Linking cold-water refuges into a biologically effective network in the Willamette River floodplain

Final Report on OWEB Research Grant, 208-8006-5780 (in partnership with Dr. Stan Gregory, Oregon State University)

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km	kilometer
m	meter
OSU	Oregon State University
PNW-ERC	Pacific Northwest Ecosystem Research Consortium
UO	University of Oregon

I. Executive Summary

The Willamette River Basin is a place of remarkable beauty, exceptionally productive farm and forestlands, and is home to the majority of people who live in Oregon. It also faces many changes; changes some argue are unprecedented since Euro-American settlement in the mid-19th century.

This report documents an effort to demonstrate and make accessible a geographic framework for tracking change over space and time in the floodplain of the Willamette River as a means of furthering natural resource conservation and restoration. The information framework seeks to pragmatically integrate the geomorphic and hydrologic processes shaping rivers, the biological communities and processes comprising river ecosystems and the human systems guiding their land and water use trajectories. It is intended to help in making decisions about what natural characteristics to conserve or restore, where best to conserve or restore them, and how proposed conservation or restoration actions may fit into a larger guiding vision of a restored Willamette River floodplain. The qualities and characteristics of this framework were, in part, informed by two 'floodplain restoration lessons learned' conferences held in the early stages of this project.

In attempting to understand the Willamette River and its floodplain, the floodplain provides the most constant and quantifiable spatial framework for comparing physical, biological, and human characteristics of the river corridor. The river's channel position, adjacent forests, and land use may all change, but the floodplain (the area historically inundated by floods) is relatively constant (Fig. 1). In short, this framework, oriented on the floodplain axis, provides a consistent basis for comparing changes in geomorphic structure, aquatic ecosystems and human settlement. We employ this framework for floodplain assessment by first mapping one-km "slices" of the floodplain at right angles to the floodplain's center axis (Hulse et al. 2002; Hulse and Gregory 2004).

Because conservation and restoration projects under consideration in the Willamette floodplain depend on the physical and biological conditions of specific locations, the work reported here relies on spatially explicit data and analyses to quantify these conditions at discrete locations in the floodplain. In order to carry out the analysis at a spatial grain sufficiently fine to serve the decision-making and monitoring objectives of intended users, we built on the previous work referenced above to create a standard spatial reporting framework for the entire Willamette River from Eugene downstream to Portland.

We refer to this spatially explicit system for tracking changes in the river and its floodplain as the “slices framework” (Fig. 1 & 2). Within each of the 229 one-km slices, numbered from 0 (zero) starting at the confluence of the Willamette and Columbia Rivers in Portland to 229 at the confluence of the Middle and Coast Forks of the Willamette just upriver of Eugene, we then subdivide each 1 km slice into ten 100-m slices.

