Dairy-McKay Private Lands Fish Passage Assessment and Prioritization
Tualatin River Watershed
Washington County, Oregon

Authors:
Cole Keppinger, TRWC employee
Stephen Cruise, TRWC member
April Olbrich, TRWC coordinator
Rich Van Buskirk, TRWC chair

Tualatin River Watershed Council
P.O. Box 338
Hillsboro, OR 97123-0338
503-846-4810
December 2016

Pacific University

Table of Contents

Acknowledgments

Thanks to TRWC field staff for all of their work:

2012: Abby Cain, Conor Peterhans

2013: Emily C. Matson, Michael S. Ducharme

2015: Cole Keppinger

2016: Cole Keppinger, Jacob Rose, Nicolas Capuzzi

Dairy-McKay Fish Passage Assessment and Prioritization on Privately Owned Lands

Summary: Between 2012 and 2016, the Tualatin River Watershed Council (TRWC) identified and surveyed privately owned culverts that pose potential passage barriers for fish to upstream habitat in the Dairy-McKay sub-basin of the Tualatin River Watershed. Using LiDAR and aerial imagery, 1623 potential culverts were identified. Of the 1623 sites identified, 159 survey targets were selected, located on 126 privately owned properties. The TRWC reached out to the 126 property owners, and received a response from approximately half of those contacted. The landowner responses either provided permission to survey or informed TRWC staff that there was no stream crossing on their property, or the crossing was a bridge. TRWC seasonal employees eliminated, through additional mapping efforts and onsite visits, a number of culverts (not surveyed) due to the size of the stream or location in the watershed. Twenty-four culverts were surveyed with nine identified as high priority fish passage barriers, further detailed in this report.

Introduction: The Dairy-McKay assessment of privately owned culverts conducted between 2012 and 2016 used methodology developed by Bureau of Land Management (BLM) and modified by Washington County Department of Land Use and Transportation (WCDLUT). The assessment's purpose was to survey and prioritize privately owned culverts that could pose barriers to fish passage in the Dairy-McKay sub-basin of the Tualatin River watershed. It was funded through Bureau of Land Management Secured Rural Schools Title II monies. The prioritization built on work completed by BLM and WCDLUT to assess and prioritize all culverts on lands/roads owned by the BLM and Washington County in this watershed. The current assessment helped to identify high priority, privately owned passage barriers for replacement, and will hopefully lead to future partnerships with landowners to improve fish passage and access to important spawning and rearing habitat.

The Dairy-McKay watershed (HUC 17090001001) is a sub-basin of the Tualatin River watershed (17090010), which is located in northwest Oregon and empties into the Willamette River. The Tualatin River drains 712 square miles of forest, agricultural plains and urban area. The urban areas comprising 25% of the watershed include southwest Portland, Hillsboro, Tigard and Beaverton and contain some of Oregon's fastest growing urban populations. Forest and agriculture compose up to 48% and 33% of the remaining area, respectively.

The Dairy-McKay watershed drains 231 square miles (147,956 acres) in the northern part of the Tualatin River basin. It is the largest watershed contributing to the Tualatin River and constitutes nearly one-third of the basin. From its headwaters in the Tualatin Mountains, the main stem tributaries flow in a general southerly direction joining the Tualatin River at River Mile 45 near the city of Hillsboro. The sub-basin contains important salmonid habitat, including salmon and steelhead spawning, rearing and migration habitat.

The majority of federal lands in Washington County also reside within this watershed. The Dairy-McKay watershed is located almost entirely within Washington County with small upper headwater reaches beginning in Columbia County to the north and Multnomah County to the east. The watershed includes mountainous regions, foothills and plains. The variety in terrain results in a wide array of culvert sites to be surveyed.

Fish distribution in the Dairy-McKay watershed: TRWC contracted with Bio-Surveys, LLC, an aquatic consulting firm, to perform rapid bio-assessments (snorkel surveys) during the summers of 2013 and 2014. The purpose of these surveys was to quantify the distribution and relative abundance of juvenile salmonid species during the summer low flow regimes. The census is a 20% sub-sample of pool rearing habitats beginning at select main stem locations and at the mouth of each tributary. Surveys continued through the extent of current Coho and winter steelhead distribution but did not extend to the end of cutthroat trout distribution. The selected survey starting location for East Fork Dairy Creek began at the Highway 26 crossing and continued 15.5 miles upstream to where reduced flows and natural debris jams defined the upper extent of anadromous potential. The selected survey starting location for West Fork Dairy Creek was 1000 feet above the confluence of Garrigus Creek, (about ½ mile above the Green Mountain Road crossing) and included 28.3 miles of main stem and tributaries combined. The selected survey starting location for McKay Creek was the West Union Road bridge crossing in North Plains, and included a total of 16.5 mile of the main stem and tributaries.

The abundance estimates in the final reports for Coho and steelhead distribution are to be utilized as interannual trend analyses and do not represent estimates of total abundance (Tables 1-4). Estimates provided for 0+ populations listed in the tables below are young of the year fry of combined steelhead/cutthroat populations. The surveys also noted beaver dams and both natural and manmade juvenile and adult barriers. The 2013 surveys included five subwatersheds: Upper Tualatin River, Gales Creek, East Fork Dairy Creek, West Fork Dairy Creek and McKay Creek. The percentages in Table 1 indicate the distribution percentage of each individual species amongst the five watersheds surveyed. The percentages identified in Tables 2, 3, and 4 represent the distribution of individual species amongst the watersheds of East Fork Dairy Creek, West Fork Dairy Creek and McKay Creek, respectively The 2014 surveys included only two subwatersheds inventoried in the 2013 survey, Gales and East Fork Dairy Creeks. The information below is from Tualatin River Rapid Bio-Assessment 2013 Final Report and Tualatin River 2013 & 2014 Final Report.

Table 1. Dairy-McKay watersheds expanded estimates (2013-14)

Year	Sub-basin	Coho	0+	Steelhead	Cutthroat
2013	East Fork Dairy Creek	37,124 (41.2%)	12,849 (30.5%)	1,965 (71.5%)	3,776 (31.4%)
2013	West Fork Dairy Creek	13,369 (14.8%)	4,770 (11.6%)	0	1,565 (13.0%)
2013	McKay Creek	8,855 (9.8%)	8,855 (9.8%)	0	1,984 (16.5%)
2014	East Fork Dairy Creek	28,779	5,081	2,276	3,437

Table 2. East Fork Dairy Creek watershed and tributaries expanded estimates 2013-14 with percentage in East Fork Dairy Creek in parentheses beneath counts.

