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Upper Columbia Basin Network
Stream Channel Characteristics and Riparian Condition
Annual Report 2013

John Day Fossil Beds National Monument (JODA)

Natural Resource Data Series NPS/UCBN/NRDS—2015/808

ON THE COVER
Bridge Creek, July 2013- John Day Fossil Beds National Monument- Painted Hills Unit.
NPS photo

Upper Columbia Basin Network Stream Channel Characteristics and Riparian Condition Annual Report 2013

John Day Fossil Beds National Monument (JODA)

Natural Resource Data Series NPS/UCBN/NRDS—2015/808

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Executive Summary

The mission of the National Park Service is "to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations" (NPS 1999). To uphold this goal, the Director of the NPS approved the Natural Resource Challenge to encourage national parks to focus on the preservation of the nation's natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). Through the Challenge, 270 parks in the national park system were organized into 32 inventory and monitoring networks.

The Upper Columbia Basin Network (UCBN) has identified 14 priority park vital signs, indicators of ecosystem health, which represent a broad suite of ecological phenomena operating across multiple temporal and spatial scales. Our intent has been to come up with a balanced and integrated "package" of vital signs that meets the needs of current park management, but will also be able to accommodate unanticipated environmental conditions in the future. Stream channel characteristics and riparian condition are particularly high priority vital signs for five of the nine UCBN parks. The UCBN contains more than 34 rivers, streams, ponds and reservoirs located in nine park units spread over four large western states. Unlike many National Parks that are large and often encompass entire watersheds, most UCBN parks and water bodies are small and embedded in large watersheds with diverse land use. Stream channel and riparian conditions in most UCBN streams have not been directly assessed.

Data from the 2013 field sampling effort was collected following methods detailed in the UCBN stream channel characteristics and riparian condition monitoring protocols (Starkey et al. 2011a, Starkey et al. 2011b) and the United States Forest Service- PACFISH/INFISH Biological Opinion (PIBO) peer reviewed protocols (Archer et al. 2012a, Archer et al. 2012b). The UCBN stream channel characteristics protocol was formally peer-reviewed and approved for implementation in December 2010. The UCBN riparian condition protocol was formally peer-reviewed and approved for implementation in September 2011. These protocols can be found on the UCBN website at: http://science.nature.nps.gov/im/units/ucbn/.

Note that field work for this protocol is completed by PIBO through an interagency agreement with the UCBN. Benthic macroinvertebrates were also collected by PIBO according to their peer reviewed protocol (Archer et al. 2012a). Results of macroinvertebrate sampling are reported in the 2013 JODA integrated water quality annual report (Starkey 2015).

This annual report details the status of key stream channel characteristics and riparian attributes obtained from monitoring on Bridge Creek and John Day River within John Day Fossil Beds National Monument. This report is intended as a release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but thorough analysis and interpretation of the data has not been completed. More extensive analysis and discussion of stream channel characteristics and riparian will occur as part of the trend analysis, which will be available after 3 years of monitoring data become available.

Acknowledgments

Funding for this project was provided through the National Park Service Natural Resource Challenge and the Servicewide Inventory and Monitoring Program. We would like to thank the PACFISH/INFISH- Biological Opinion Effectiveness Monitoring Program (PIBO-EM) for their many contributions to the UCBN stream channel characteristics and riparian condition protocols. Their willingness to collaborate with regional partners will greatly contribute to the understanding of water resources throughout the region. The UCBN would also like to thank JODA staff for the review of this report.

Introduction and Background

In 2013, the UCBN began its second year of stream channel characteristics and riparian condition monitoring on the John Day River and first year of monitoring on Bridge Creek at John Day Fossil Beds National Monument (JODA). Stream channel characteristics and riparian condition have been identified as high priority vital signs in the Upper Columbia Basin Network (UCBN). Stream channel and bank morphology, stability, and composition are fundamental and directly measurable attributes of lotic systems that directly affect riparian vegetation, water quality, and aquatic fauna, particularly macroinvertebrates and fish (Garrett et al. 2007). Water resources, including stream channels and riparian plant communities, in the semi-arid west have been strongly affected by human activity (Elmore and Kauffman 1994); and streams within the UCBN are of no exception. Most UCBN streams and their aquatic resources, such as migratory fish, are strongly influenced by activities in the larger watersheds outside park boundaries. Understanding the current status of freshwater ecosystems will help guide management and restoration efforts within park boundaries, assist with collaborative efforts between nearby landowners, and provide insight into ecosystem change in a landscape with changing climate and dynamic human influences.

As many authors have noted, there is an intimate connection between stream channels and the surrounding landscape (Gregory et al. 1991, Elmore and Kauffman 1994, Richards et al. 1996, Rosgen 1996, Sweeney et al. 2004). Stream channels are a product of regional geomorphology, hydrology, riparian vegetation, upland vegetation, land use and water use. Within a stream, channel characteristics profoundly influence habitat for macroinvertebrates and fish. This connection between the surrounding landscape, stream channels, and aquatic habitat makes monitoring channel characteristics and riparian condition an important aspect of natural resource monitoring in the UCBN.

Well-articulated desired future condition statements have not yet been developed for stream channel characteristics or riparian condition in UCBN parks. However, the mission statements for the NPS as a whole and for the individual parks clearly state the intent “to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations” (NPS 1999). Stream channels and riparian areas are of particularly high importance due to their connection to both aquatic and terrestrial ecosystem health, as well as their impact on cultural resources. It is assumed that desired future conditions for all UCBN parks will include streams and rivers that support natural processes, and provide visitors with recreational and scenic experiences. By monitoring stream channel characteristics and riparian condition the UCBN will be directly measuring attributes important to park mission, visitor experience, and desired future conditions.

Objectives

The overarching programmatic goal of the UCBN Stream Channel Characteristics and Riparian Condition Monitoring Protocols is to obtain information that will aid management and restoration decisions pertaining to stream channels and riparian areas within UCBN parks. The primary objective of current stream channel and riparian management in UCBN parks is to prevent extensive changes from that of historic conditions and to restore stream channels and riparian communities, if necessary, to maintain a system with biotic integrity and good hydrologic function.

Stream Channel Characteristics

Given the lack of available data on channel characteristics in UCBN parks, the following fundamental questions drive much of the UCBN's inquiry.

- Are stream channel attributes improving or degrading over time?
- Do planform and cross section measures collected within UCBN streams indicate changes in land use or management practices?
- How do UCBN stream channel conditions compare to those in the watershed and region?
- Do cross section measures collected within UCBN streams indicate impaired habitat for macroinvertebrates or fishes?
- Are cultural resources at risk of degradation due to stream bank erosion?

In light of these questions and the broader goals outlined above, the stream channel characteristics monitoring protocol addresses the following specific measurable monitoring objectives:

1. Determine the status of bank stability, percent undercut, bank angle, percent fines, and other key stream channel characteristics for selected wadeable stream reaches.
2. Determine the direction and magnitude of change over time for bank stability, percent undercut, bank angle, percent fines, and other key stream channel characteristics, and establish whether those changes reflect impacts from management or land use activities.
3. Determine the condition of key stream channel attributes within selected wadeable UCBN stream reaches, relative to PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO) sample reaches in the same watershed.
4. Determine if changes in stream channels, specifically bank erosion, are likely to negatively impact cultural resources within the floodplain.

Riparian Condition

Given the lack of available data on riparian condition in UCBN parks, the following fundamental questions drive much of the UCBN's inquiry.

- What is the status of biotic integrity and hydrologic function of UCBN riparian zones?
- What is the direction and magnitude of change in UCBN riparian zone condition, as indicated by greenline and channel cross-section measures of vegetation cover collected along select UCBN streams?
- How do UCBN riparian conditions compare to those in the watershed and region?
- Do cover measures collected along UCBN streams indicate impaired habitat for macroinvertebrates or fishes (e.g., reduced shading)?