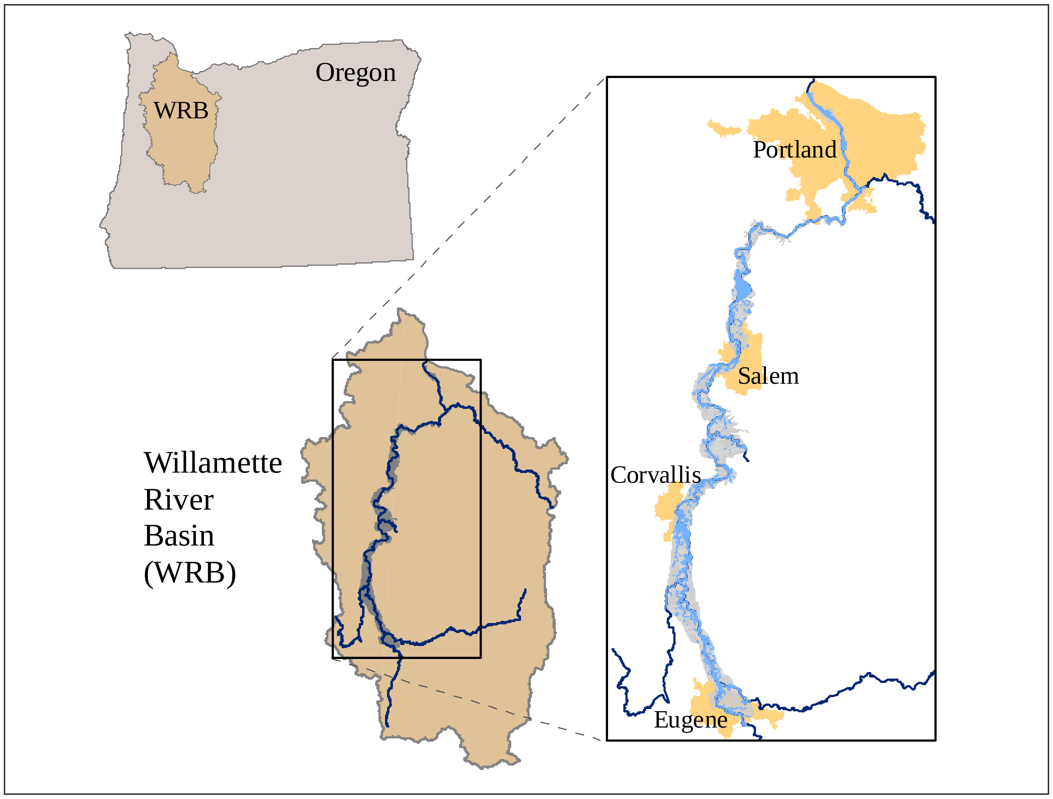

Figure 1. *Western Oregon’s Willamette River Basin and the project study area, which is the pragmatic floodplain of the Willamette River, located between the metropolitan areas of Eugene and Portland, Oregon.*

Within these 100-m slices we measure and report characteristics that represent the dynamic processes that structure and are structured by the river and its floodplain, and that together capture key relations of ecological dynamism and resilience. The science that clarifies the importance of these characteristics to native river processes is well established. In its final form, the slices framework will include data on **channel complexity, floodplain forests, number and location of cold water refuges, native and non-native fish species richness and the capacity for non-structural flood storage**. The current version includes data on channel complexity and floodplain forests for a select set of past, present and (projected) future years.

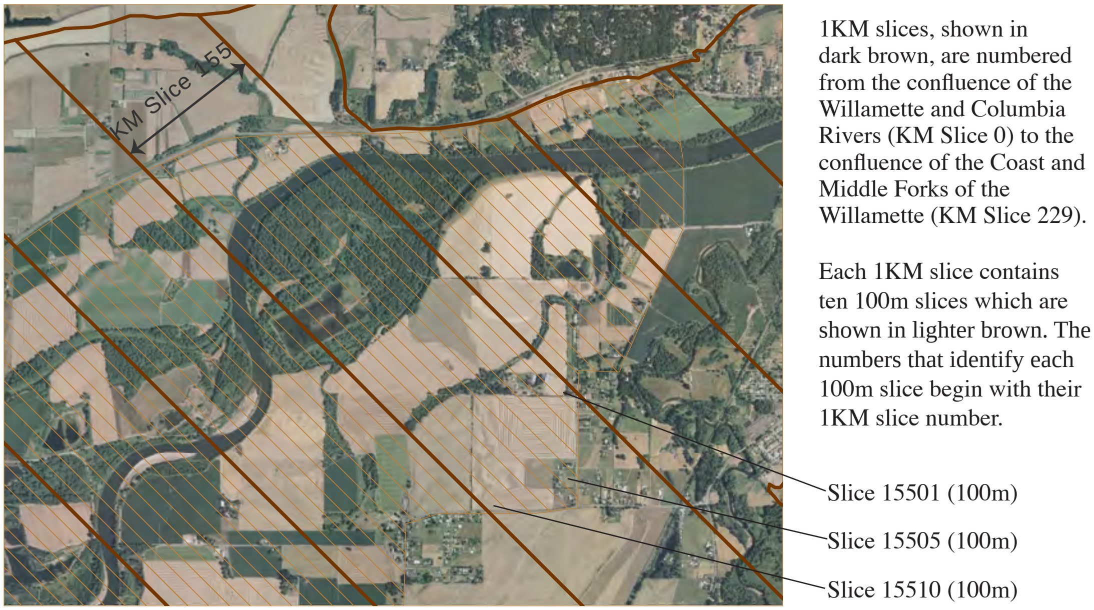

Figure 2*. Slices at Bowers Rock – diagram of 1Km slice #155 and 100m slices #15501-15510 as a framework for tracking progress.*

The questions and needs such a framework must answer were informed by the findings of two 'lessons learned' conferences held in 2008, in the early stages of this effort, and by subsequent efforts since. These subsequent efforts include regular meetings and exchanges regarding information and decision-making needs of the Willamette Special Investment Partnership and its Restoration Review Team, as well as the Willamette Habitat Restoration and Protection Program Monitoring Strategy.