Year	Stream	Coho	0+	Steelhead	Cutthroat
2013	East Fork Dairy Creek	35,175 (94.8%)	8180 (65.5%)	1,950 (99.2%)	2,635 (65.5%)
2013	Campbell Creek	388 (<1%)	1280 (10.2%)	0	280 (7.4%)
2013	Denny Creek	419 (<1%)	1205 (9.6%)	5 (0.3%)	280 7.5%)
2013	Rock Creek	219 (<1%)	1095 (8.8%)	0	265 (7.0%)
2014	East Fork Dairy Creek	26,188 (91%)	3595 (70.8%)	2,265 99.5%)	2,680 78%)
2014	Campbell Creek	0	415 (8.2%)	0	225 6.5%)
2014	Denny Creek	813 (2.8%)	340 (6.7%)	0	200 (5.8%)
2014	Rock Creek	19 (<1%)	440 (8.7%)	0	120 (3.5%)

Table 3. West Fork Dairy Creek watershed and tributaries expanded estimates 2013 with percentage in West Fork Dairy Creek in parentheses beneath counts.

Year	Stream	Coho	0+	Cutthroat
2013	West Fork Dairy Creek	2544 (19%)	1205 (25.3%)	375 (24%)
2013	Garrigus Creek	2794 (20.9%)	240 (9.9%)	150 (9.6%)
2013	Mendenhall Creek	2931 (21.9%)	995 (20.9%)	395 (25.2%)
2013	Whitcher Creek	2038 (15.2%)	525 (11%)	125 (8.0%)
2013	Williams Creek	1519 (11.4%)	260 (5.5%)	90 (5.8%)
2013	Burgholzer Creek	888 (6.6%)	470 (9.9%)	115 (7.3%)
2013	Cummings Creek	175 (1.3%)	430 (9.0%)	50 (3.2%)
2013	Cedar Canyon Creek	0	335 (7.0%)	180 (11.5%)

Table 4. McKay Creek watershed and tributaries expanded estimates 2013 with percentage in McKay Creek in parentheses beneath counts.

Year	Stream	Coho	0+	Cutthroat
2013	McKay Creek	4669 (52.7%)	1390 (55.8%)	975 (49.1%)
2013	East Fork McKay	3881 (43.8%)	1045 (41.9%)	970 (48.9%)

Project Description The assessment project was divided into three distinct parts. Staff first identified known and likely barriers on private lands via aerial imagery, USGS maps, and LiDAR; culverts were further pared down to reach location and property proximity. Tualatin River Watershed Council staff then made contact with land owners, in order to gain permission to enter the identified property to conduct an on-site survey(s). Once permission for access was obtained, trained TRWC staff assessed private barriers using the established WCDLUT forms and methodology that was developed in 2006 using Title II funds to survey publicly owned culverts. The identified barriers were then prioritized based on the collected data. This data consists of measurement of habitat quantity and quality, the barrier's proximity to Essential Salmonid Habitat (ESH) streams, and the severity of the barrier. This report and the list of prioritized barriers will be shared with BLM, Washington County, and ODFW. The identified barriers will be included in ODFW's Fish Passage Barriers dataset.

Assessment Methodology: The first step in the culvert inventory involved identifying culverts on or adjacent to fish bearing waterways in the Dairy-McKay watershed. The survey method followed the methodology used by WCDLUT, based on the BLM's *Fish Passage through Road Crossing Assessment* (see Appendix A). It was assumed that all streams in the Dairy-McKay watershed currently have, or historically had the potential to support fish, and no part of the watershed was ruled out based on degraded habitat quality.

Potential culverts were first identified using ArcGIS to view LiDAR imagery (DOGAMI), stream polylines (DOGAMI) orthophoto imagery and tax lot information, in conjunction with historic barrier inventories based on a variety of compiled sources. Culverts were differentiated from other potential passage barriers based upon LiDAR imagery. Unmarked private roads are generally visible in LiDAR imagery as a low-grade regular surface that contrasts with more variable surrounding topography. Locations where LiDAR-inferred roads crossed streams were marked as potential barriers. Bridges generally appeared as a break in the LiDAR image, since the LiDAR data were coded to display the lowest visible surface (e.g. the stream channel). Previous barrier inventories compiled both by staff and from other sources were verified using LiDAR, and then checked using satellite terrain maps; new passage barriers were also added to the data set in 2015 based on the 2013 and 2014 rapid bio-assessment surveys.

After the potential barriers had been compiled, landowners were contacted by staff to gain permission for access and to schedule an assessment of the barrier. Fifty percent of the landowners (50) contacted did not respond to TRWC request for access and assessment. Fifty-two landowners did respond and provided information that eliminated additional identified crossings due to the crossing being a bridge or no stream crossing existing. TRWC staff eliminated additional crossings (not surveyed) due to the size of the stream or its location in the watershed.

Prioritization Methodology. Once inventoried, the culverts were ranked to identify which barriers prevented access to high quality habitat areas. The culvert surveys measured four surrogate indicators to determine a culvert's ability to pass fish, or its barrier severity. These four surrogate indicators are culvert gradient, stream bankfull width, inlet blockage, and outlet perch. Using Washington County's methodology, these surrogates were chosen based on the understanding that functional fish passage culverts closely resemble the stream channel they carry. In addition to barrier severity, habitat quality, upstream channel length, and proximity to Essential Salmonid Habitat (ESH) were included as components of the overall prioritization score.

Barrier Severity: Barrier severity determination was based on the *BLM Coarse Screen Filter Version 2.2*. (See Appendix B) The filter identifies a culvert's barrier level based on the requirements of juvenile salmonids. It was chosen because of its stringent ratings and compatibility with the surveys performed on public roads and BLM land in the Dairy-McKay sub-basin. The model evaluated culverts based on the surrogate indicator data collected in the culvert data set. The four surrogates (culvert gradient, ratio of culvert width to bankfull width, percent inlet blockage, and outlet perch) were analyzed to determine the barrier severity of a culvert to provide migratory fish passage. Culvert type dictated the acceptable range of culvert gradient with respect to stream gradient. When a culvert's gradient exceeded this acceptable range, it was considered a barrier; a culvert width of less than the stream's bank full width, a ten percent blockage of a culvert's inlet, and a jump or perched outlet greater than six inches were also considered barriers. After each barrier type was evaluated for compliance, the number of barrier violations were added together to arrive at a total score (0-4) for barrier severity.

Habitat Quality: Habitat quality was determined using a method developed from an Audubon Society habitat assessment (See Appendix C). Instream and surrounding areas were observed to provide an overall habitat score for each culvert site. The assessment did not go into great detail but provided a reliable quantitative metric to compare culvert habitat. Each culvert received a score from 1-4, with the best habitat receiving the highest score.

Proximity to Essential Salmonid Habitat (ESH) (as identified by Oregon Department of State Lands): Streams designated as ESH in the Dairy-McKay subwatershed provide habitat for a variety of salmonid species including Coho salmon and steelhead trout. The presence of these species are indicative of overall stream health and importance in the watershed. The distance to the nearest ESH stream was measured using Oregon Department of State Lands Essential Salmonid Habitat (2010-2015) maps and StreamNet Mapper (a databased hosted by Pacific Marine Fisheries Commission). Culverts were ranked based on proximity to ESH with the scores ranging from 0-1. Because the maximum points available is ¼ of the other scoring factors, proximity to ESH streams did not weigh as heavily in the total score for barrier prioritization.