In light of these questions and the broader goals outlined above, the riparian condition monitoring protocol addresses the following specific measurable monitoring objectives:

1. Determine the status of riparian condition, as measured by greenline and channel cross section wetland ratings (i.e., obligate wetland riparian plant species cover), effective ground cover, and greenline woody vegetation cover for selected wadeable stream reaches.
2. Determine the direction and magnitude of change over time for obligate wetland riparian plant species cover, effective ground cover, and woody vegetation cover.
3. Determine the condition of riparian zones along selected wadeable UCBN stream reaches, relative to PIBO sample reaches in the same watershed.
4. Determine the status and trend in the cover of non-native invasive plant species (e.g. *Phalaris arundinacea, Equisetum arvense*) found along UCBN streams, as estimated from PIBO sample reaches.

Study Area

Bridge Creek- John Day Fossil Beds National Monument (JODA) Painted Hills Unit

The Painted Hills unit of JODA is in the Lower John Day Watershed, Hydrologic Unit 17070204 (United States Geologic Survey [USGS]), in Wheeler County, Oregon (Figures 1-3, Appendix B). The drainage area for Bridge Creek above the USGS gage (#14046778) is approximately 692 square km (267 square miles) and consists of several land cover types (NPS 1997). According to Bell and Hinson 2010, the Painted Hills watersheds are dominated by the following land cover types: big sagebrush-bluebunch wheatgrass (40.34%), Wyoming big sagebrush (33.06%), and less than 2% of the watersheds in agriculture or developed lands.

Designated beneficial uses for the Bridge Creek include: public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality (OR DEQ 2010). Designated fish use is for salmon and trout rearing and migration (note: includes all salmon species, steelhead, rainbow and cutthroat trout. The designated salmon and steelhead spawning use is from January 1 – May 15(OR DEQ 2010, Admin. Rules of OR 2013, 340-041-001 [through 12/15/2013]).

Stream channel and riparian monitoring started at JODA in 2010 (see Starkey 2011 and Starkey 2013); however, Bridge Creek was not monitored due to the abundance of monitoring being conducted by NOAA fisheries-Columbia River Habitat Monitoring Program (CHaMP) and Integrated Status and Effectiveness Monitoring Program (ISEMP). More information on the intensively monitored restoration of Bridge Creek can be found in Pollock (2007), Pollock et al. (2011), ISEMP (2009), and Hall et al. (2010). In 2013, the UCBN and JODA staff decided to monitor stream channel characteristics and riparian condition on Bridge Creek. This additional monitoring on Bridge Creek will allow the UCBN to compare our findings to that of CHaMP/ISEMP and provide a consistent dataset across monitored streams at JODA. Two sample site/reaches were established starting at the downstream park boundary. Both stream channel characteristics and riparian condition were evaluated at each site. The most upstream sample site ended near the Painted Hills unit picnic area (Figure3). Due to field logistics Bridge Creek was sampled in 2014 and not as originally planned in 2013.

Figure 1. Bridge Creek looking upstream towards the picnic area.

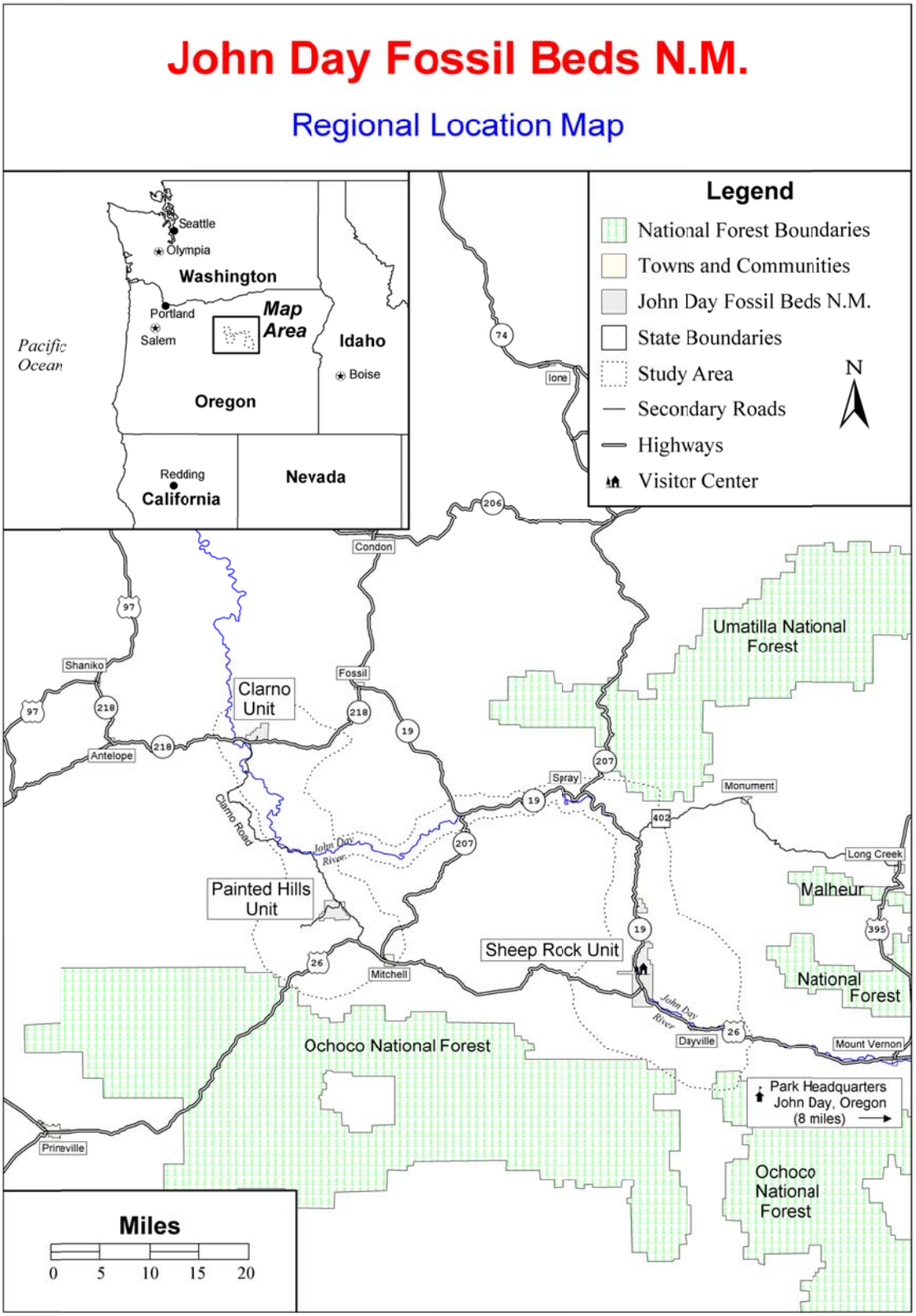

Figure 2. John Day Fossil Beds National Monument regional map (NPS 1997).

