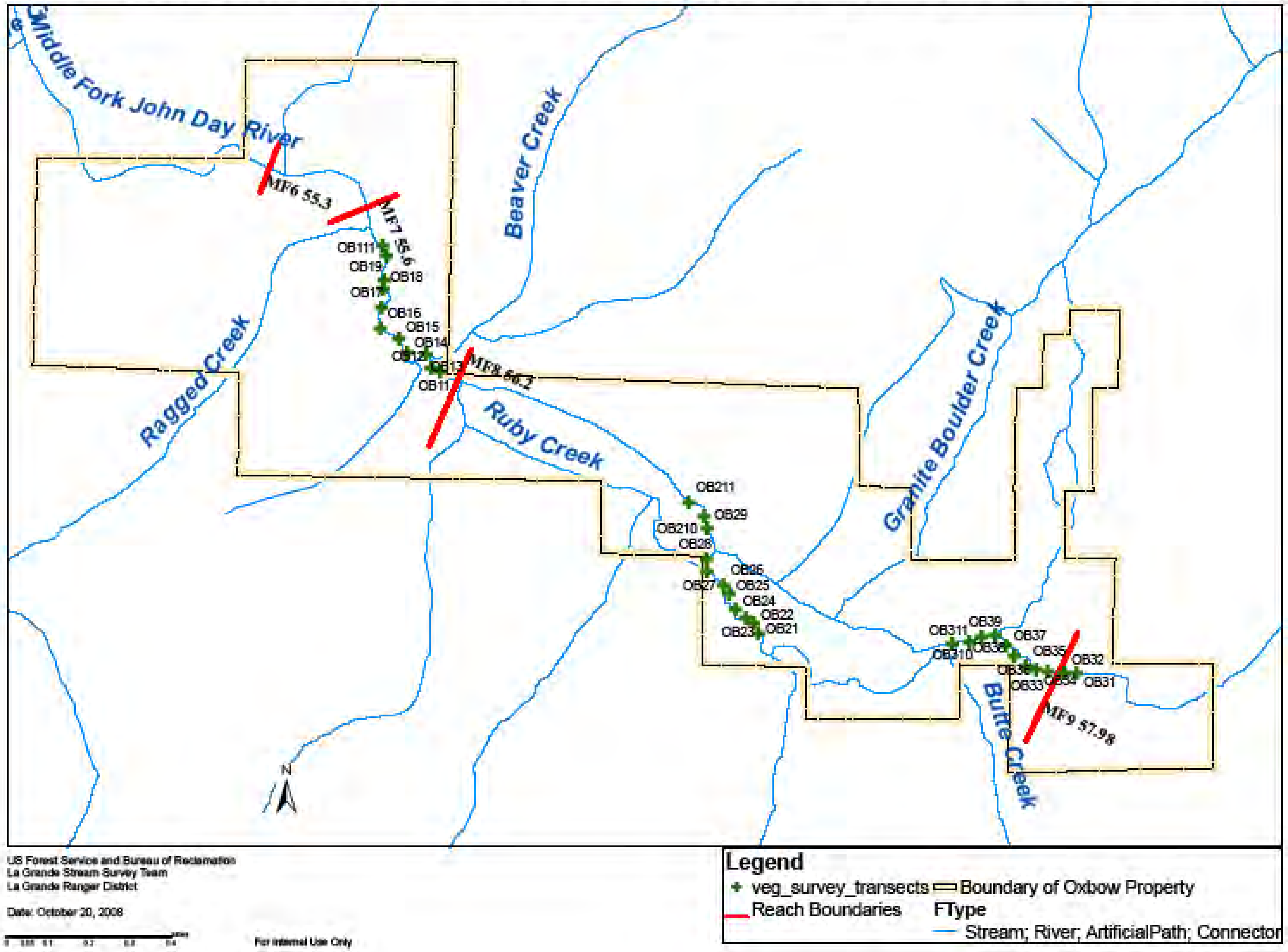
Map 2


BOR STREAM SURVEY- Middle Fork John Day River- Forrest Property- Vegetation Survey Map 2008
Vincent Creek
Vinegar Creek
Middle Fork John Day River
Davis Creek
Bridge Creek
MF14 66.53
MF15 67.65
N
US Forest Service and Bureau of Reclamation
La Grande Stream Survey Team
La Grande Ranger District
Date: October 20, 2008
For Internal Use Only
Legend
veg_survey_transects
Boundary of Forrest Property
Reach Boundaries
FType
Stream; River; ArtificialPath; Connector

Map 3


BOR STREAM SURVEY- Middle Fork John Day River- Oxbow Property - Survey Map 2008
Middle Fork John Day River
Beaver Creek
Ragged Creek
Ruby Creek
Granite Boulder Creek
Butte Creek
MF6 55.3
MF7 55.6
MF8 56.2
MF9 57.98
MF7START
MF8START
MF5F15
MF6F25
MF6S12
MF7S21
MF7F35
MF8F45
MF8S31
MF8F56
MF8S41
MFRS5
MFRF7
MFRS18
MFRS28
MFRF17
MF9S52
MF9F68
MF9S61
MF9F77
N
US Forest Service and Bureau of Reclamation
La Grande Stream Survey Team
La Grande Ranger District
Date: October 20, 2008
For Internal Use Only
Legend
stream_survey_reach_breaks
mf_measured
large_woody_debris
wolmann_pebble
Pool_3ft
side_channels
tributaries
Reach Boundaries
Boundary of Oxbow Property
FType
Stream; River; ArtificialPath; Connector