Total Score: Combining the scores for barrier severity, habitat length, habitat quality, and proximity to ESH provided a first pass score for each culvert. High scores represented culverts with several barrier types, large amounts of high quality upstream habitat, and in close proximity to ESH streams. Eight culverts were designated high priority barriers, and are discussed below. The remaining sixteen barriers are included in the dataset, but will not receive further discussion in this report.

Results: In the initial assessment process using GIS analysis of road, stream and LiDAR map layers, 1,623 potential road crossings on private lands in the Dairy-McKay watershed were identified. Starting from this first pass of potential barriers, the draft sites were more carefully analyzed based on position in the watershed, stream order, and proximity to ESH. Ultimately 159 potential barriers located on 126 properties were identified as targets for survey in the Dairy-McKay watershed (Figure 1). Requests for access to private lands were mailed out to these landowners.

Through conversations with property owners, access granted for surveys, and RBA surveys for juvenile fish, 24 culverts were surveyed and 31 crossings identified as bridges. Of the 24 culvert surveyed, nine were selected (Table 5) as high priority passage barriers. The furthest high priority passage barrier was over 1.4 miles from Essential Salmon Habitat, and two of the barriers were located on one stream (Sadd Creek).

Table 5. High priority privately owned culverts that act as fish passage barriers in the Dairy-McKay sub-basin. Total Score is the cumulative scores for the stated assessment categories based on the assessment methodology used by TRWC.

Rank	Stream	Culvert ID	Habitat Length	Habitat Quality	Barrier Severity	Proximity to ESH	Total Score
1	McKay Creek	1	4	4	2	1.0	11.0
2	Kuder Creek	2	4	4	2	0.8	10.8
3	Rock Creek	3	4	4	2	1.4	10.5
4	Sadd Creek	4	4	3	2	1.0	10.0
5	Plentywater Creek	5	3	4	2	0.5	9.5
6	Sadd Creek	6	4	3	1	1.0	9.0
6	Cougar Creek	7	4	2	2	1.0	9.0
8	Neil Creek	8	4	3	1	0.9	8.9
9	Roundy Creek	9	4	3	1	0.5	8.5

Mapped locations of the 24 surveyed culverts are presented in Figures 2-6, which provide subbasin depictions of upper and middle West Fork Dairy Creek, upper and lower East Fork Dairy Creek and upper McKay Creeks. In each of the subbasin maps, surveyed culverts are broken down into those that present some form of barrier to fish passage (Culverts 1-21) and those that were determined to present no barrier to fish passage (Culverts 22-24).

(*See Appendix D for Dairy-McKay Fish Passage Assessment and Prioritization 2012-2016 for raw data.*)

The above prioritization results do not account for natural or manmade barriers that may be located downstream of the surveyed barrier culverts. The above prioritization only ranks the highest priority privately owned barriers included in this survey. Culverts with a score greater than 8.5 out of a total possible score of 13 were considered high priority barriers.

Discussion
The variety of land uses comprising the middle and upper reaches of the watershed include rural residential, agricultural, private woodlands, and industrial timberlands. Its large size and smaller population have resulted in poor networking opportunities. There is a lack of active civic groups or organizations such as Citizen Participation Organizations, granges or neighborhood watch groups in this watershed. TRWC was successful in reaching out to woodland owners through a TRWC member, Washington County Small Woodlands, which resulted in a number of landowners responding. In addition, the Tualatin River Watershed Council is not well known in this subwatershed since it has focused its previous efforts and programs in other Tualatin River subwatersheds. The 2013-2014 RBA surveys contacted landowners in order to secure access for the juvenile snorkel surveys and helped provide landowner connections for TRWC in 2015 and 2016.

Negative past experiences with volunteers performing culvert surveys in other watersheds made one large landowner wary of allowing trained TRWC staff to perform surveys. It takes times to build relationships with landowners, especially if they've had a negative experience in the past. Owners of working lands have concerns that bad data or the discovery of threatened species may negatively impact their methods of production and threaten their livelihoods.

Comparison between this project, which looked exclusively at private culverts, and earlier efforts which looked at publicly owned county culverts will necessarily be skewed by the limited private culvert data. From what data there is, the private culverts have a lower ratio of passage barriers to total surveyed culverts (~30%) when compared to County owned culverts (~45%). Though both the County and private culverts were spread throughout the watershed, on the whole, there was greater variation within the County's culverts. The private culverts averaged over 3 miles of upstream habitat. Combining the private and public data, the presence of high priority barriers on McKay, Neil, and Rock Creek and their tributaries indicate that these creeks deserve the most immediate attention.

Whereas the public data of previous years has representation throughout the sub-basin, the private data was concentrated in the middle to upper reaches of the Dairy-McKay watershed. As such, there could be unidentified barriers in the lower sub-basin that block significant amounts of upstream habitat.

One example of a potential unsurveyed culvert that could be high priority barrier is a failing six-inch perched culvert that was identified by the Tualatin River Rapid Bio-Assessment 2013 Final Report, but was not included in this survey and assessment. The culvert is located on Mendenhall Creek, approximately 110' above its confluence with West Fork Dairy Creek, and may impact fish access to Mendenhall Creek from West Fork Dairy Creek. Approximately 20% of the Coho and 0+ age class and 25% of cutthroat populations were inventoried in Mendenhall Creek during the 2013 survey.

The use of LiDAR to identify potential culverts to survey was assessed. Main stem East Fork and West Fork Dairy Creek landowners confirmed that 27 crossings identified as culverts were either bridges or had no crossings, which equates to approximately 17% of the identified survey sites.

TRWC seasonal staff also eliminated 18 crossings due to stream size and/or location in the upper watershed. LiDAR is one tool that provides initial information that needs to be fact-checked in the field. The 2013 and 2013-14 rapid bio-assessment surveys also provided “in the field” information from the survey work of natural and manmade barriers. Since TRWC was unable to survey half of the 159 identified sites, it is difficult to know what percentage of unsurveyed sites identified by LiDAR may have been eliminated due to presence of bridges, lack of crossings, or stream size that is unable to support key fish species.

An important key for successfully obtaining passage barrier assessments on private lands is building relationships with landowners in subwatersheds of interest. These landowner relationships can often take several years to build so it would be beneficial to start several years prior to assessment activities. Other landowner trusted agencies and organizations can also assist with the relationship building for these activities by lending credibility to the organization that will be performing the assessment activities.

References

Bio-Surveys, LLC. Tualatin River Rapid Bio-Assessment 2013 Tualatin River & 2014 Final Reports. Tualatin River Watershed Council, Clean Water Services. Washington County, Hillsboro, Oregon. May 2014 and September 2015.