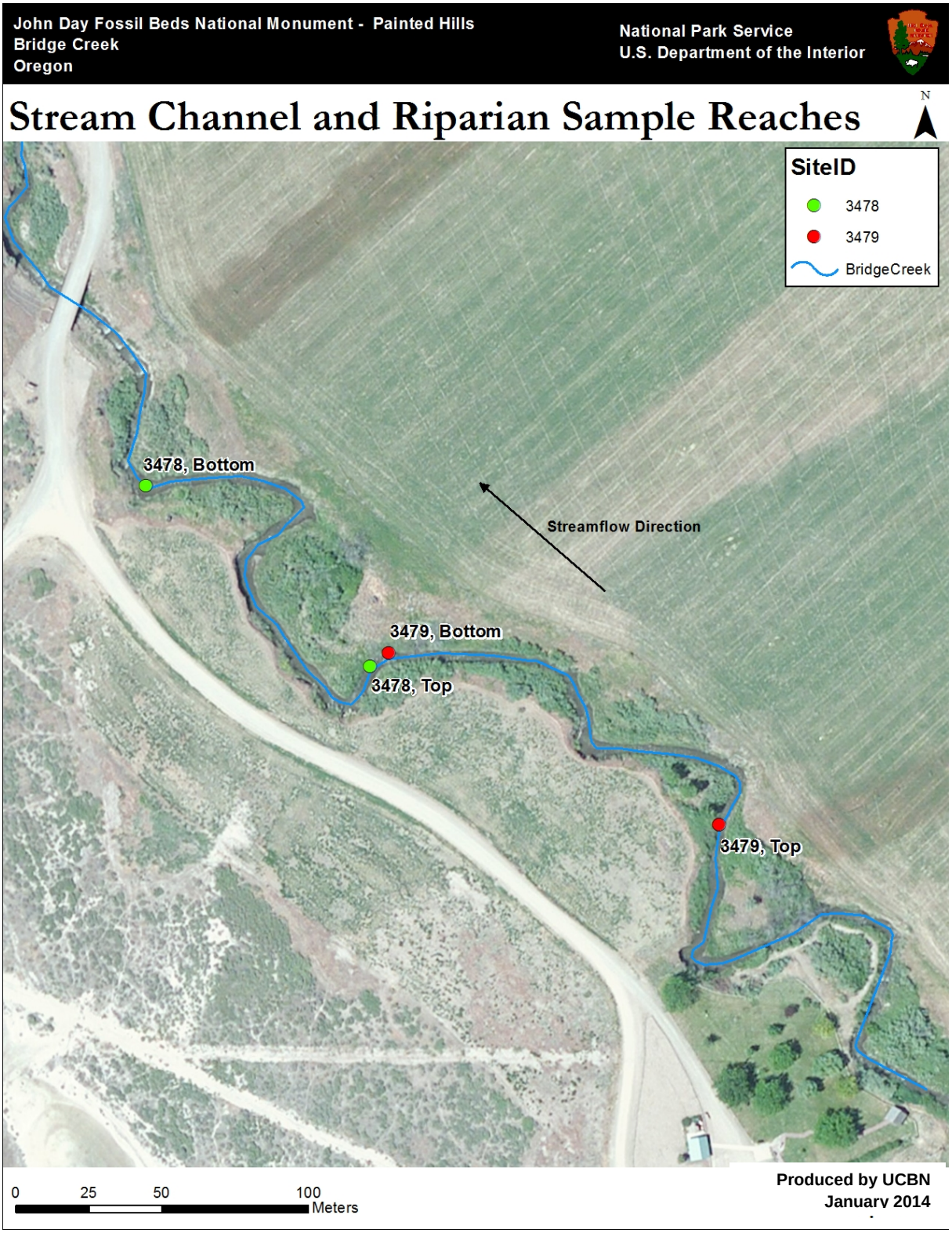

Figure 3. Top and bottom of stream channel characteristic and riparian condition monitoring sites in Bridge Creek 2014.

John Day River- John Day Fossil Beds National Monument (JODA), Sheep Rock Unit

The Sheep Rock unit of JODA is in the Upper John Day Watershed, Hydrologic Unit 17070201 (United States Geologic Survey [USGS]), in Grant County, Oregon (Figures 4 and 5, Appendix B). The drainage area for the John Day River above the park is approximately 4,351 square km (1,680 square miles) and consists of several land cover types (NPS 1997). According to Bell and Hinson 2010, Sheep Rock's watersheds are dominated by the following land cover types: big sagebrush-bluebunch wheatgrass (*Aretimisia tridentate, Pseudoroegneria spicata*) (36.59%), Wyoming big sagebrush (*Aretimisia tridentata* spp. *wyomingensis*) (13.63%), and has less than 3% of the watersheds in agriculture or developed lands. In addition, over 25% of the Sheep Rock watersheds are tree dominated vegetation, primarily ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*)[Bell and Hinson 2010].

Designated beneficial uses for the John Day River and all its tributaries include: public and private domestic water supply, industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality (OR DEQ 2010). Designated fish use is for salmon and trout rearing and migration (note: includes all salmon species, steelhead, rainbow and cutthroat trout. The designated salmon and steelhead spawning use is from January 1 – May 15(OR DEQ 2010, Admin. Rules of OR 2013, 340-041-001 [through 12/15/2013]).

Five sample sites/reaches were established starting from the downstream park boundary. Both stream channel characteristics and riparian condition were evaluated at each site. The most upstream sample site ended just upstream of the Cant ranch house (Figure 5). Note that stream channel characteristics and riparian condition were not evaluated at sample site #3078, it was sampled exclusively for benthic macroinvertebrates.

Figure 4. John Day River looking upstream towards picture gorge.

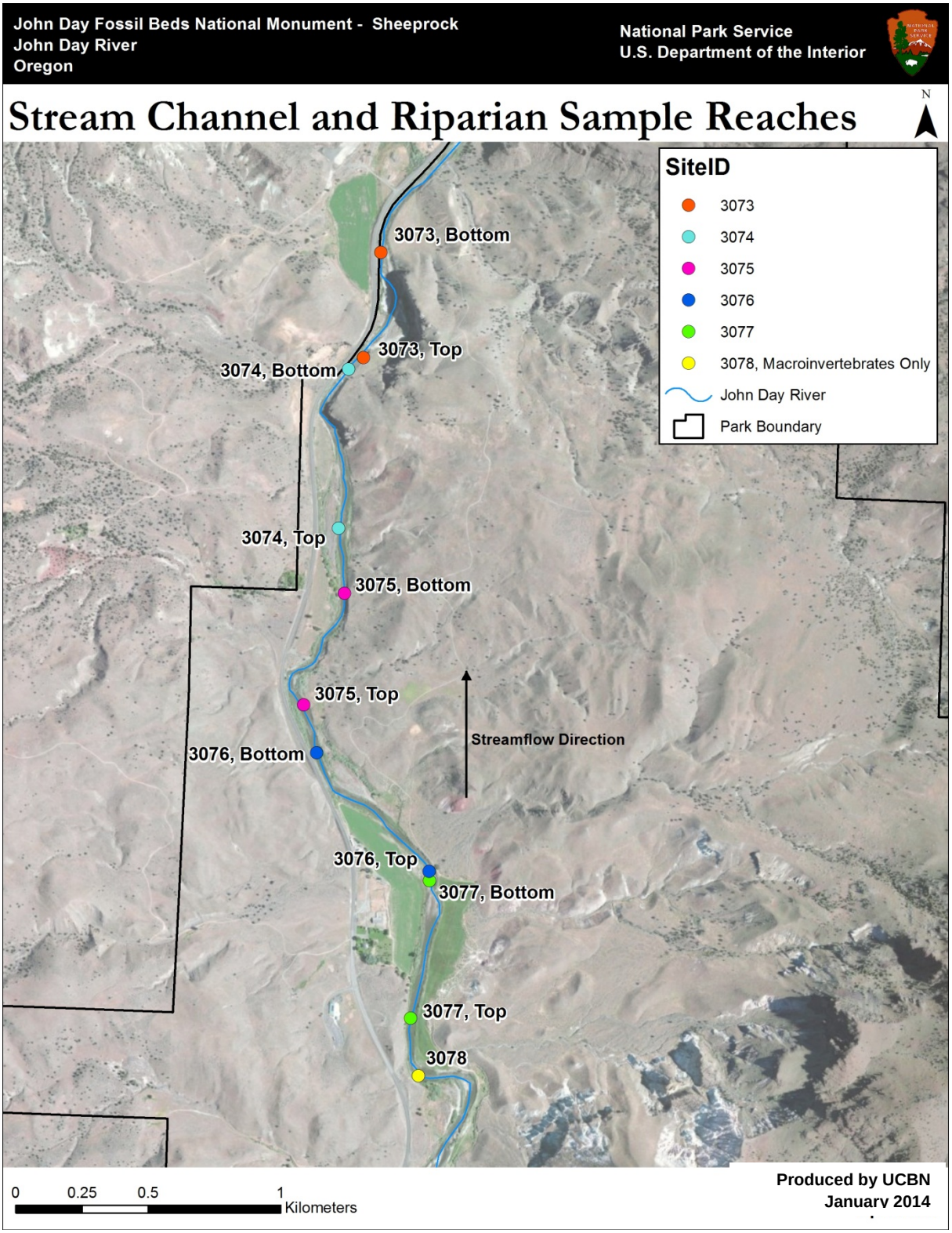

Figure 5. Top and bottom of stream channel characteristic and riparian condition monitoring sites in the John Day River 2013.