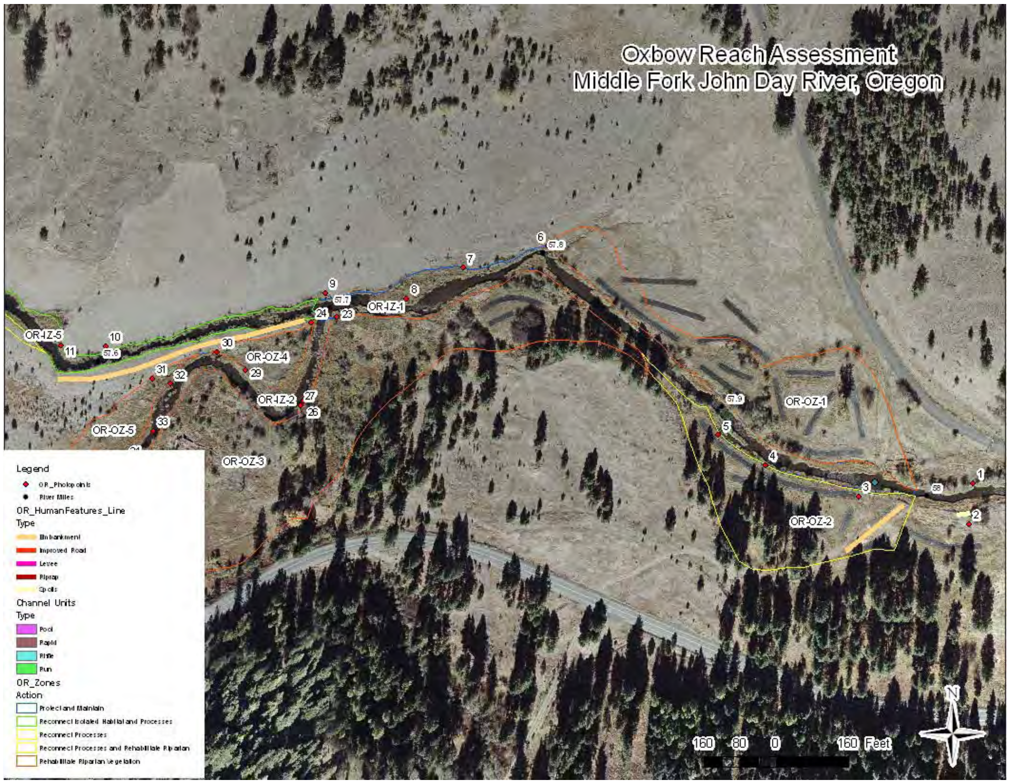
BOR STREAM SURVEY- Middle Fork John Day River- Oxbow Property - Vegetation Survey Map 2008