Clarkin, Kim et al. National Inventory and Assessment Procedure. U.S. Department of Agriculture Forest Service National Technology and Development Program. San Dimas, California. 2005.

Griebling, Scott et al. Dairy-McKay Fish Passage Assessment and Prioritization. Washington County. Hillsboro, Oregon. 2006.

Hawksworth, John. Dairy –McKay Watershed Analysis. Washington County Soil and Water Conservation District. Tillamook, Oregon. February 1999.

Hoffman, Rachel. Nestucca/Neskowin Watersheds Culvert Prioritization and Action Plan for Fish Passage. Tillamook Estuaries Partnership. Garibaldi, Oregon. 2006.

Tualatin River Watershed Action Plan. Prepared by the Tualatin River Watershed Council. February 3, 1999. http://www.trwc.org/about/documents/ActionPlan.pdf

Tualatin River Watershed Council website. http://www.trwc.org/tualatin_info.html

Figures 1 – 6

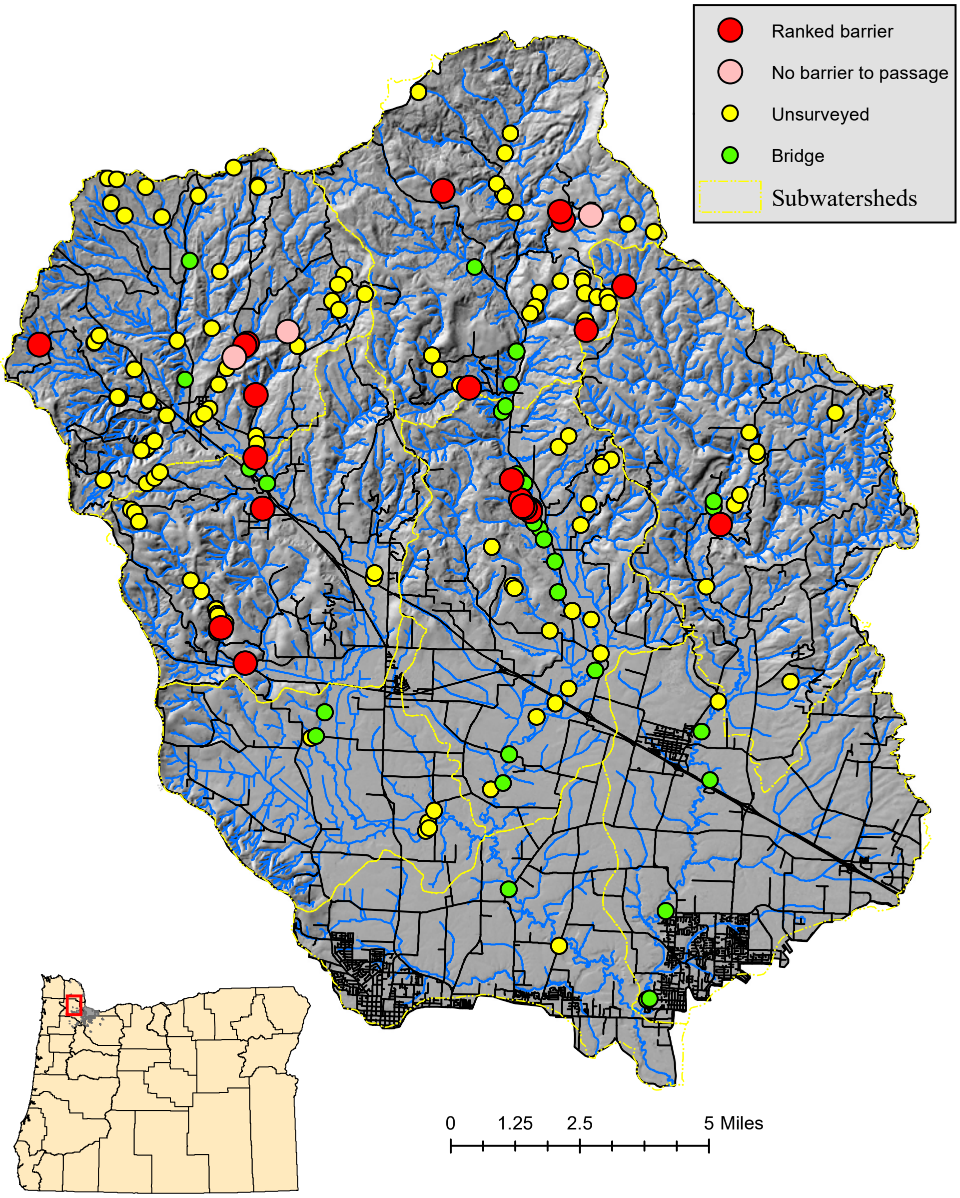

Figure 1. Potential fish passage barriers on private lands in the Dairy-McKay watershed, Washington County, Oregon.