Methods

Data from the 2013 field sampling effort was collected following methods detailed in the UCBN stream channel characteristics and riparian condition monitoring protocols (Starkey et al. 2011a, Starkey et al. 2011b). The UCBN's protocols mirror existing monitoring protocols developed by the United States Forest Service (USFS) PACFISH/INFISH Effectiveness Monitoring (PIBO-EM) Program (Archer et al. 2012a and Archer et al. 2012b). In addition to the use of existing protocols, the UCBN has formed an interagency agreement with the USFS such that the PIBO program collects the data necessary to complete stream channel and riparian monitoring in the UCBN. The use of existing tested protocols and a trained field crew promotes data quality and integration of data from the UCBN with data collected throughout the region. This approach will provide a unique opportunity to examine park stream channel and riparian resources relative to regional status and trends. A more detailed description of the PIBO program's purpose and approach to monitoring can be found in Kershner et al. (2004) and Henderson et al. (2005).

To achieve the measurable objectives, the PIBO program established sites as described below and sampled the John Day River in August 2013 and Bridge Creek in July 2014, during base flow conditions. Note that Bridge Creek will normally be sampled in the same year as the John Day River.

Data Collection

All data collection was conducted by the USFS PIBO Program in accordance with the PIBO Sampling Protocol for Stream Channel Attributes (Archer et al. 2012a) and Sampling Protocol for Vegetation Parameters (Archer et al. 2012b). These protocols are available from the PIBO website (http://www.fs.fed.us/biology/fishecology/emp/ Accessed 21 February 2014).

Locating Stream Channel and Riparian Sample Reaches

Sample reach selection differed slightly from standard PIBO methods due to the restriction placed on the sampling design by park boundaries. Typically sample reach locations are chosen by moving upstream from the bottom of a randomly selected 6th field HUC until a pool tail is reached. As a result of this boundary restriction, the location of the first sample reach was determined by the field crew moving upstream from the park boundary until the first pool tail was identified. Subsequent sample reaches within the park were determined by moving upstream from a previous sample reach until another pool tail was identified. Pools are clearly defined in the "Pools" section of the PIBO Sampling Protocol for Stream Channel Attributes (Archer et al. 2012a). It is important to note that stream channel and riparian sample reaches are co-located. The additional benthic macroinvertebrate sample location was identified in the same manner and fell above the most upstream stream channel sample reach. The top and bottom of each sample reach were permanently marked using a 1 inch by 3 inch piece of aluminum with PIBO EM scratched into them (Figure 6). The top of each reach was labeled with the site number and TR for Top Reach and the bottom of each reach with the site number and BR for Bottom Reach. In subsequent years, during revisits, field crews will navigate back to the same sample reach using a reach description, photographs, topographic map and UTM coordinates. Reach descriptions, photographs and topographic maps are archived on the UCBN server.

Figure 6. Marker at the bottom of JODA reach #3074, August 2010.

Results

Note that this report is a data series report and intended as a release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but thorough analysis and interpretation of the data has not been completed. More extensive analysis and discussion of stream channel characteristics and riparian condition will occur as part of the trend analysis, which will be available after 3 years of monitoring data become available.

Stream Channel Characteristics/Riparian Condition

The status of individual stream channel parameters is shown in Tables 1 and 2. Greenline wetland ratings and status of individual riparian attributes are shown in Tables 3 and 4. A summary of weeds encountered during the riparian assessment is given in Tables 5 and 6. Descriptions of each parameter are given in Appendix C.

Data collected on Bridge Creek in 2014 represents the first stream channel and riparian assessment. Therefore, all data should be considered baseline information to which future assessments can be compared. Data from the John Day River in 2013 may be compared to 2010 data; however, this should be done with some caution since the sample size is limited. The next assessment will occur in 2016, with a preliminary assessment of trend in 2019.

Table 1. Vital sign summary table for stream channel characteristics in Bridge Creek JODA, July 2014.

Bridge Creek Stream Channel Characteristics Summary 2014

		Site ID/Reach ID			
Parameter (Units)	Abbreviation	3478/8322	3479/8323	Mean	Standard Deviation
Index of physical habitat integrity	HabIndex	24.5	26.6	25.5	1.4
Average bankfull width from transects (m)	Bf	4.5	4.4	4.4	0.0
Gradient of stream reach (%)	Grad	0.706	0.680	0.7	0.0
Sinuosity of stream reach (ratio)	Sin	1.7	1.3	1.5	0.3
Residual pool depth (m)	PoolDp	0.3	0.2	0.3	0.0
Percent pools (%)	PoolPct	50.6	47.3	49.0	2.3
Number of pools per kilometer.(# / km)	PoolFrq	59.3	53.2	56.3	4.3
Bankfull width to depth ratio at transects (ratio)	WDTrans	9.9	12.2	11.0	1.6
Wetted width to depth ratio at transects (ratio)	WDwetTrans	16.4	29.5	22.9	9.3
Diameter of the 50th percentile streambed particle (m)	D50	0.03100	0.01950	0.0	0.0
Percent pool tail fines < 2mm (%)	PTFines2	9.0	5.2	7.1	2.7
Percent pool tail fines < 6mm (%)	PTFines6	13.7	11.0	12.4	1.9
Average bank angle (degrees)	BnkAngl	109	113	111.0	2.8
Percent stable banks (covered stable, false bank, and uncovered stable). (%)	Stab	95.2	97.6	96.4	1.7
Vegetated Stability	VegStab	95.2	95.2	95.2	0.0
Percent of bank angles < 90 (%)^{o}	UnCutPct	30.95	28.57	29.8	1.7
Large wood frequency (pieces / km)	LWfrq	11.9	17.7	14.8	4.2
Large wood volume (m^3 / km)	LWVol	0.2	5.1	2.6	3.5

Table 2. Vital sign summary table for stream channel characteristics in John Day River River within JODA, August 2013.

John Day River Stream Channel Characteristics Summary 2013

		Site ID/Reach ID						
Parameter (Units)	Abbreviation	3073/7687	3074/7688	3075/7689	3076/7690	3077/7691	Mean	Standard Deviation
Index of physical habitat integrity	HabIndex	NC*	NC*	NC*	NC*	NC*	NC*	NC*
Average bankfull width from transects (m)	Bf	22.4	26.4	21.9	27.2	27.5	25.1	2.7
Gradient of stream reach (%)	Grad	0.673	0.410	0.384	0.350	0.276	0.4	0.2
Sinuosity of stream reach (ratio)	Sin	1.1	1.1	1.2	1.0	1.1	1.1	0.1
Residual pool depth (m)	PoolDp	1.4	0.7	0.8	0.8	0.9	0.9	0.3
Percent pools (%)	PoolPct	70.5	38.3	74.5	74.8	64.8	64.6	15.2
Number of pools per kilometer.(# / km)	PoolFrq	6.5	7.6	11.0	9.3	10.7	9.0	1.9
Bankfull width to depth ratio at transects (ratio)	WDTrans	20.3	35.4	26.0	30.5	27.5	27.9	5.6
Wetted width to depth ratio at transects (ratio)	WDwetTrans	29.1	61.8	52.3	75.0	74.5	58.5	19.0
Diameter of the 50th percentile streambed particle (m)	D50	0.10300	0.11500	0.07200	0.04550	0.04250	0.1	0.0
Percent pool tail fines < 2mm (%)	PTFines2	1.1	0.3	1.6	9.2	3.1	3.1	3.6
Percent pool tail fines < 6mm (%)	PTFines6	10.4	0.7	19.8	16.2	7.1	10.8	7.5
Average bank angle (degrees)	BnkAngl	140	126	130	111	129	127.2	10.5
Percent stable banks (covered stable, false bank, and uncovered stable). (%)	Stab	100.0	100.0	100.0	97.9	97.6	99.1	1.2
Vegetated Stability	VegStab	65.9	78.0	81.0	83.3	83.3	78.3	7.3
Percent of bank angles < 90 (%)^{o}	UnCutPct	9.09	22.45	19.05	29.17	14.29	18.8	7.7
Large wood frequency (pieces / km)	LWfrq	0.0	6.1	7.3	0.0	0.0	2.7	3.7
Large wood volume (m^3 / km)	LWVol	0.0	2.0	0.5	0.0	0.0	0.5	0.9

*NC= not calculated

Table 3. Vital sign summary table for riparian condition along Bridge Creek within JODA, July 2014.