II. Overview of major tasks

There were two over-arching parts for the UO component of this grant, both of which were highly collaborative with our OSU colleagues Stan Gregory and Randy Wildman:

Part A) Organize and conduct a series of Willamette floodplain restoration 'lessons learned' conferences in the south valley and north valley: and,

Part B) Refine the existing (Hulse et al. 2002) spatial framework of information to add new, more spatially detailed data on floodplain forests, channel complexity, cold-water refuges and native fish usage of them to the geographic data on the Willamette river floodplain.

We address each briefly below.

III. Summary description of Lessons Learned conferences

On March 20 and May 30, 2008 two Willamette Valley Floodplain Restoration Lessons Learned Conferences were held, the first in Eugene, the second in Aurora, Oregon. The first focused on floodplain restoration efforts in the southern part of the Willamette floodplain, the second on the northern part. Over thirty participants spent the morning of each day hearing from experienced restoration practitioners regarding lessons learned from work completed in the past 5 - 10 years, and the afternoon traveling to see/hear first hand one of the projects presented in the morning sessions. Lessons indicate that the past decade of floodplain restoration projects have been primarily opportunistic, with short-term stakeholder-oriented definitions of success and a focus on gaining land control with partnered agency funding. Private non-profits have played a leadership role in the south valley while rate-payer utilities and metropolitan agencies have been instrumental in the north. The next decade offers the potential to move from an era of opportunism to one of floodplain-wide strategy once new prioritization and assessment tools and information become widely available.

IV. Summary description of 100m slices framework

The spatial framework takes the form of a series of digital maps and associated tools constructed for the purpose of organizing and presenting information on key ecological characteristics within the Willamette River floodplain. Phenomena such as the structure of the river channel and the extent of various vegetative communities, what we call the 'key characteristics', are quantified and reported separately for each 100 meters of distance along the River's central axis. These quantities have been extracted from remotely sensed as well as in-the-field sources and presented in spreadsheet form. Available with supporting on-line materials (http://ise.uoregon.edu/slices/Main.html), the maps (available in both pdf and GIS formats) and the spreadsheet are the principal products of the UO component of the project.

The size of the spatial reporting unit, the 100 meter "slice", was chosen to balance the requirements of selecting and implementing restoration projects, the spatial precision of the available source data, and the desire to monitor phenomena and processes at a range of spatial and temporal scales.

The framework is intended to support three principal activities, the tabulation and depiction of conditions as they exist at particular times, the prioritization of sites for conservation and/or restoration activities, and the monitoring over time of the status and amounts of key ecosystem characteristics. We anticipate that users may add to the framework by including information on other characteristics beyond the five we have identified.

As of this report, the spatial framework and the information that comprises it report river channel length and amount of wetted area ca. 2010, as well as for a potential future condition ca. 2050 (the Conservation 2050 scenario) defined by the assumptions of a scenario emphasizing the conservation and restoration of ecosystem function derived from the work of the Pacific Northwest Ecosystem Research Consortium (PNW-ERC) (http://www.fsl.orst.edu/pnwerc/wrb/access.html). The current version of the slices information also now includes area of floodplain forest ca. 1990 and ca. 2000, as well as for the PNW-ERC's Conservation 2050 scenario. Comparisons between conditions at a given location at these various times can be made for the reported key characteristics using either the digital map or the associated spreadsheet.

V. Conclusions

The lessons from the past decade of floodplain conservation and restoration in the Willamette demonstrate the importance of having solid information on which to base decisions about where to conserve and restore, when and how. These lessons also underscore the essential importance of landowner support for such actions. When such support is missing, the likelihood of restoration success diminishes rapidly.

The construction of spatial reporting units and the tabulation of important ecosystem characteristics provides a defensible foundation for the prioritization of conservation and restoration work, and for the efficient tracking of change over time. Such a spatially explicit framework also allows for quantitative models to be used to explore alternative futures and to understand better the sensitivity of ecosystems to environmental change. It is now one more tool that can be brought to bear in conducting these important tasks.