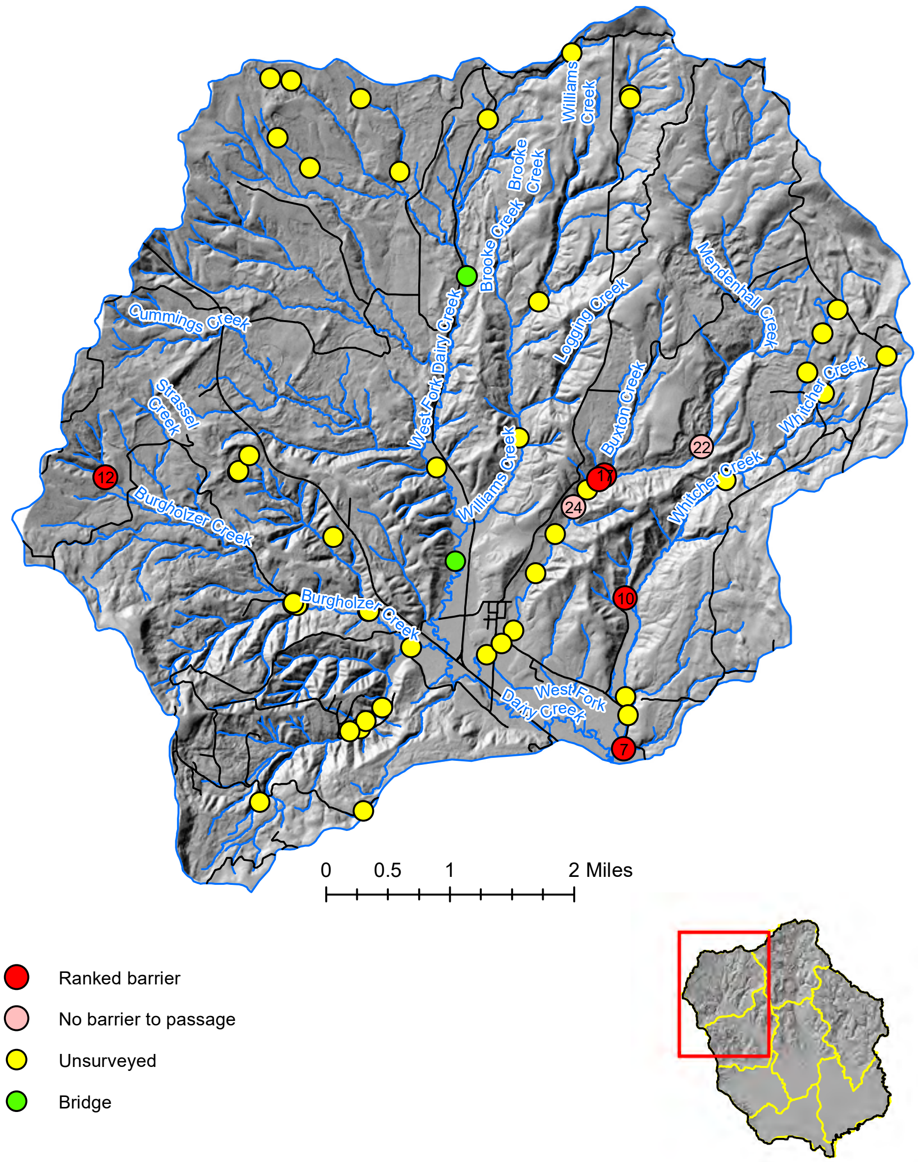

Figure 2. Surveyed culverts, potential barriers and unidentified bridges in upper West Fork Dairy Creek subwatershed.

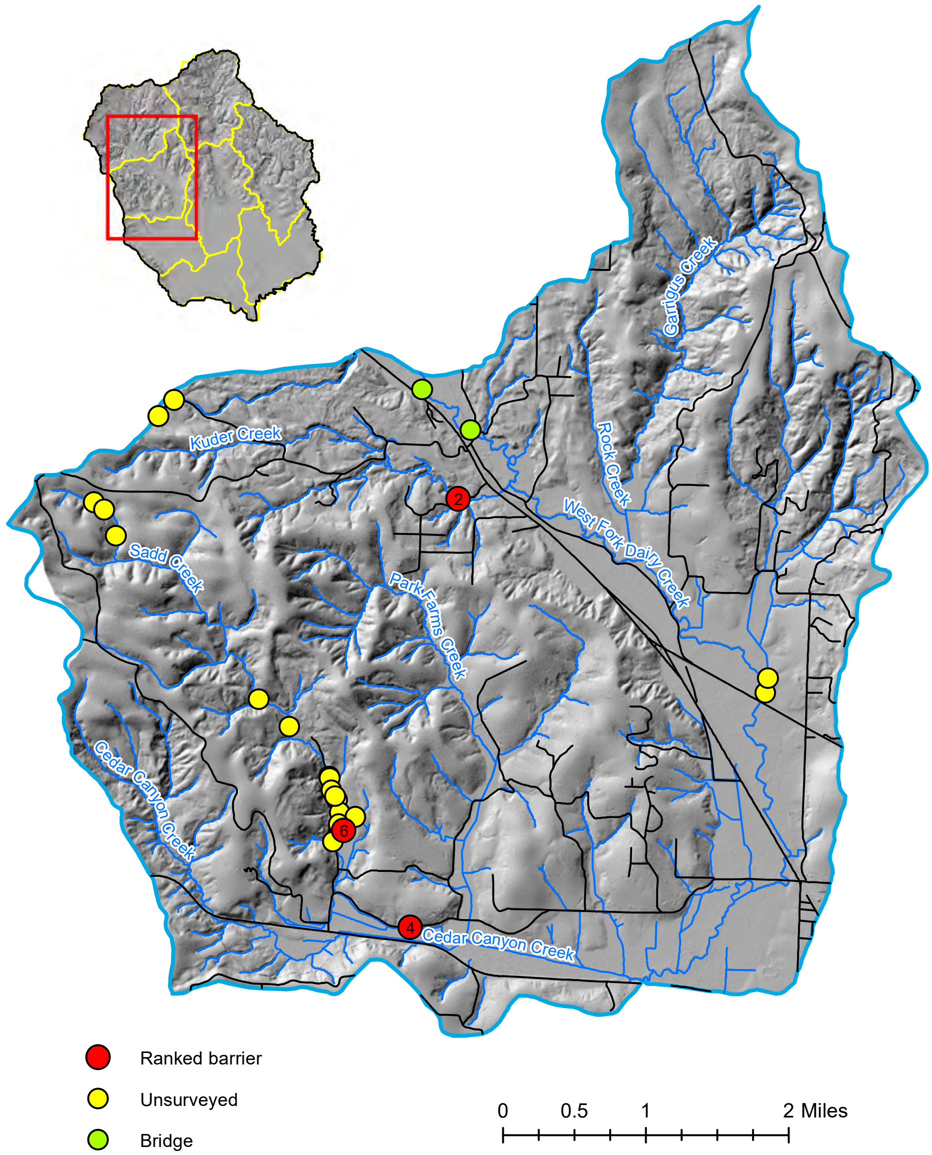

Figure 3. Surveyed culverts, potential barriers and unidentified bridges in middle West Fork Dairy Creek subwatershed.