Bridge Creek Riparian Condition Summary 2014

		Site ID/Reach ID			
Parameter (Units)	Abbreviation	3478/8322	3479/8323	Mean	Standard Deviation
Greenline total cover (%)	GLTotalCv	62.1	78.2	70.1	11.4
Greenline relative alien cover (%)	GLRAC	18.1	24.4	21.3	4.5
Greenline relative cover nativity unknown (%)	GLUnid	0.0	0.0	0.0	0.0
Cross-section total cover (%)	XSTotalCv	56.9	86.7	71.8	21.1
Cross-section relative alien cover (%)	XSRAC	44.2	44.0	44.1	0.1
Cross-section relative cover nativity unknown (%)	XSUnid	0.0	0.0	0.0	0.0
Reach native cover (%)*	RchNtvCv	42.9	54.7	48.8	8.4
Reach alien cover (%)	RchAlnCv	17.0	27.0	22.0	7.1
Reach cover nativity unknown (%)	RchUnidCv	0.0	0.0	0.0	0.0
Reach total cover (%)	RchTotalCv	59.9	81.7	70.8	15.4
Richness native (# native species)	SNtv	17	15	16.0	1.4
Richness alien (# non-native species)	SAln	9	11	10.0	1.4
Effective ground cover (%)	EGC	89.0	92.5	90.7	2.5
Greenline woody cover (%)	GLwoodyCv	6.3	16.9	11.6	7.5
Greenline wetland rating (unitless)	GLWetRat	67.9	67.3	67.6	0.5
Cross-section wetland rating (unitless)	XSWetRat	55.7	56.8	56.2	0.7

* Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Table 4. Vital sign summary table for riparian condition along John Day River within JODA, August 2013.

John Day River Riparian Condition Summary 2013

		Site ID/Reach ID						
Parameter (Units)	Abbreviation	3073/7687	3074/7688	3075/7689	3076/7690	3077/7691	Mean	Standard Deviation
Greenline total cover (%)	GLTotalCv	73.3	72.9	79.8	72.5	68.6	73.4	4.0
Greenline relative alien cover (%)	GLRAC	6.5	3.4	1.5	2.1	1.1	2.9	2.2
Greenline relative cover nativity unknown (%)	GLUnid	6.3	0.0	0.0	0.0	0.0	1.3	2.8
Cross-section total cover (%)	XSTotalCv	28.0	41.7	46.4	60.3	59.8	47.2	13.5
Cross-section relative alien cover (%)	XSRAC	10.7	13.2	17.7	8.0	2.2	10.4	5.8
Cross-section relative cover nativity unknown (%)	XSUnid	7.2	0.0	0.0	0.0	0.0	1.4	3.2
Reach native cover (%)*	RchNtvCv	47.3	57.6	61.8	65.0	64.0	59.1	7.2
Reach alien cover (%)	RchAlnCv	4.1	3.6	4.1	2.8	1.0	3.1	1.3
Reach cover nativity unknown (%)	RchUnidCv	3.5	0.0	0.0	0.0	0.0	0.7	1.6
Reach total cover (%)	RchTotalCv	54.9	61.2	65.9	67.8	65.0	63.0	5.1
Richness native (# native species)	SNtv	12	15	18	14	16	15.0	2.2
Richness alien (# non-native species)	SAln	7	6	6	4	3	5.2	1.6
Effective ground cover (%)	EGC	82.4	90.4	83.6	84.3	85.6	85.3	3.1
Greenline woody cover (%)	GLwoodyCv	31.0	7.1	17.1	8.8	11.2	15.1	9.7
Greenline wetland rating (unitless)	GLWetRat	83.0	78.9	82.1	80.0	75.8	80.0	2.8
Cross-section wetland rating (unitless)	XSWetRat	63.9	66.5	67.4	70.4	50.8	63.8	7.6

* Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Table 5. Vital sign summary table for weeds in riparian areas along Bridge Creek within JODA, July 2014. Note that species listed as weeds are listed as noxious weeds in the INVADERS Database System http://invader.dbs.umt.edu (Rice 2014).

Bridge Creek Weeds Summary 2014

Site ID	Reach ID	Stream	Plant Species	Common Name	Greenline weed cover (%)	Cross-section weed cover (%)
3478	8322	Bridge 1	*Sonchus arvensis*	field sowthistle	1.9	0.3
3478	8322	Bridge 1	*Acroptilon repens*	hardheads	0.8	0.0
3478	8322	Bridge 1	*Phalaris arundinacea*	reed canarygrass	22.8	17.6
3478	8322	Bridge 1	*Equisetum arvense*	field horsetail	10.9	3.1
3479	8323	Bridge 2	*Phalaris arundinacea*	reed canarygrass	19.3	8.8
3479	8323	Bridge 2	*Sonchus arvensis*	field sowthistle	4.6	0.3
3479	8323	Bridge 2	*Equisetum arvense*	field horsetail	12.5	0.0
3479	8323	Bridge 2	*Acroptilon repens*	hardheads	0.0	8.7

Table 6. Vital sign summary table for weeds in riparian areas along John Day River within JODA, August 2013. Note that species listed as weeds are listed as noxious weeds in the INVADERS Database System http://invader.dbs.umt.edu (Rice 2014).

John Day River Weeds Summary 2013

Site ID	Reach ID	Stream	Plant Species	Common Name	Greenline weed cover (%)	Cross-section weed cover (%)
3073	7687	John Day	*Elymus repens*	quackgrass	2.2	0.7
3073	7687	John Day	*Phalaris arundinacea*	reed canarygrass	5.9	4.6
3074	7688	John Day	*Equisetum arvense*	field horsetail	0.8	0.0
3074	7688	John Day	*Phalaris arundinacea*	reed canarygrass	7.3	9.7
3074	7688	John Day	*Xanthium spinosum*	spiny cockleburr	1.7	0.7
3075	7689	John Day	*Phalaris arundinacea*	reed canarygrass	21.8	12.4
3075	7689	John Day	*Equisetum arvense*	field horsetail	3.2	0.0
3076	7690	John Day	*Equisetum arvense*	field horsetail	0.4	0.0
3076	7690	John Day	*Phalaris arundinacea*	reed canarygrass	21.7	40.0
3077	7691	John Day	*Phalaris arundinacea*	reed canarygrass	26.2	16.3