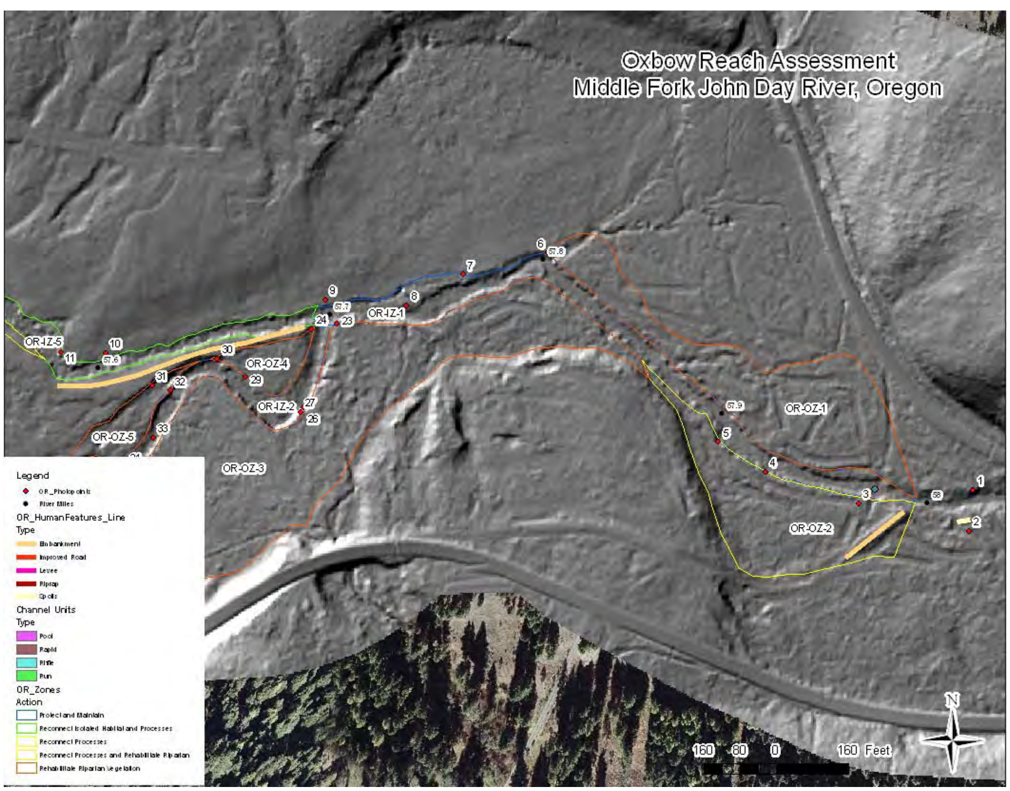


APPENDIX C

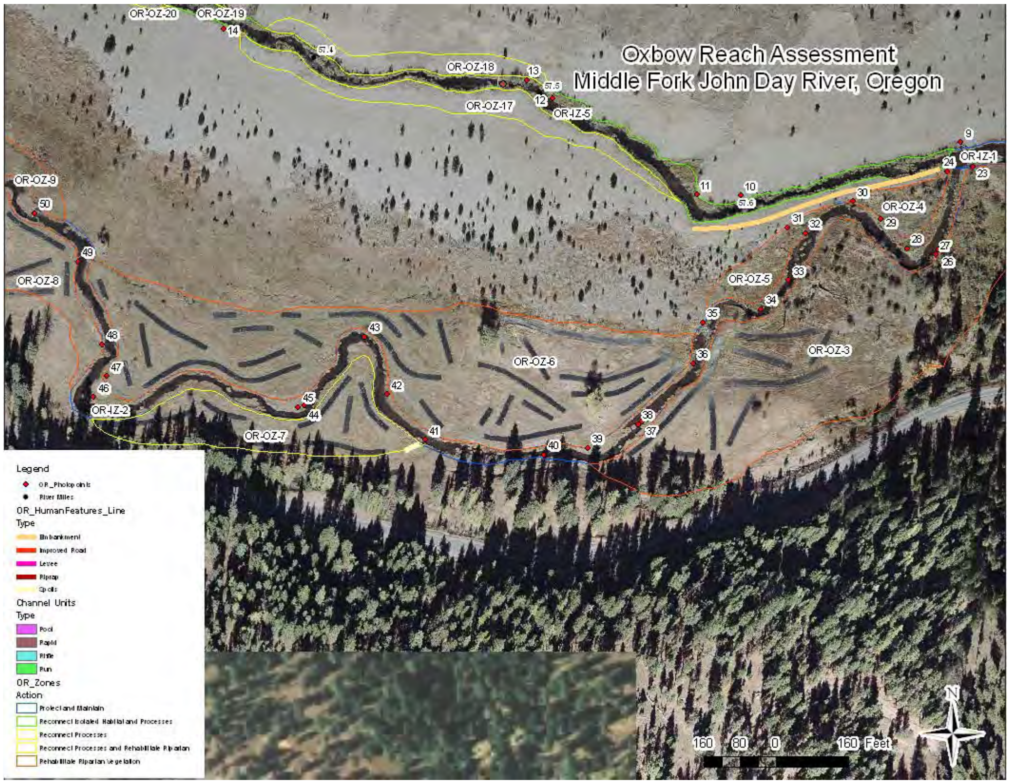
Initial Site Assessment

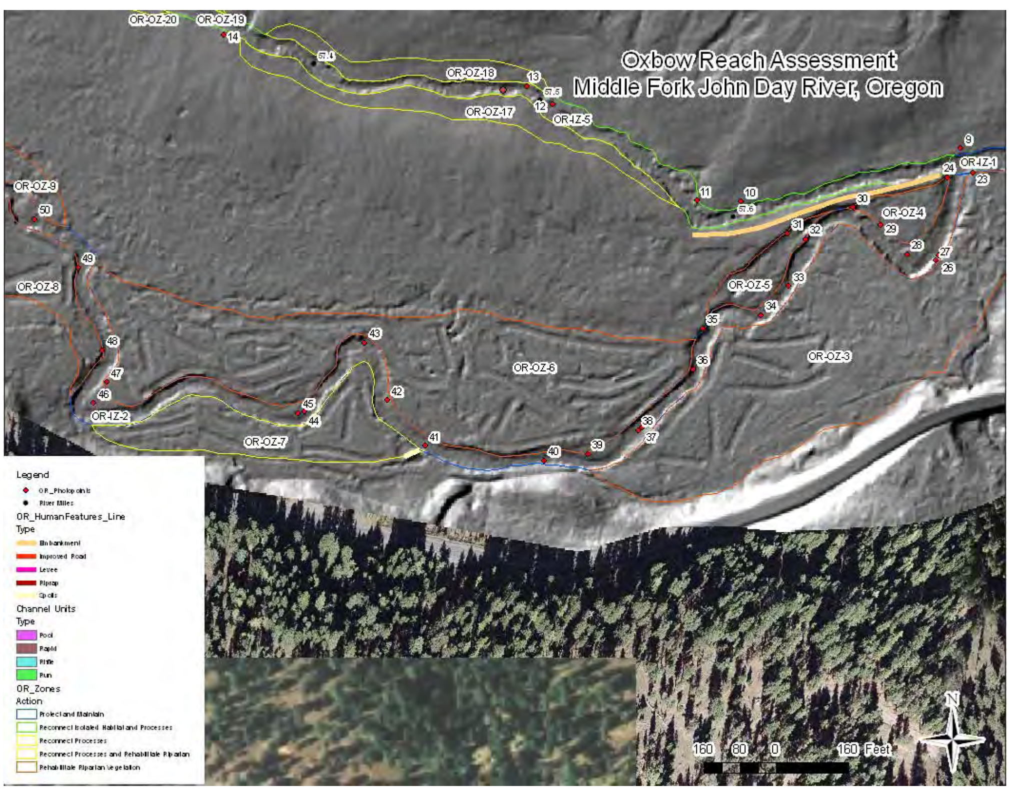
RM 58.0-57.6 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.