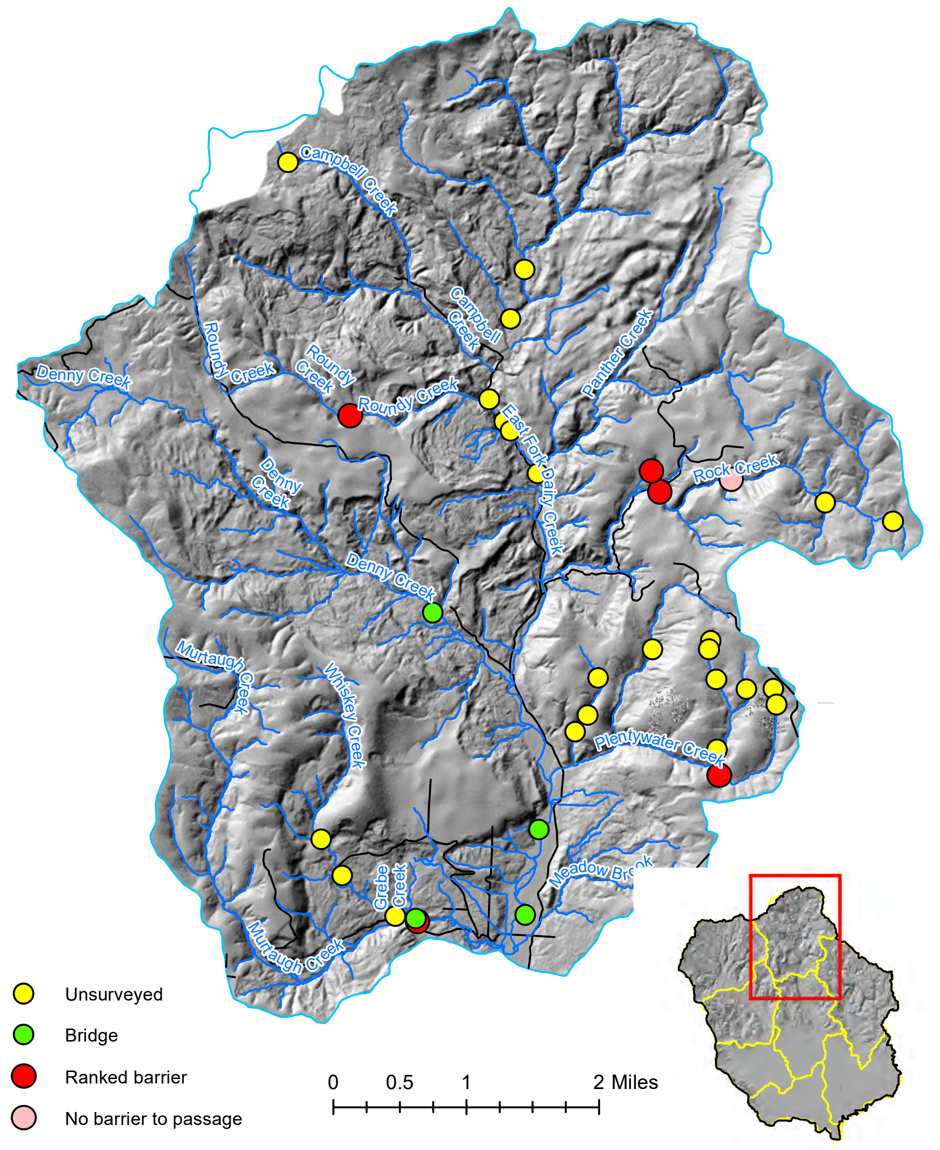

Figure 4. Surveyed culverts, potential barriers and unidentified bridges in upper East Fork Dairy Creek subwatershed.

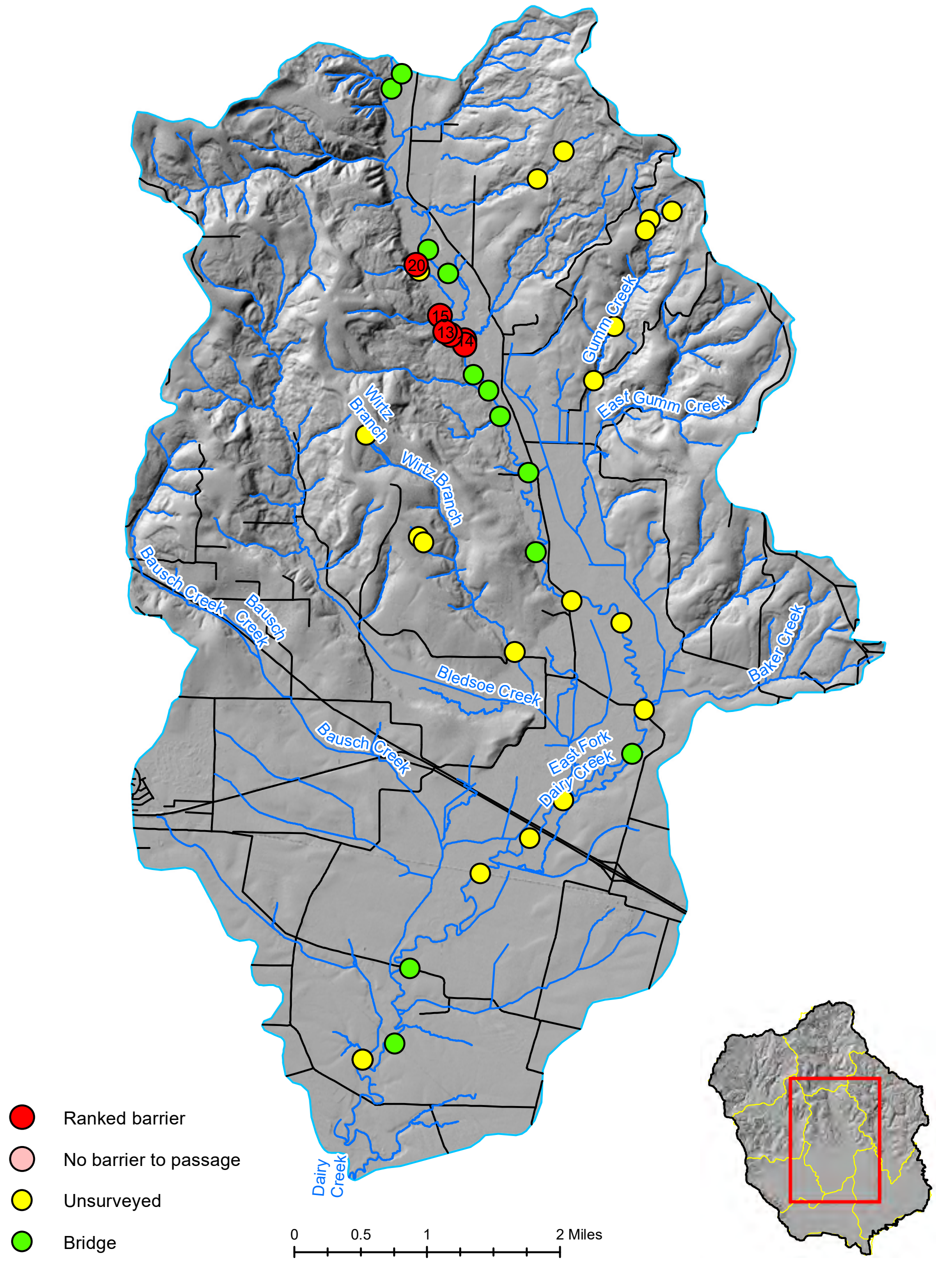

Figure 5. Surveyed culverts, potential barriers and unidentified bridges in lower East Fork Dairy Creek subwatershed.