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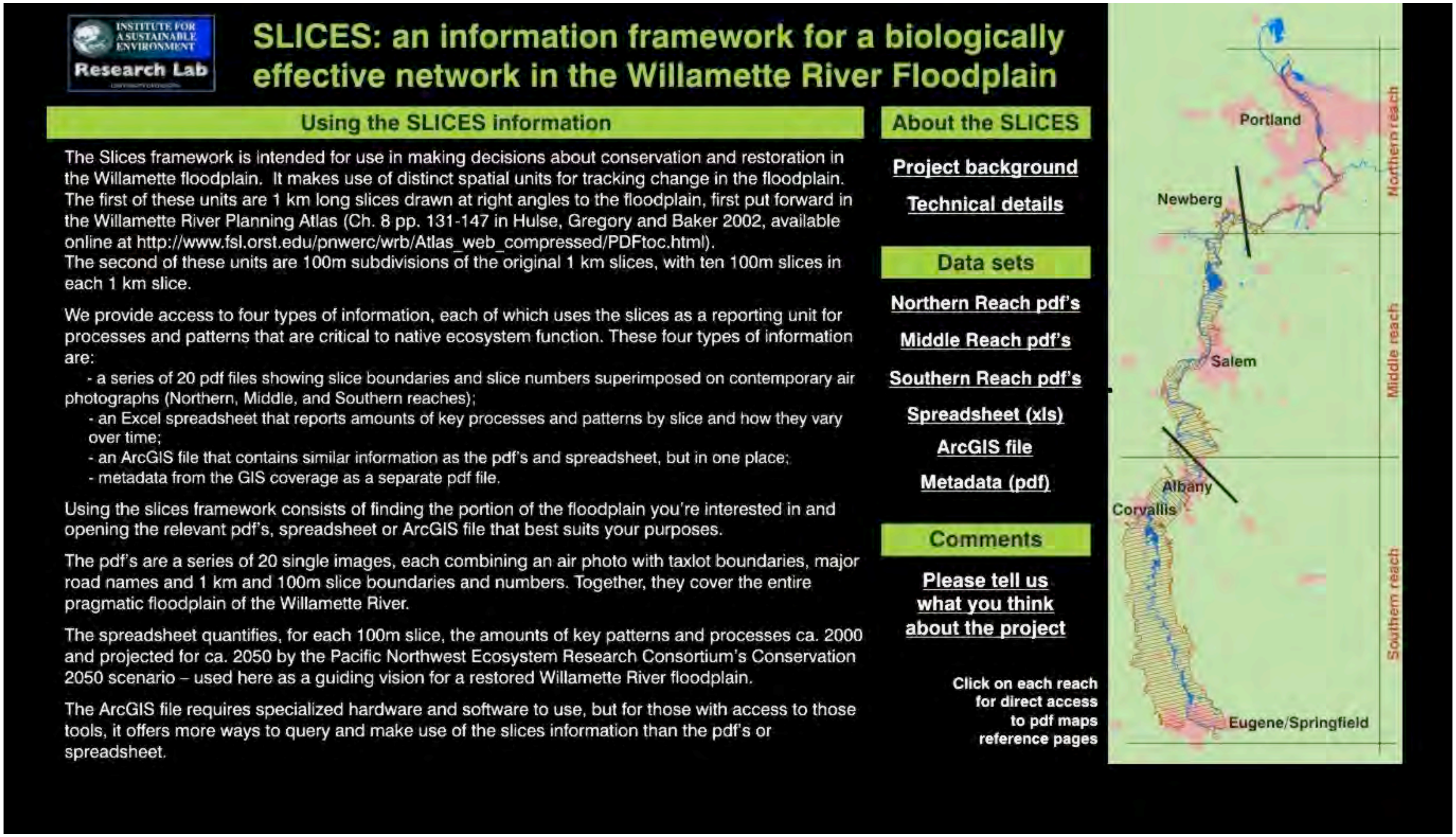
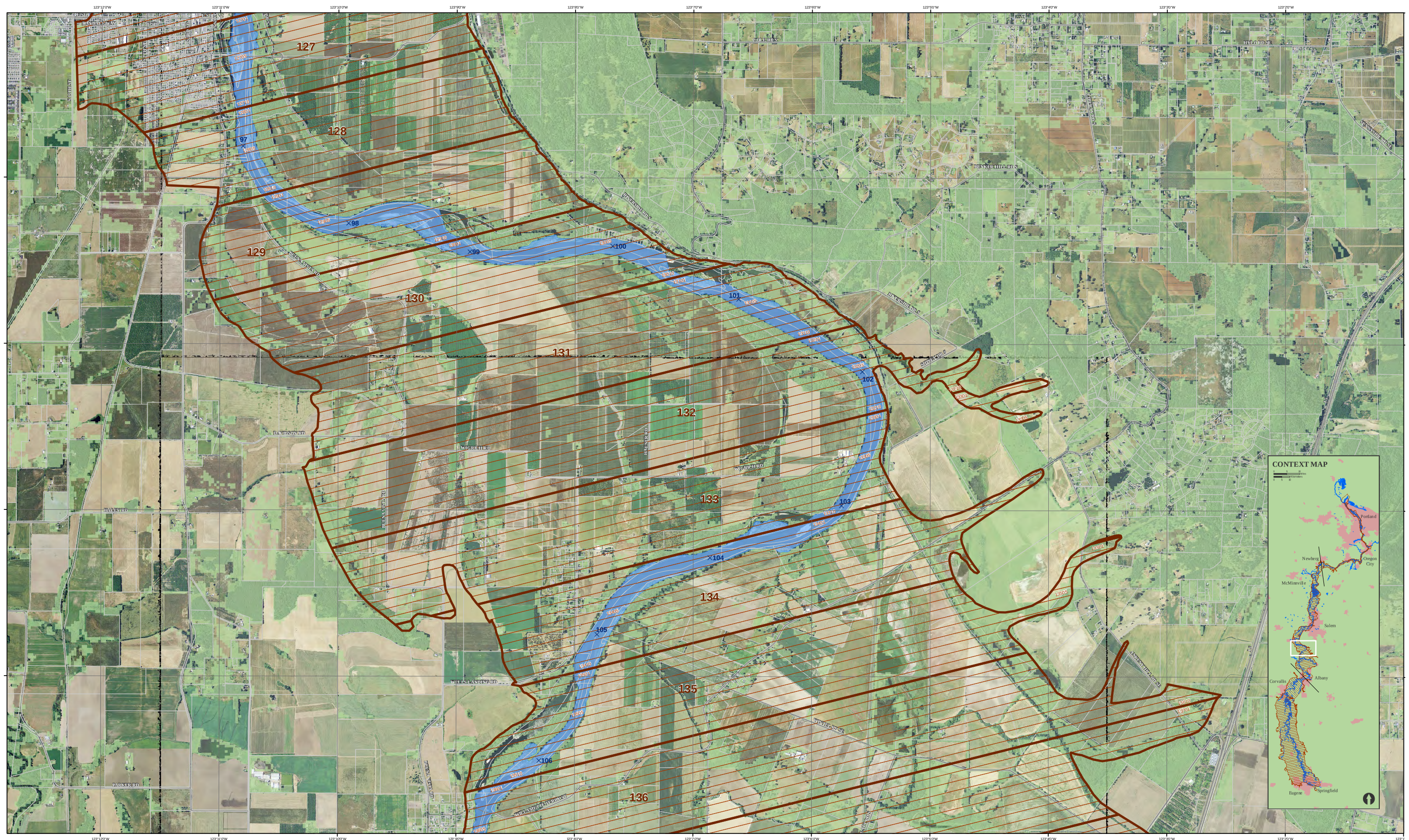