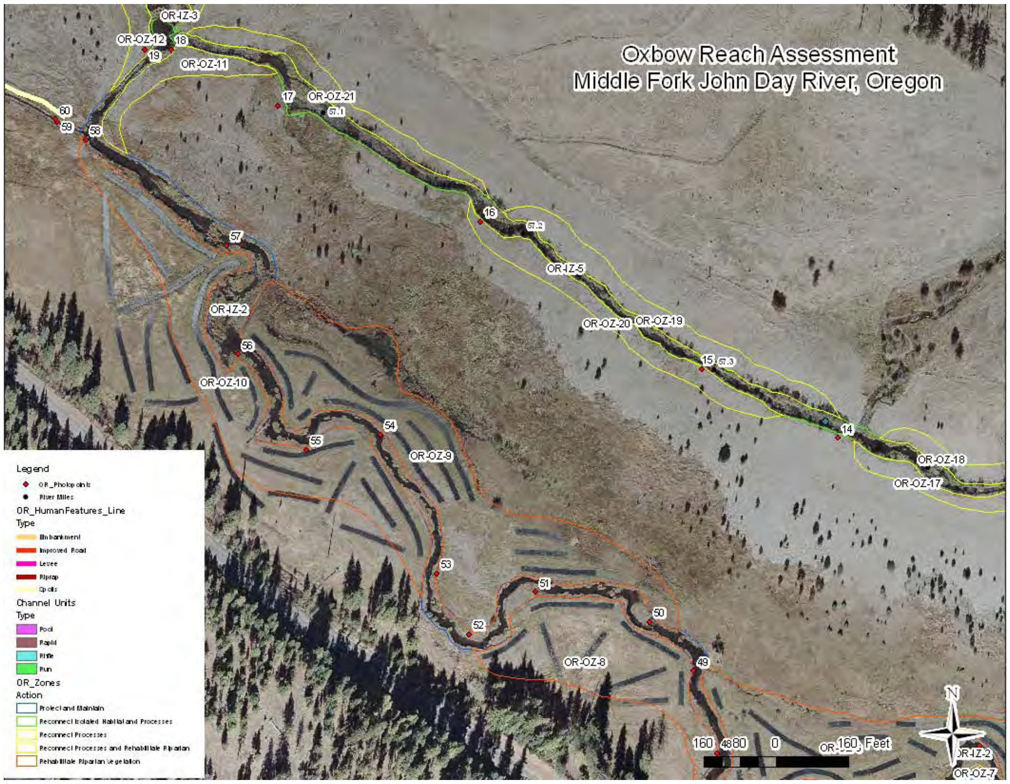


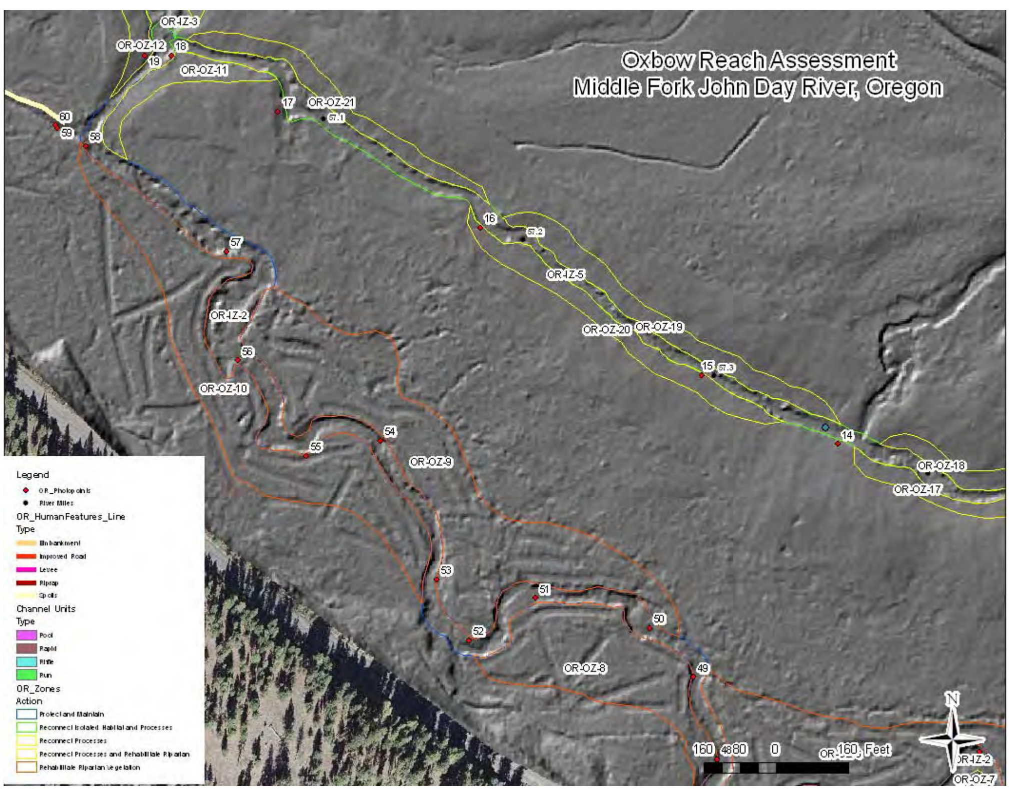
RM 57.7-57.4 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.



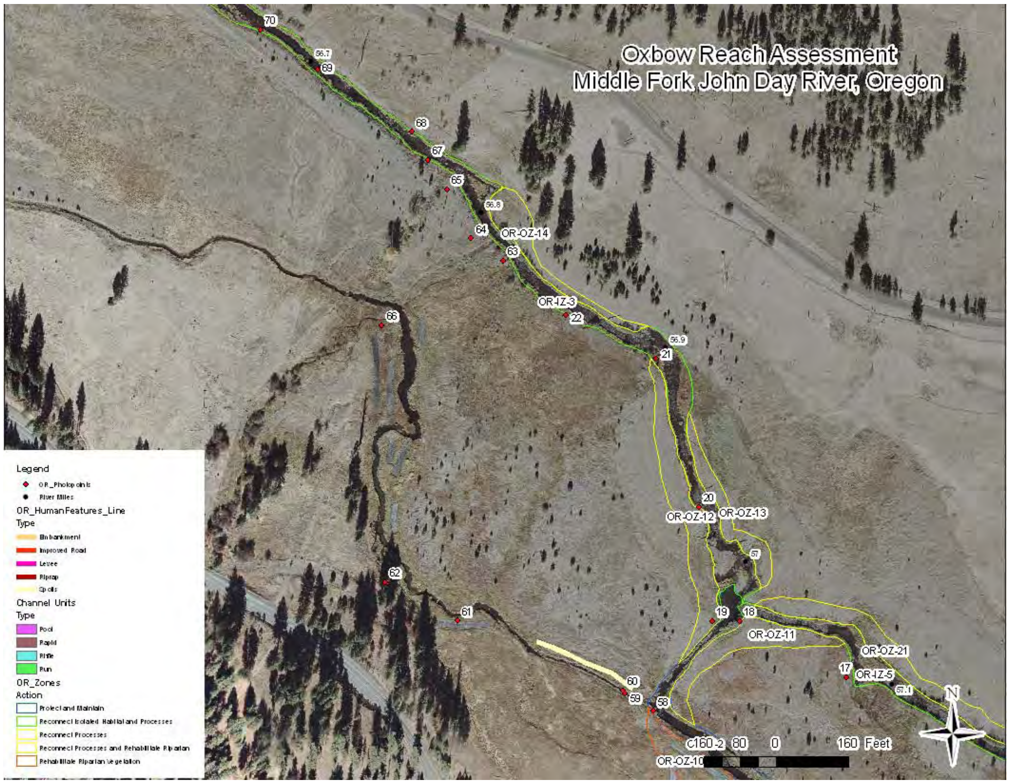


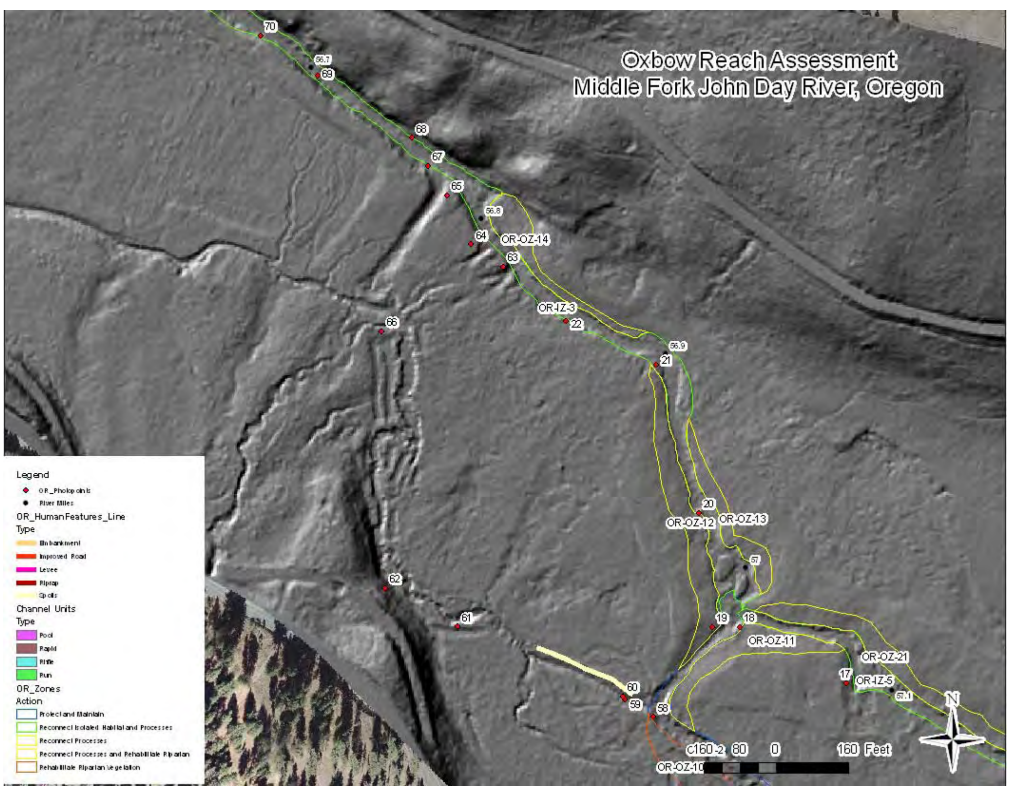
RM 57.4-57.0 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.