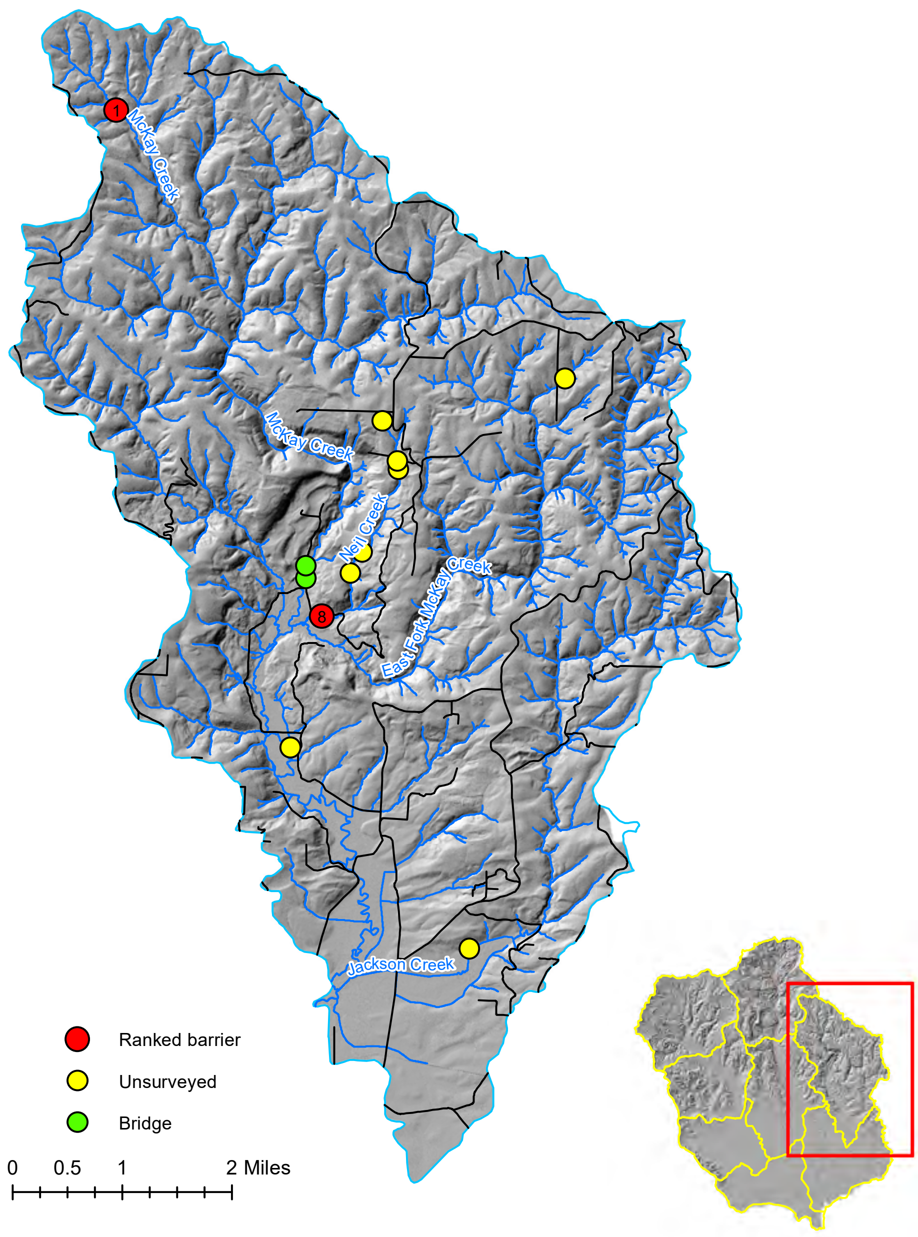

Figure 6. Surveyed culverts, potential barriers and unidentified bridges in upper McKay Creek subwatershed.

Appendices

Appendix A: Assessment Forms: 1) BLM Fish Passage Through Road Crossing Assessment Form; 2) Washington County Transportation Department Fish Passage Assessment Form

Appendix B: BLM Coarse Screen Filter – Juvenile salmonid passage evaluation criteria Version 2.2

Appendix C: Wildlife Habitat Assessment Form

Appendix D: High Priority Barrier Raw Data

Appendix A

Assessment Forms

BLM Fish Passage Through Road Crossing Assessment Form

Washington County Transportation Department Fish Passage Assessment Form

Date: ___________

Fish Passage Through Road Crossings Assessment

Culvert:________

SITE INFORMATION

RECORDER:

District: __Salem District__________________

Field Office:__Tillamook Resource Area______________________

6th Field Watershed Number: ________________

Stream Name:____

Road Number: ___________________________

Road Name: ____

7.5-minute Quad: _________________________

UTM: Zone __10__ **East** _______________ **North** _________ **NAD27**

Surveyors: ______________________________

Legal Description: T. _____, **R.** _____, **Sec.** _____, ____ **¼ of**____**¼**

____

Ownership: BLM__ **USFS**__ **Private**__ **Private Industrial**__ **Other**__

CULVERT STRUCTURE

Barrel Shape
- ☐Box
- ☐Circular
- ☐Open Bottom Arch
- ☐Pipe-Arch

Horizontal size
- Width ______inches
- Diam. ______inches

Vertical size
- Height _____inches
- Diam. _____ inches

Ford Crossing
- Sag____
- F_1______
- F_2______

Construction
- ☐2 2/3x½ in. corr.
- ☐3x1 in. corr.
- ☐5x1 in. corr.
- ☐SSP 6x2 in. corr.
- ☐Smooth

Culvert Material
- ☐Spiral CMP
- ☐Annular CMP
- ☐SSP (Steel)
- ☐ABS (Plastic)
- ☐Concrete
- ☐Wood/Log

Culvert Condition

(Check all that apply)
- ☐Bent inlet
- ☐Debris plugging inlet
- ☐Bottom worn thru
- ☐Water under culvert
- ☐Fill eroding
- ☐None

Overall Condition
- ☐Good
- ☐Fair
- ☐Poor
- ☐Undetermined

Culvert Inlet Type
- ☐Projected
- ☐Mitered
- ☐Wingwall 10-30°
- ☐Wingwall 30-70 °
- ☐Headwall

End Sections Inlet

Y N

Headwall Inlet

Y N

Inlet Alignment
- ☐0-30°
- ☐30-60°
- ☐ 60-90°
- Left/Right

Inlet Blockage
- ☐Not Blocked
- ☐< 10% Blockage
- ☐> 10% Blockage

Culvert Outlet Type
- ☐At streambed elevation
- ☐Cascade over riprap
- ☐Freefall into pool
- ☐Freefall onto riprap
- ☐Outlet apron

End Sections Outlet

Y N

Headwall Outlet

Y N

Baffles

Y N ___________Type

Baffles Covered

Y N

Weirs

Y N ___________Type

Weir Height ______in

Max Pool Depth ______in

Multiple Structures

Structure___ of ___

__#Identical orifices- no extra form

__#Different orifices- w/ forms done

__#Overflow pipes- w/o forms done

__N/A

Barrel Sections

1 2 3 4 5 6 U NA

Diversion Potential (Stream)

Y U N

Rustline/Scour

Height _______ in

Outlet Scour

Y N

Breaks in Slope

Y N

Horiz. Dist. from Outlet ________ft

Vert. Dist. To Break ________ft

Culvert/Drainage Device

MA MI DD LC FD

Shape and/or Condition Comments:

SUBSTRATE

Substrate in Culvert (Visual estimate. Circle one)

Culvert (metal) Sand/Gravel Gravel/Cobble Cobble/Boulder Boulder/Log Bedrock

Natural Bottom Roughness In Culvert (Visual estimate. Circle one)

None Gravels with no riffles Smooth with Cobbles Gravels/Cobbles/Few Boulders Cobbles with Large Boulders