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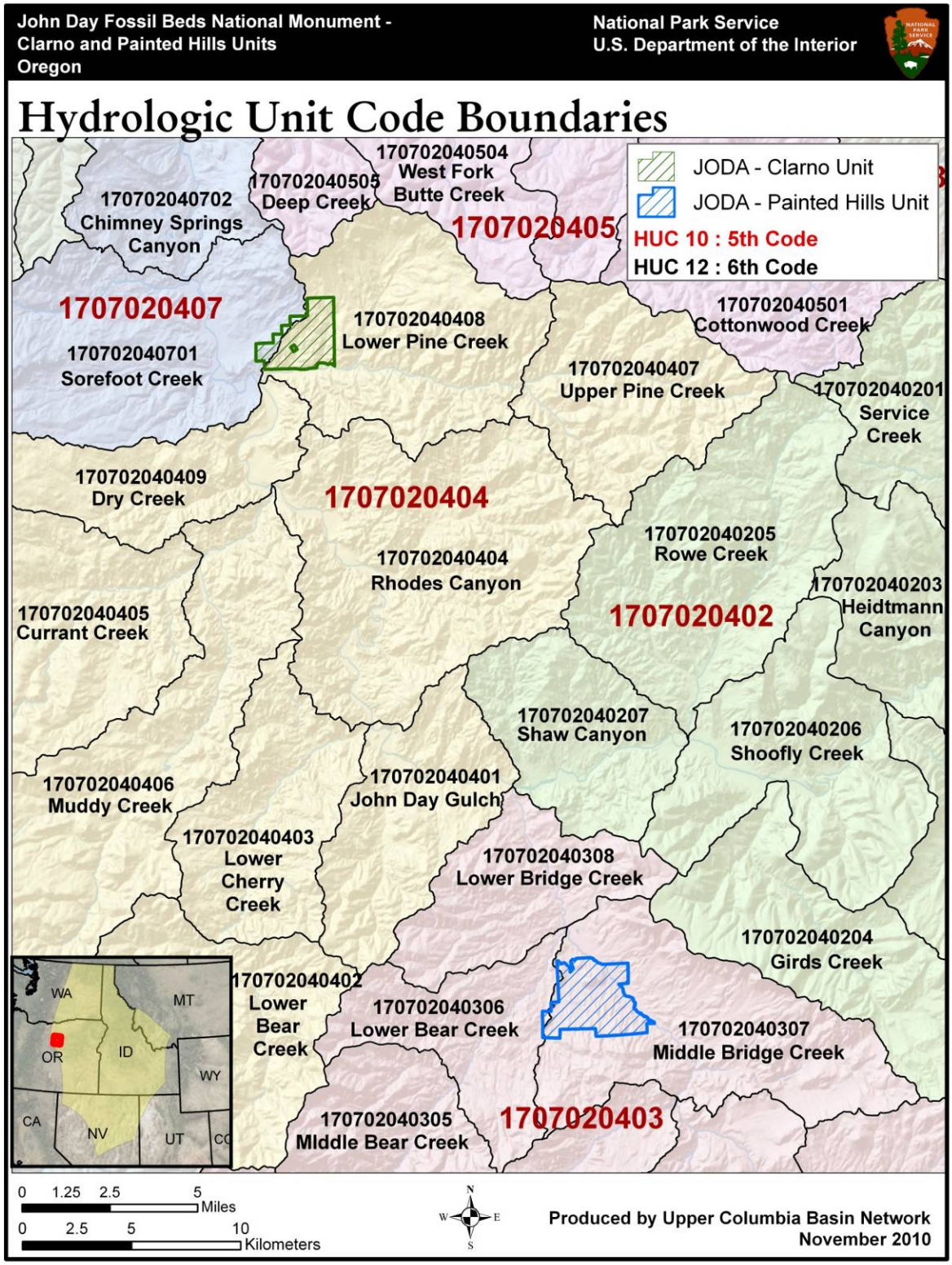
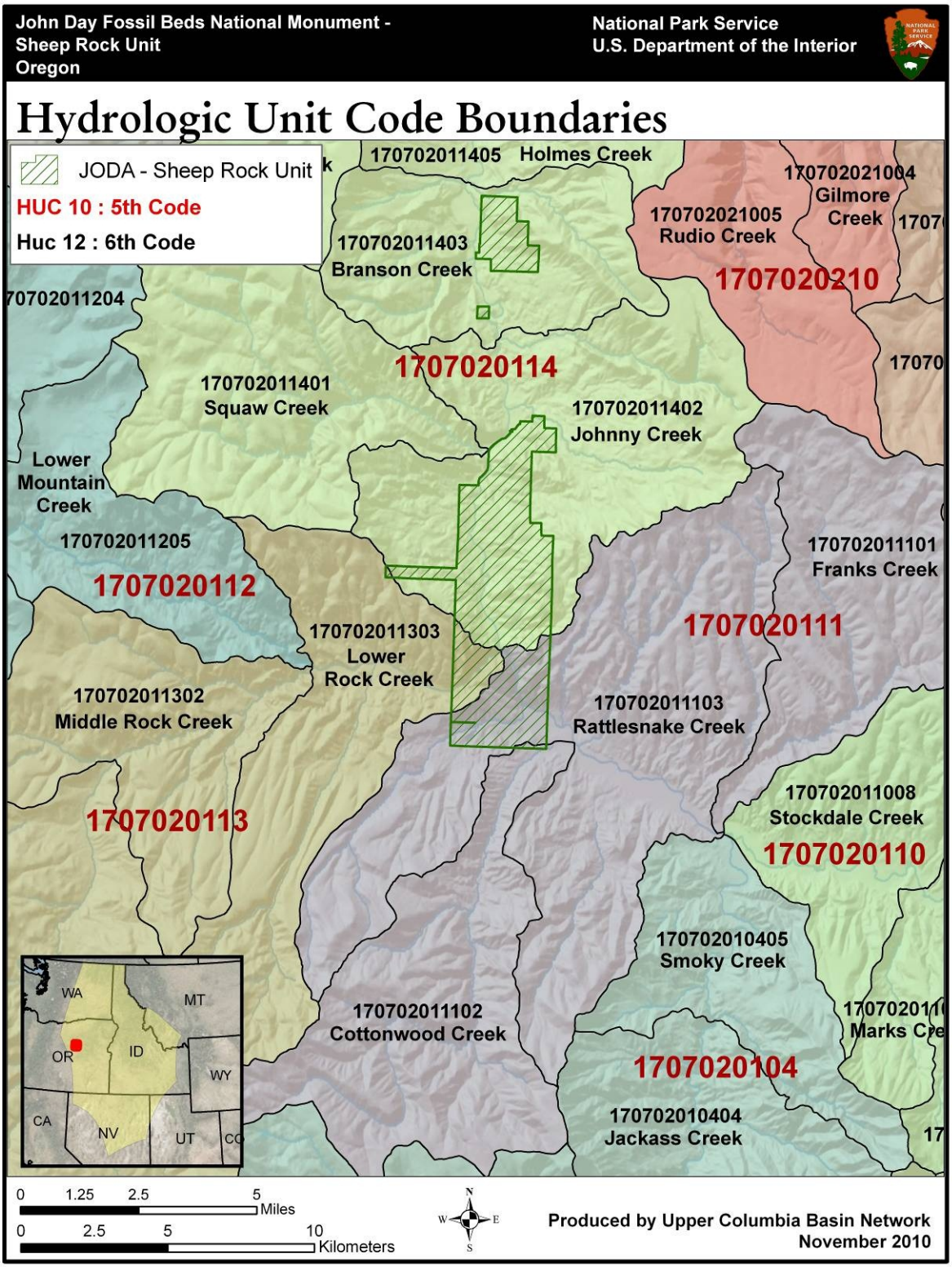
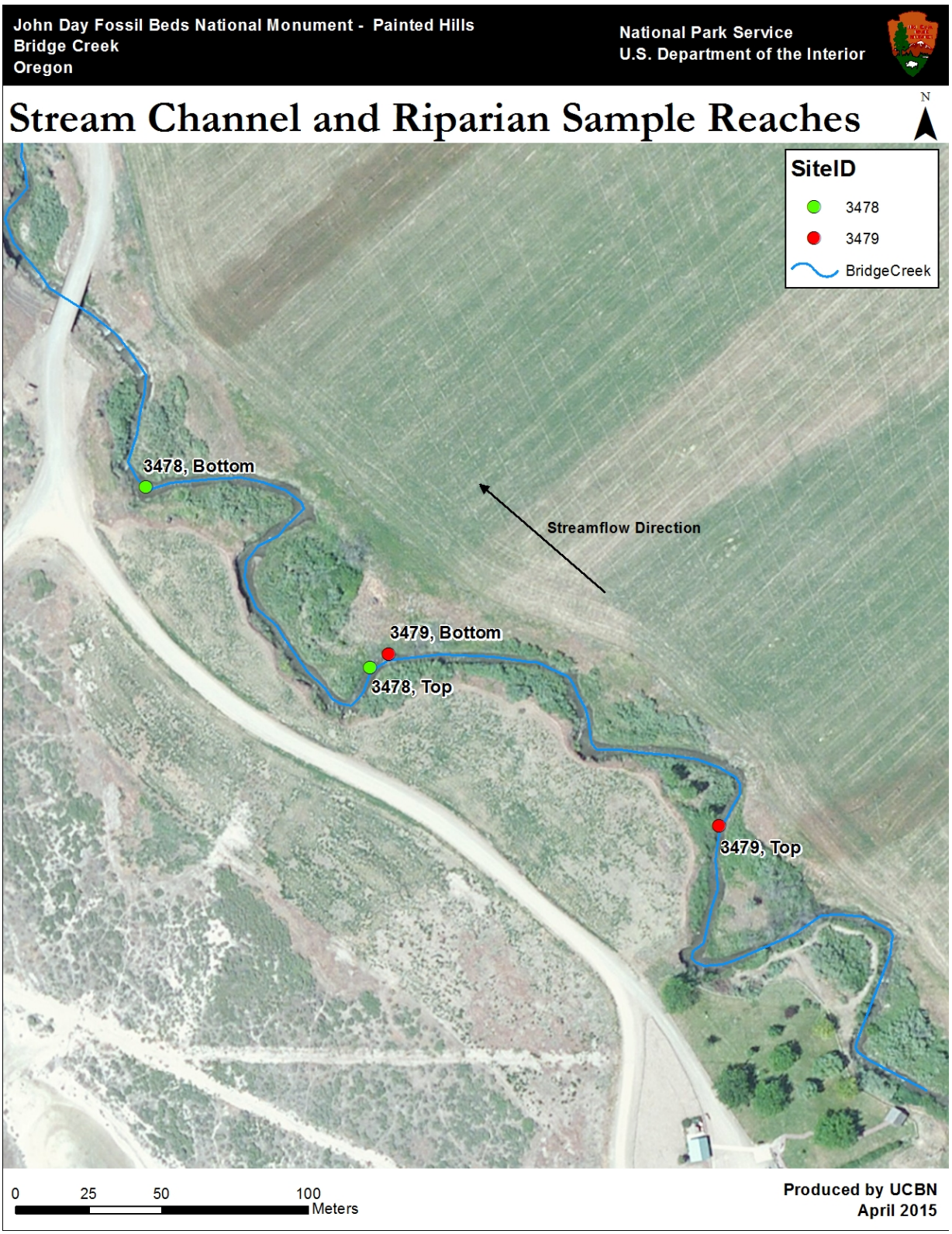
Appendix A. Hydrologic Unit Code Boundaries, JODA