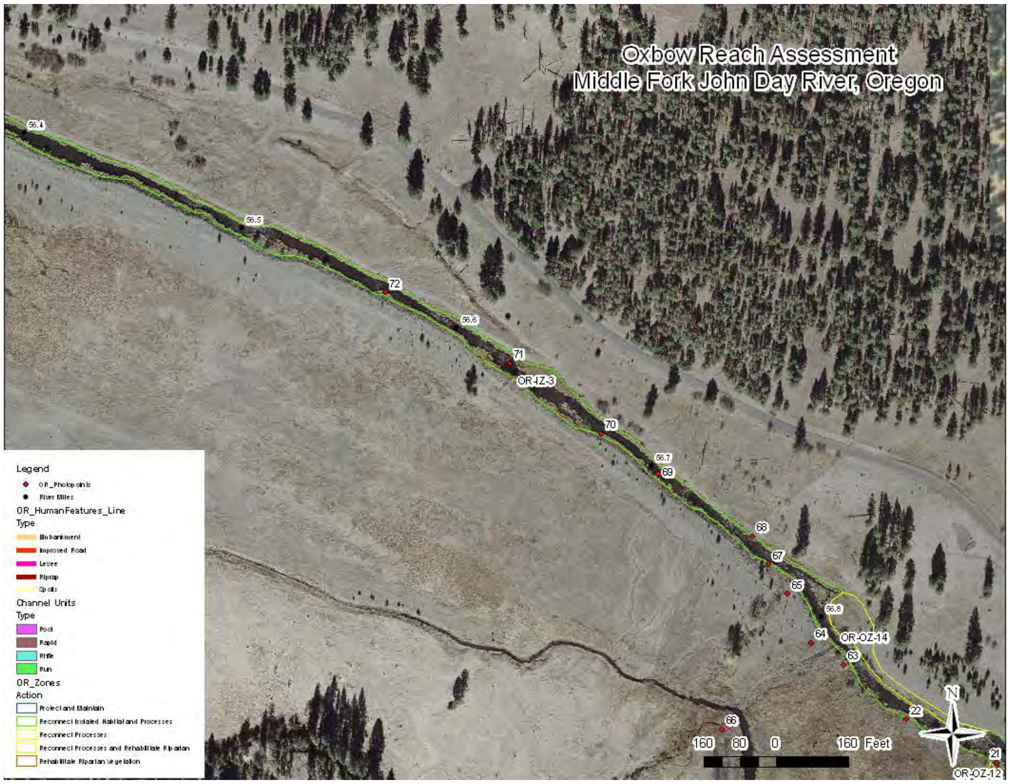


RM 57.1-56.7 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.