INSTITUTE FOR A SUSTAINABLE ENVIRONMENT
Research Lab
SLICES: an information framework for a biologically effective network in the Willamette River Floodplain
Using the SLICES information
The Slices framework is intended for use in making decisions about conservation and restoration in the Willamette floodplain. It makes use of distinct spatial units for tracking change in the floodplain. The first of these units are 1 km long slices drawn at right angles to the floodplain, first put forward in the Willamette River Planning Atlas (Ch. 8 pp. 131-147 in Hulse, Gregory and Baker 2002, available online at http://www.fsl.orst.edu/pnwerc/wrb/Atlas_web_compressed/PDFtoc.html).
The second of these units are 100m subdivisions of the original 1 km slices, with ten 100m slices in each 1 km slice.
We provide access to four types of information, each of which uses the slices as a reporting unit for processes and patterns that are critical to native ecosystem function. These four types of information are:
- a series of 20 pdf files showing slice boundaries and slice numbers superimposed on contemporary air photographs (Northern, Middle, and Southern reaches);
- an Excel spreadsheet that reports amounts of key processes and patterns by slice and how they vary over time;
- an ArcGIS file that contains similar information as the pdf's and spreadsheet, but in one place;
- metadata from the GIS coverage as a separate pdf file.
Using the slices framework consists of finding the portion of the floodplain you're interested in and opening the relevant pdf's, spreadsheet or ArcGIS file that best suits your purposes.
The pdf's are a series of 20 single images, each combining an air photo with taxlot boundaries, major road names and 1 km and 100m slice boundaries and numbers. Together, they cover the entire pragmatic floodplain of the Willamette River.
The spreadsheet quantifies, for each 100m slice, the amounts of key patterns and processes ca. 2000 and projected for ca. 2050 by the Pacific Northwest Ecosystem Research Consortium's Conservation 2050 scenario – used here as a guiding vision for a restored Willamette River floodplain.
The ArcGIS file requires specialized hardware and software to use, but for those with access to those tools, it offers more ways to query and make use of the slices information than the pdf's or spreadsheet.
About the SLICES
Project background
Technical details
Data sets
Northern Reach pdf's
Middle Reach pdf's
Southern Reach pdf's
Spreadsheet (xls)
ArcGIS file
Metadata (pdf)
Comments
Please tell us what you think about the project
Click on each reach for direct access to pdf maps reference pages
Portland
Newberg
Salem
Albany
Corvallis
Eugene/Springfield
Northern reach
Middle reach
Southern reach