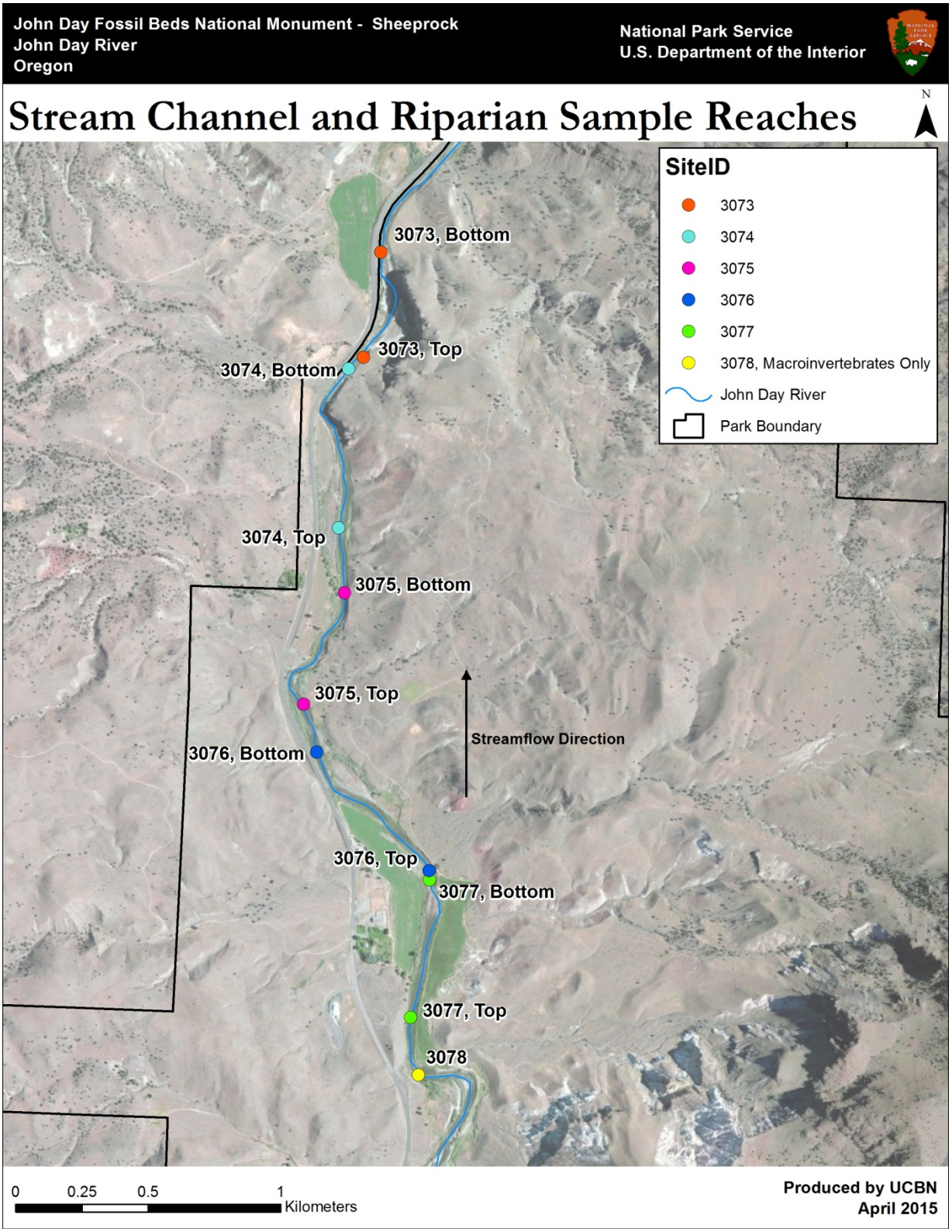
Appendix A. Hydrologic Unit Code Boundaries, JODA (continued)



Appendix B. Stream Channel/Riparian Monitoring Locations, JODA 2013



Appendix B. Stream Channel/Riparian Monitoring Locations, JODA 2013 (continued)



Appendix C. Parameter Descriptions for Riparian, Stream Channel and Weed Monitoring

The descriptions of each parameter have been provided by PIBO as part of the data summaries for stream channel and riparian monitoring.

Riparian Condition

Cross-section relative alien cover: The proportion of cross-section plant cover coming from non-native species. Calculated as species cover of non-natives divided by total species cover, and multiplied by 100. (Magee et al. 2008.)

Cross-section relative cover nativity unknown: The relative cross-section plant cover of species with nativity status unknown. Calculated as cover of species with nativity unknown divided by total species cover, and multiplied by 100. NOTE: This value is relativized, and not comparable to other reported (actual) cover values.