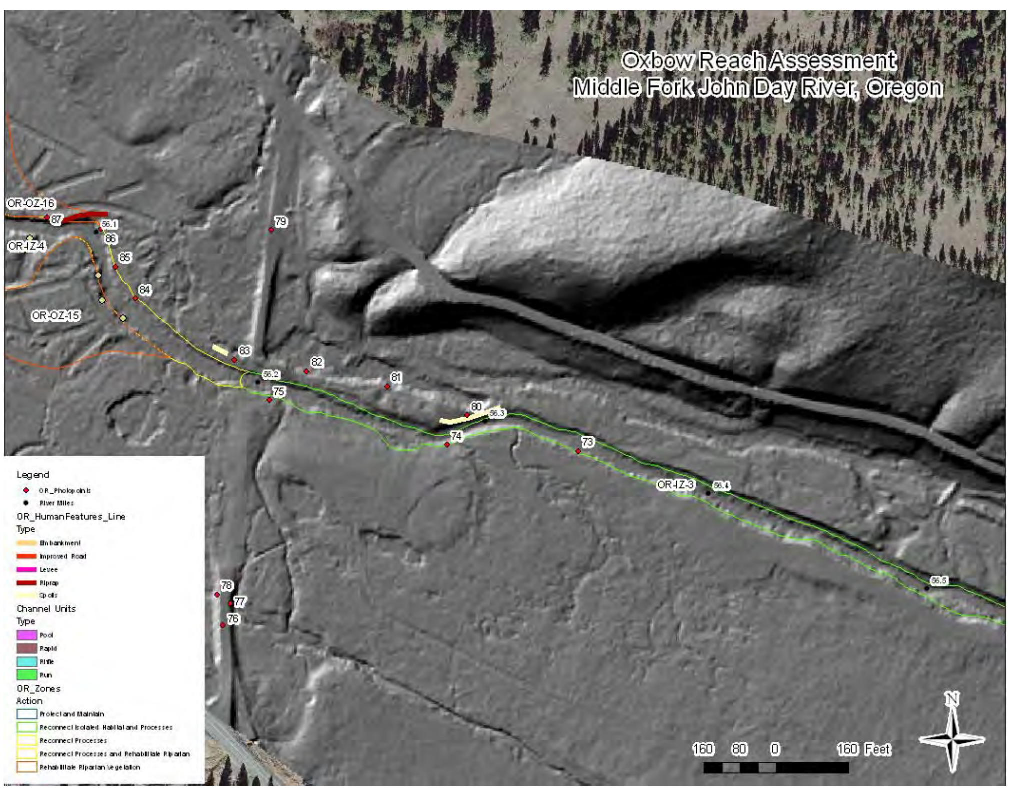




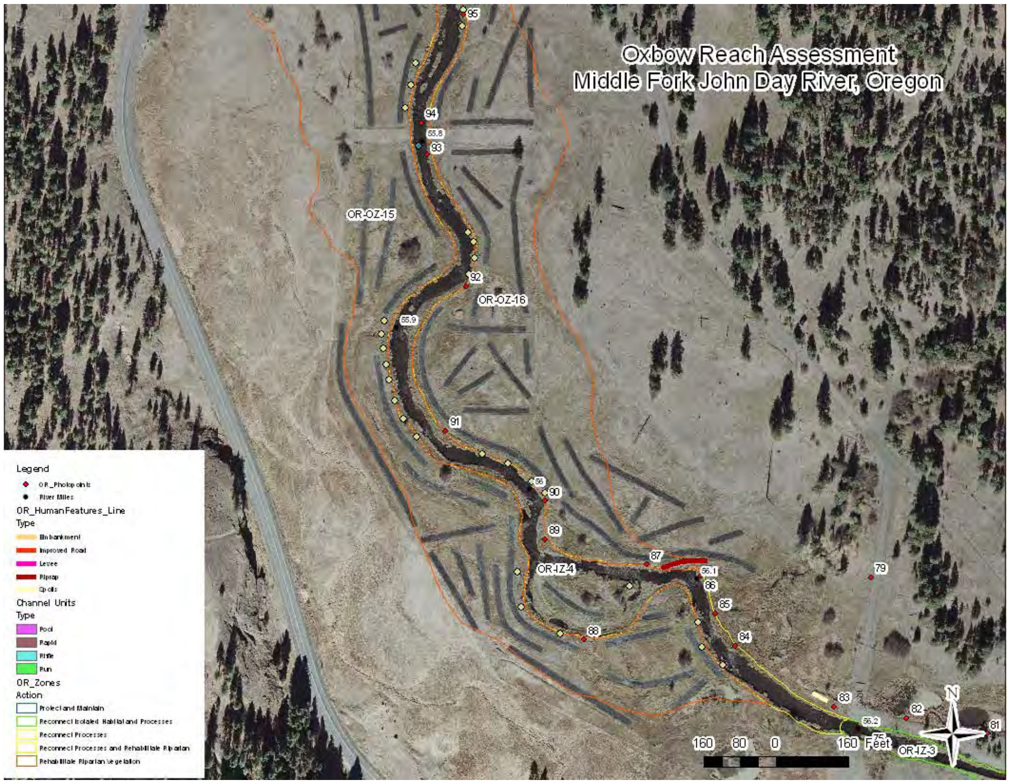
RM 56.8-56.4 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.

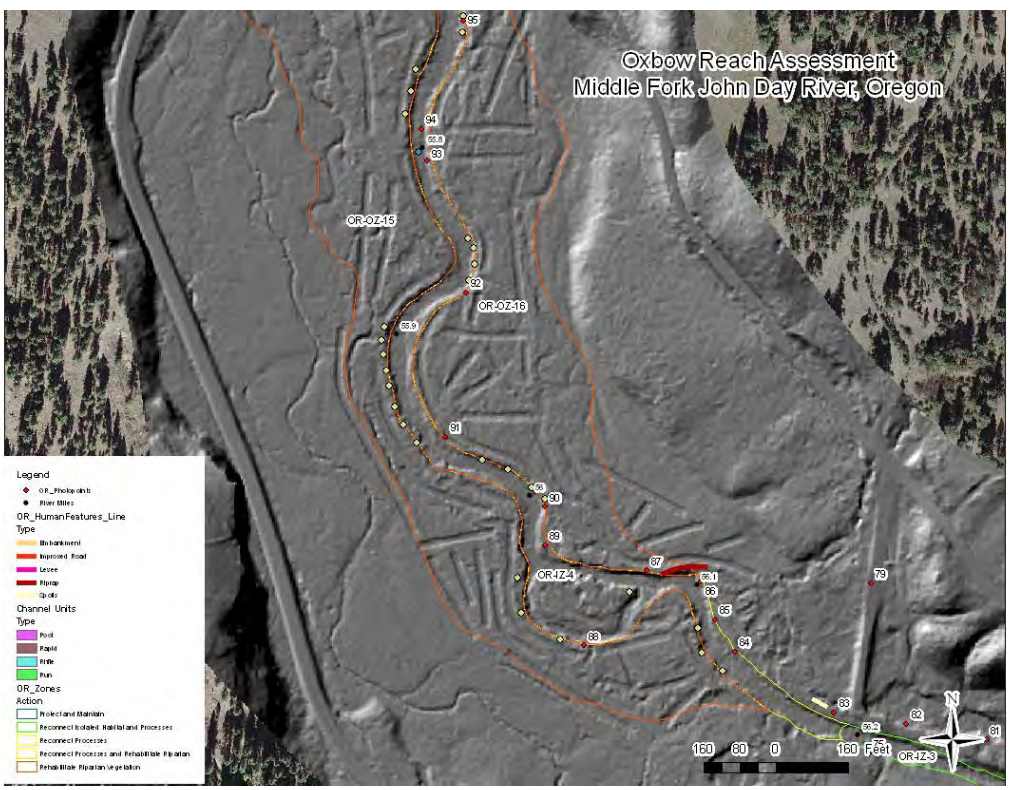


RM 56.5-56.1 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.