WILLAMETTE RIVER FLOODPLAIN | 100 METER SLICES FRAMEWORK

Continued on map WR 09



Continued on map WR 11

100 METER SLICES
1 KM SLICES
TAXLOT BOUNDARIES
FLOODPLAIN FOREST ca. 2000
MAIN RIVER CHANNEL ca. 2010
ROADS
RIVER MILES

This PDF has special features. Map layers can be turned on and off and map coordinates can be identified using Acrobat's Analysis toolbar. You must be running Adobe Acrobat Reader 9 or later to access some of these special features.

Map Created: September 2010
Data Sources: See metadata
Aerial Photography: NAIP, 2009
Projection: NAD 1983 UTM Zone 10 North

0 mi 0.25 mi 0.5 miles
0 m 200 m 400 m 800 meters

Project funded in part by the Meyer Memorial Trust and the Oregon Watershed Enhancement Board

N

WR 10
Slices 12707 to 13604
River Miles 97 to 106

Spreadsheet format for 100m slices

100m slice Number	1KM slice number	100m slice area (acres)	2010 Channel Length (meters)	2010 Channel Area (acres)	Cons 2050 Channel Length (meters)	Cons 2050 Channel Area (acres)	1990 Floodplain Forest (acres)	2000 Floodplain Forest (acres)	Cons 2050 Floodplain Forest (acres)
101	1	33	110	17	110	17	4	4	2
102	1	15	102	14	102	14	0	0	0
103	1	15	102	14	102	14	0	1	0
104	1	15	105	14	105	14	0	0	0
105	1	18	105	14	105	14	0	0	0
106	1	22	105	14	105	14	0	0	0
107	1	28	106	14	106	14	0	1	0
108	1	36	106	15	106	15	0	1	2
109	1	38	106	17	106	17	1	1	2
110	1	41	102	18	102	18	2	2	3
201	2	43	104	17	104	17	1	0	2
202	2	44	102	17	102	17	2	1	3
203	2	46	103	17	103	17	2	0	2
204	2	48	106	16	106	16	1	2	2
205	2	50	106	15	106	15	0	1	2
206	2	49	106	14	106	14	1	1	2
207	2	44	99	15	99	15	1	0	3
208	2	34	99	16	99	16	0	0	1
209	2	25	99	16	99	16	0	0	0
210	2	19	98	18	98	18	0	0	0
301	3	19	100	17	100	17	0	0	0
302	3	17	99	16	99	16	0	0	0
303	3	18	99	17	99	17	0	0	0
304	3	16	99	14	99	14	0	0	0
305	3	14	96	11	96	11	0	0	0
306	3	14	96	11	96	11	0	0	0
307	3	13	96	10	96	10	0	0	0
308	3	14	97	11	97	11	0	0	0
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310	3	12	94	10	94	10	0	0	0
401	4	12	100	11	100	11	0	0	0
402	4	11	97	10	97	10	0	0	0
403	4	11	97	10	97	10	0	0	0
404	4	10	97	9	97	9	0	0	0
405	4	10	95	9	95	9	0	0	0