Cross-section total cover: Total plant cover for riparian cross-section. Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Cross-section wetland rating: A measure of the abundance of wetland species in the riparian area. A wetland rating of 100 indicating all obligate wetland species and 1 being all upland species. The rating is calculated for each reach by summing the product of the relative cover of each species for which a wetland indicator status can be determined and a value corresponding to the species' wetland indicator status (1=upland, 25= facultative upland, 50=facultative, 75=facultative wet, 100=obligate wetland. Coles-Ritchie et al. 2007).The cross-section sample area was a fixed area, 3 to 9.5 m from the greenline.

Effective ground cover: The percent of the riparian area (not including the greenline) with effective ground cover. The cross-section average percent cover of bare soil is subtracted from 100 to calculate effective ground cover. Live vegetation within 1 m of the ground, litter, and rocks greater than 2.5 cm are considered effective ground cover. Prior to 2009, data for calculating effective ground cover were collected at the four corners of the quadrat, rather than for the entire quadrat. Because of the different methods, 2009 to the present dates effective ground cover data are not comparable to earlier years.

Greenline relative alien cover: The proportion of greenline plant cover coming from non-native species. Calculated as species cover of non-natives divided by total species cover, and multiplied by 100. (Magee et al. 2008.)

Greenline relative cover nativity unknown: The relative greenline plant cover of species with nativity status unknown. Calculated as cover of species with nativity unknown divided by total species cover, and multiplied by 100. NOTE: This value is relativized, and not comparable to other reported (actual) cover values.

Appendix C. Parameter Descriptions for Riparian, Stream Channel and Weed Monitoring (continued)

Greenline total relative cover: Total plant relative cover for greenline. Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Greenline wetland rating: A measure of the abundance of wetland species along the streambank. A wetland rating of 100 indicating all obligate wetland species and 1 being all upland species. The rating is calculated for each reach by summing the product of the relative cover of each species for which a wetland indicator status can be determined and a value corresponding to the species' wetland indicator status (1=upland, 25= facultative upland, 50=facultative, 75=facultative wet, 100=obligate wetland. Coles-Ritchie et al. 2007).

Greenline woody cover: The sum of the relative cover of woody species along the greenline. These could be any woody species, such as willows, pines, or currants. Greenline woody cover can be up to 200% because cover estimates are a combination of two layers.

Reach alien cover: Non-native species cover for combined greenline and cross-section. Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Reach cover nativity unknown: Species relative cover with nativity status unknown for combined greenline and cross-section. Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Reach native cover: Native species relative cover for combined greenline and cross-section. Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Reach total cover: Total species relative cover for combined greenline and cross-section. Because cover is estimated for two layers (1m and below, above 1m) total species cover can be a maximum of 200 percent.

Richness alien: Number of non-native species for combined greenline and cross-section.

Richness native: Number of native species for combined greenline and cross-section.

Richness nativity unknown: Number of species with nativity status unknown for combined greenline and cross-section.

Richness total: Total number of species for combined greenline and cross-section.

Appendix C. Parameter Descriptions for Riparian, Stream Channel and Weed Monitoring (continued)

Stream Channel Characteristics

Average bankfull width from transects: Bankfull widths are measured at each transect. This is the average of the 21-25 transects typically measured at each reach.

Bank angle: Average of all bank angle measurements. Bank angles <45 degrees are summarized as 45 degrees.

Bankfull width-to-depth ratio at riffles: 2001-2008. Average of the bankfull width-to-depth ratios from four channel cross-sections. Cross-sections were measured at the widest location (bankfull width) in the first 4 riffles within straight stream segments. Each ratio was calculated as bankfull width divided by the bankfull depth. Bankfull depth was calculated as the total bankfull area divided by the bankfull width. Some reaches had <4 cross sections if suitable locations could not be found.

Bankfull width-to-depth ratio at transects: ≥ 2009. Average of the bankfull width-to-depth ratio from 10 cross sections at / near even numbered transects 2-20. If there were <6 suitable measurements, or water surface was not level (>0.03cm variance between banks) no value is reported. Each ratio was calculated as bankfull width divided by the bankfull depth. Bankfull depth was calculated as the total bankfull area divided by the bankfull width.

Diameter of the 50th percentile streambed particle: Diameter of the 50th percentile particles. Typically more than 100 particles measured per reach. Bedrock and bank particles are measured but later excluded from the calculation. Sampling methods have changed. Presently, five particles are collected along each transect (2004-present). From 1998-2003, measured particles were gathered within riffle habitat.

Gradient of stream reach: The difference between the elevation of the water surface at the bottom of the reach and the elevation of the water surface at the top of the reach divided by the reach length (measured along the thalweg). The result is multiplied by 100 to express the value as a percent.

Large wood frequency: Number of category 1 large wood pieces measured within the reach and then standardized to per kilometer. Category 1 criteria: length ≥1m, diameter ≥0.1m, some portion must be within the bankfull channel and below the bankfull elevation.

Large wood volume: Volume of category 1 large wood pieces measured within the reach and then standardized to per kilometer. Category 1 criteria: length ≥1m, diameter ≥0.1m, some portion must be within the bankfull channel and below the bankfull elevation.

Length of sampling reach: Length of sampling reach measured along the thalweg

Appendix C. Parameter Descriptions for Riparian, Stream Channel and Weed Monitoring (continued)

Number of pools per kilometer: Number of pools within the sampled reach standardized to pools per kilometer.

Percent of bank angles < 90°: Number of transect locations with bank angles <90 degrees divided by the total number of transect bank measurements. The result is multiplied by 100 to express the value as a percent.

Percent pool tail fines: Quantified using a 0.36m x 0.36m grid with 50 intersections. The grid is placed at 3 locations along each pool tail. The percentage of particles <2mm and <6mm is calculated for each grid, averaged for each pool, then averaged for all pools within the reach.

Percent pools: Sum of all qualifying pool lengths divided by the reach length. The result is multiplied by 100 to express the value as a percent.

Percent stable banks: The number of covered stable, uncovered stable, and false bank measurements divided by the total number of measurements. The result is multiplied by 100 to express the value as a percent.

Residual pool depth: Average of the residual pool depth values for all pools in a reach. Residual pool depth is calculated for each qualifying pool by subtracting the pool tail depth from the max depth.

Sinuosity of stream reach: Reach length measured along the thalweg divided by the straight valley length from the bottom of the reach to the top of the reach. Straight valley length is presently determined using UTM coordinates, but was measured using a tape measure <2009.

Wetted width-to-depth ratio at riffles: 2001-2008. Average ratio of wetted width-to-depth ratio from four channel cross-sections. Cross-sections were measured at the widest location (bankfull width) in the first 4 riffles within straight stream segments. Each ratio was calculated as wetted width divided by the wetted depth. Wetted depth was calculated as the total wetted area divided by the wetted width. Some reaches had <4 cross sections if suitable locations could not be found.

Wetted width-to-depth ratio at transects: ≥ 2009. Average of the wetted width-to-depth ratio from 10 cross sections at / near even numbered transects 2-20. If there were <6 suitable measurements, or water surface was not level (>0.03cm variance between banks) no value is reported. Each ratio was calculated as wetted width divided by the wetted depth. Wetted depth was calculated as the total wetted area divided by the wetted width.

Appendix C. Parameter Descriptions for Riparian, Stream Channel and Weed Monitoring (continued)

Weeds

Common name: Common name of plant species.

Cross-section weed cover (%): The percent cover of the species in the riparian cross-section, 3 to 9.5 m from the greenline, that is on a combined list of noxious weeds, based on Rice (2012), for any of five states (ID, MT, NV, OR, WA) in the study area.

Greenline weed cover (%): The relative cover along the greenline of the species that is on a combined list of noxious weeds, based on Rice (2012), for any of five states (ID, MT, NV, OR, WA) in the study area.

Plant species: Scientific name of plant species.

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