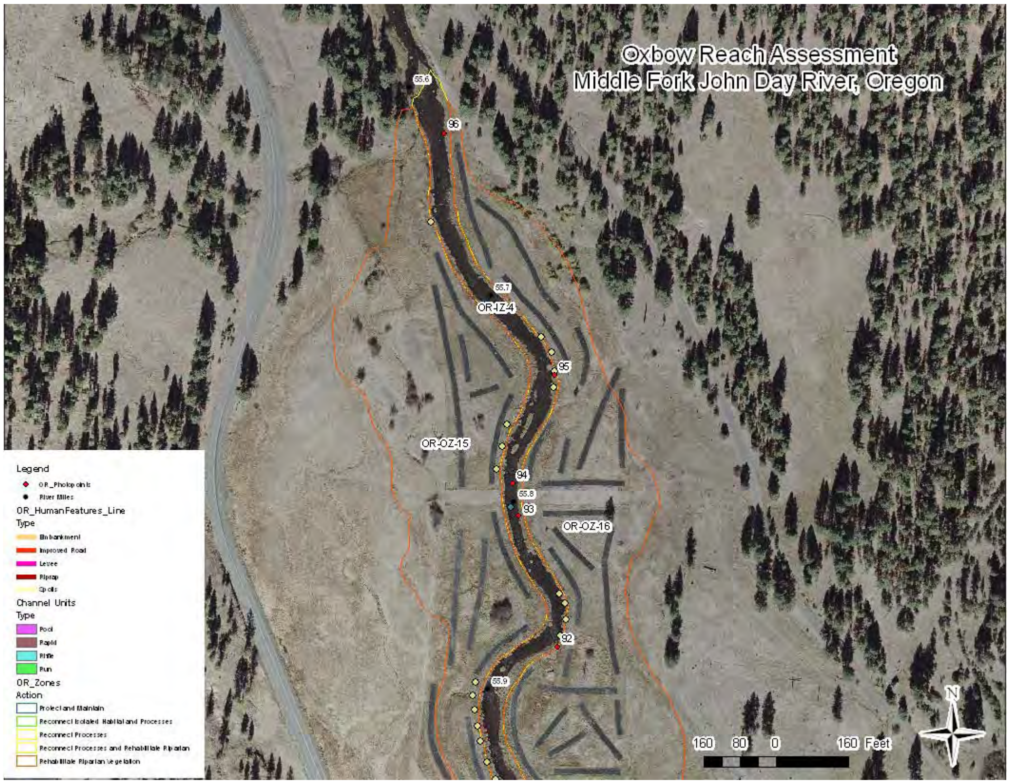


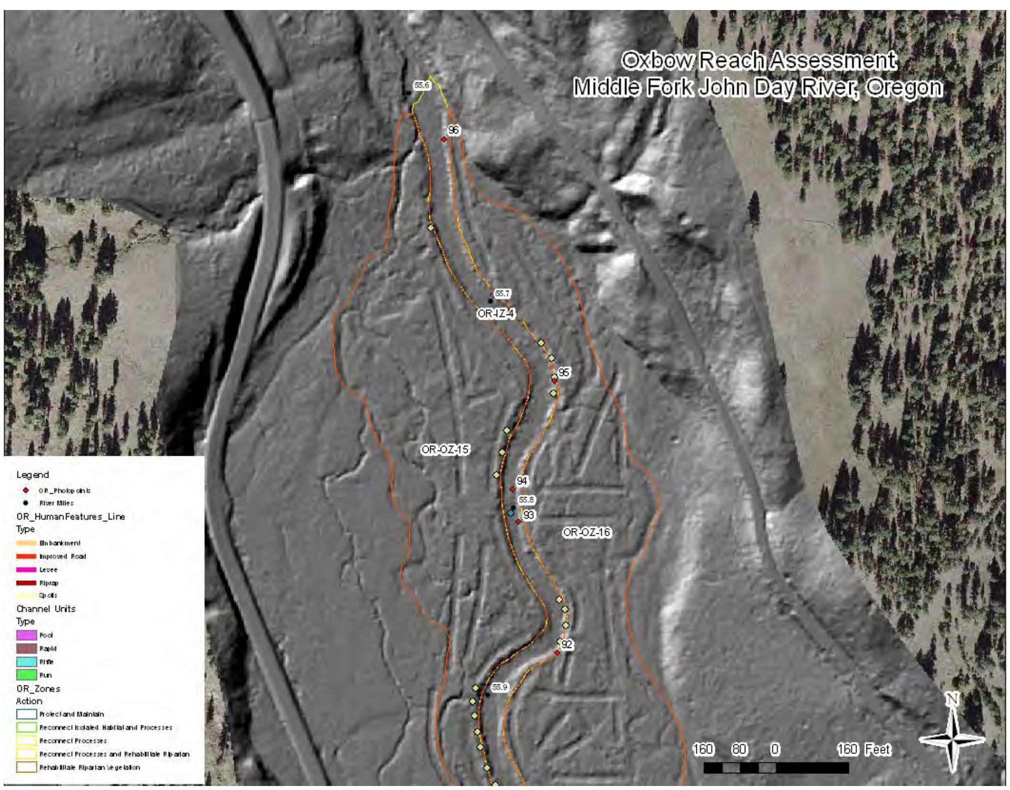
RM 56.2-55.8 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.





RM 55.9-55.6 Maps: Orthophotograph and LiDAR maps showing locations of photographs and anthropogenic features.





Photographic Documentation

Photograph No. 1. View is to the west looking across the river at historic bridge abutment along river right that restricts lateral migration of the river. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 2. View is to the north looking at levee placed along river left that restricts floodplain connectivity. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 3. View is to the northeast looking upstream at cattle crossing. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 4. View is to the northwest looking downstream at side-channel along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 5. View is to the northeast looking at the mouth of an overflow channel that is blocked due to small woody debris accumulation and sediment. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 6. View is to the southwest looking downstream at the mouth of tributary flowing into the Middle Fork along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 7. View is to the southwest looking downstream at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 8. View is to the south looking at a tributary entering the Middle Fork along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 9. View is to the southwest looking downstream at flow split to the North and South Channels. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 10. View is to the east looking upstream from river right at road grade (right of center in tan grass). Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 11. View is to the northwest looking downstream along the North Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 12. View is to the northwest looking downstream along the North Channel at foot-bridge. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 13. View is to the southeast looking at foot-bridge crossing the North Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 14. View is to the west looking at the mouth of Granite Boulder Creek as it enters the North Channel along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 15. View is to the northwest looking downstream along the North Channel. Project Area RM 56.5-57.9 – Oxbow Reach Assessment – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 16. View is to the northwest looking downstream along the North Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 17. View is to the southeast looking upstream at side-channel on the North Channel along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 18. View is to the north looking downstream at island along the North Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 19. View is to the southwest looking upstream where the South Channel enters the North Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 20. View is to the north looking downstream below the confluence of the North and South Channels. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 21. View is to the north looking downstream from river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 22. View is to the west looking at a small push-up levee along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 23. View is to the west looking at the split of the North and South Channels. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 24. View is to the west looking at an embankment that bisects the floodplain between the North and South Channels. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 25. View is to the southeast looking at the mouth of a tributary that flows into the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 26. View is to the southeast looking at the mouth of a tributary that flows into the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 27. View is to the southeast looking at a tributary entering the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 28. View is to the west looking downstream at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 29. View is to the west looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 30. View is to the west looking at backwater area along the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee July 17, 2007.

Photograph No. 31. View is to the west looking at a road embankment along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 32. View is to the south looking at ponded water along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 33**.** View is to the south looking at erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 34. View is to the south looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 35. View is to the south looking at riprap placed along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 36. View is to the south looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 37. View is to the southwest looking at bank erosion along river left where a silty-clay crops out. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 38. View of silty-clay along river left with overlying cobbles and gravels. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 39. View is to the south looking at boulder-sized material along river left. Note the gravelometer for scale. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 40. View is to the west looking downstream at several boulders in the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 41. View is to the southwest looking at a spoil pile along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 42. View is to the southwest looking at bank erosion along river left. The bank is comprised of a clayey material. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 43. View is to the west looking at bank erosion along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 44. View is to the south looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 45. Close-up view of the left bank showing bedded clayey material. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 46. View is to the south looking at a possible run-off inlet along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 47. View is to the northwest looking at the head of an overflow (?) channel along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 48. View is to the east looking at bank erosion along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 49. View is to the south looking upstream at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

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Photograph No. 50. View is to the west looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 51. View is to the north looking at bank erosion along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 52. View is to the south looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 53. View is to the west looking at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 54. View is to the west looking at bank erosion along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 55. View is to the west looking downstream. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 56. View to the west looking at a shallow pool in the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 57. View is to the west looking downstream at grass covered banks along the South Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 58. View is to the northeast looking at where the majority of the water in the South Channel turns to join the North Channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 59. View is to the west looking at a small continuation of the South Channel (irrigation ditch). Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 60. View is to the west looking at a spoil pile that runs along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 61. View is to the west looking at a shallow still water channel with moss and algae. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 62. View is to the south along the South Channel (irrigation ditch). Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 17, 2007.

Photograph No. 63. View is to the northwest looking downstream from river left. Note location of staff gauge on river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 64. View is to the southeast looking at a historical channel path on the Ruby Creek alluvial fan along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 65. View is to the northwest looking at historical channel path (primary) on the Ruby Creek alluvial fan along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 66. View is to the east looking at Ruby Creek where it is diverted into an irrigation ditch. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 67. View is to the northwest looking downstream along the main channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 68. View is to the west looking at the mine tailings (about 12-feet in height) along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 69. View is to the west looking at the mine tailings (about 12-feet in height) along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 70. View is to the west looking at the mine tailings along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 71. View is to the west looking at the mine tailings along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 72. View is to the west looking at the mine tailings along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 73. View is to the west looking at the mine tailings (about 12-feet in height) along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 74. View is to the west looking at the mine tailings (about 12-feet in height) along river left where the river has been channelized. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 75. View is to the northwest looking at the bridge abutment along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 76. View is to the north looking at the road embankment that bisects the floodplain. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 77. View is to the southeast looking at the Ruby Creek channel path(?) or historical channel swale upstream of road embankment. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 78. View is to the northwest looking at the Ruby Creek channel path(?) or channel swale downstream of road embankment. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 17, 2007.

Photograph No. 79. View is to the south looking at road embankment that bisects the floodplain. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 80. View is to the west looking at mine tailings that separate the river from wetland area along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 81. View is to the northwest looking at wetland area disconnected from river by mine tailings. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 82. View is to the northwest looking at remains of dredge left in the wetland area. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 83. View is to the northwest looking at spoil pile along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 84. View is to the west looking downstream at rock spurs placed along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 85. View is to the northwest looking downstream at a rock spur on river left and riprap along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 86. View is to the west looking downstream at riprap placed along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 87. View is to the south looking across the river at a side-channel with a rock spur at its entrance along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 88. View is to the northwest looking downstream at rock spurs placed along the left bank of the side-channel. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 89. View is to the west looking downstream at bank erosion along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 90. View is to the northwest looking downstream at rock spurs placed along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 91. View is to the northwest looking downstream at rock spurs placed along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 92. View is to the north looking downstream at rock spurs placed along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 93. View is to the north looking at cattle crossing across river. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 94. View is to the north looking downstream at rock spurs placed along river left. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 95. View is to the north looking downstream at rock spurs placed along river right. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

Photograph No. 96. View is to the north looking downstream along the river. Oxbow Reach – Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 18, 2007.

APPENDIX D

GIS Database

Appendix D

GIS Databases

The Oxbow Reach GIS (Geographic Information System) File Geodatabase was produced in support of the document, *Oxbow Ecosystem Baseline Assessment, Middle Fork John Day River, Grant County, Oregon*. More file geodatabases at the valley segment spatial scale are contained in the *John Day River Tributatary Assessments, Grant County, Oregon* (Reclamation, 2008), *Middle Fork John Day River, 2008 Stream Survey Report, Malheur National Forest, Blue Mountain Ranger District* (Appendix C), and *Geomorphology and Hydraulic Model Analysis of the Oxbow Conservation Area, Middle Fork John Day River, Grant County, Oregon* (Appendix D).

The ***OxbowReach*** File Geodatabase includes multiple feature classes:

Feature Classes	Description
OR_Channel Units	Physical attributes of the channel
OR_HumanFeatures_Point	Human created features (point)
OR_HumanFeatures_Line	Human created features (polyline)
OR_Zones	Inner/outer zone divisions
OR_Photopoints	Photograph locations (point)

For more information or to request a copy of the Oxbow Reach GIS File Geodatabase on DVD, contact Kristin Swoboda at the Reclamation's Pacific Northwest Regional Office, kswoboda@usbr.gov.

Oxbow Reach File Geodatabase

Project Feature Classes

Feature Class – OR_Zones
Title – OR_Zones: This feature class was created for the *Oxbow Ecosystem Baseline Assessment, Middle Fork John Day River, Grant County, Oregon*
Keyword – Inner zone, outer zone, subreaches, Oxbow reach
Abstract – This feature class contains polygons that show the location and extent of the inner and outer zones, and subreaches of the Oxbow reach area.

Feature Class – OR_ChannelUnits
Title – OR_ChannelUnits: This feature class was created for the *Oxbow Ecosystem Baseline Assessment, Middle Fork John Day River, Grant County, Oregon*
Keywords – Channel units, Oxbow reach
Abstract – This feature class contains polygons that show the location and extent of channel units within the Oxbow reach area.

Feature Class – OR_HumanFeatures_Point
Title – OR_HumanFeatures_Point: This feature class was created for the *Oxbow Ecosystem Baseline Assessment, Middle Fork John Day River, Grant County, Oregon*
Keywords – Human features, Oxbow reach
Abstract – This feature class contains points that show the location of anthropogenic features that impact channel processes and floodplain connectivity.

Feature Class – OR_HumanFeatures_Line
Title – OR_HumanFeatures_Line: This feature class was created for the *Oxbow Ecosystem Baseline Assessment, Middle Fork John Day River, Grant County, Oregon*
Keywords – Human features, Oxbow reach
Abstract – This feature class contains polylines that show the location and extent of anthropogenic features that impact channel processes and floodplain connectivity.

Feature Class – OR_Photopoints
Title – OR_Photopoints: This feature class was created for the *Oxbow Ecosystem Baseline Assessment, Middle Fork John Day River, Grant County, Oregon*
Keywords – Photographs, Oxbow reach
Abstract – This feature class contains points that display location and photograph number that correlate to the initial site assessments in Appendix B.

References

Reclamation, 2008, John Day River Tributary Assessments, Grant County, Washington: Bureau of Reclamation, Technical Service Center, Denver, CO