Substrate in Channel (Visual estimate. Circle one)

Sand/Gravel Gravel/Cobble Cobble/Boulder Boulder/Log Bedrock

Natural Substrate in Culvert (rock-wood)

=100% <100%

Sunken Grade or **At Grade** (for FishXing)

PHOTOGRAPHS Use digital camera if possible

White Board photo number _______________

Inlet photo number [s] _________________

Outlet photo number [s] _________________

Culvert Interior (Outlet) View photo number ______________________

Overall View photo number (from downstream) ______________________

Others______________________________________

CHANNEL DESCRIPTION

		Gradient	Distance	Width	Ratio
Inlet Gradient: From pipe inlet 1 pipe diameter upstream (measured from channel bottom)		0.__ __			
Channel Gradient: Beyond culvert influence (measured from water surface)	Upstream	0.__ __	ft		
	Downstream	0.__ __	ft		
Bankfull Width: Beyond culvert influence	Upstream		ft	ft	
	Downstream		ft	ft	
Inlet Width to Bankfull Ratio: _____(Inlet)/_____(Bankfull)					0.__ __

LONGITUDINAL PROFILE These are rod heights you are measuring, except the horizontal distances

Measurement		Formula	Value
Height of the Instrument (HI)	**A**		ft
Inlet Invert Elevation	**B**	100 – _____ **(A)** – _____(Rod Height)	ft
Outlet Invert Elevation	**C**	100 – _____ **(A)** – _____(Rod Height)	ft
Outlet Pool Length*			ft
Outlet Pool Depth		_____**(E)** – _____**(D)**	ft
Substrate/Pool Bottom Elevation	**D**	100 – _____ **(A)** – _____(Rod Height)	ft
Water Surface Elevation	**E**	100 – _____ **(A)** – _____(Rod Height)	ft
Outlet Pool Tailwater Depth*	**F**		ft
Outlet Drop	**G**	_____**(C)** – _____**(E)**	ft
Vertical Leap Distance*		_____**(F)** + _____**(G)**	ft
Horizontal Leap Distance*			ft
Culvert Length	**H**		ft
Culvert Slope		_____**(B)** – _____**(C)** / _____**(H)**	0.__ __
Invert Depth		_____(Diameter or Height) – _____(Depth)	ft
Average Water Depth In Culvert			in
Culvert Wall Thickness			in
Road Surface Type			

Comments:

If no Outlet Pool exists, do not survey these attributes.

Drawings: Overall View from **Upstream** of culvert to **Downstream** of culvert. (Use additional sheets if needed)

Water Flow Near Culvert:

Date__________ **Location**________________________ ________**cfs**

TAILWATER CROSS-SECTION (For FishXing. Calculate Using **100-____ (A)–____(Rod Height)**)

Station (ft)	0.0												
Elevation (ft)													
Calculated El. (ft)													
Notes													

Substrate at Tailwater Cross-Section (Visual estimate only. Circle one)

Gravels with no riffles   Smooth with Cobbles   Gravels/Cobbles/Few Boulders   Cobbles with Large Boulders

	Channel Gradient	Length (ft)
Channel Gradient at Tailwater Control	0.__ __	

Date:________

Fish Passage Evaluation

Culvert:________

FISH INFORMATION List up to 3 species and life stages by Priority – First is highest

	First	Second	Third
Species (R)			
Critical Life Stage (adult or juvenile) (R)			
Fish Length (mm) (R)			
Water Depth			
Migration Season (Winter, Spring, Summer, Fall) (O)			

HABITAT INFORMATION

	Upstream	Downstream
Number of Culverts (list)		
Number of Known Barriers (list)		
Distance to Culvert Barriers (stream)		
Length of Historical Upstream Habitat		

FISH PASSAGE

COARSE SCREEN FILTER EVALUATION:	**GREEN**	**GREY**	**RED**
FISHXING EVALUATION:	**GREEN**	**GREY**	**RED**

ADDITIONAL MEASUREMENTS & COMMENTS

Water Flow Near Culvert:
Date___________ Location_________________________ _________cfs

Washington County Fish Passage Assessment

Date:

Recorder:

Culvert Location/Identification		1st Pass (Coarse Screen Filter)	
Road		*Perch Height (in)*	
Milepost		*Inlet Blockage (%)*	
Stream		*Upstream bankfull w. (ft)*	
Culvert Key #		*Downstream bankfull w. (ft)*	
Asset #		*Avg. bankfull width (ft)*	
GPS Latitude		*IW / BFW Ratio*	
GPS Longitude		*Upstream Gradient*	
Culvert Information		*Downstream Gradient*	
Shape		*Average Gradient*	
Material		**Culvert Slope**	
Corrugation		*Instrument Height, HI (ft)*	
Length (ft)		*Inlet Elevation (ft)*	
Width (ft)		*Outlet Elevation (ft)*	
Height (ft)		*Slope: (IE-OE)/length*	
Number of culverts			

Diversion Potential:

2nd Pass (Fine Screen Filter)		Stream Habitat Quality	
Embedded (Y/N)		*Channel Condition (0-10)*	
Depth of fill (ft)		*Flow Complexity (0-10)*	
Type of bed material		*Embeddedness (0-10)*	
Constant outlet pool (Y/N)		*Cover (0-10)*	
Outlet pool length (ft)		*Bank Stability (0-10)*	
Outlet pool bottom elev. (ft)		*Riparian Zone (0-10)*	
Water surface elevation (ft)			

Additional Notes: Inlet and outlet type, culvert condition, wiers, baffles, outlet scour, other comments

Appendix B

BLM Coarse Screen Filter – Juvenile salmonid passage evaluation criteria

Version 2.2

Coarse Screen Filter –Juvenile salmonid passage evaluation criteria **V2.2**

	Structure	Green	Grey	Red
1	Bottomless pipe arch or countersunk pipe arch, substrate 100% coverage through pipe and invert depth greater than 20% of culvert rise.	Culvert installed at channel grade (+/- 1%), culvert span to bankfull width ratio greater than 0.9, no blockage.	Culvert installed at channel grade (+/- 1%), culvert span to bankfull width ratio greater than 0.5, less than or equal to 10% blockage.	Culvert not installed at channel grade (+/- 1%), culvert span to bankfull width ratio less than 0.5, greater than 10% blockage.
2	Pipe arches (1x3 corrugation and larger). Substrate less than 100% coverage through pipe or invert depth less than 20% of culvert rise.	Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75.	Culvert gradient between 0.5 to 2.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 2.0%, greater than 4" perch, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5.
3	Circular CMP or ABS, 48 inch span and smaller, spiral or annular (CMP) corrugations, regardless of substrate coverage.	Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75	Culvert gradient 0.5 to 1.0%, perch less than 4 inches, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 1.0%, perch greater than 4 inches, blockage greater than 10%, span to bankfull width ratio less than 0.5.
4	Circular CMPs with annular corrugations larger than 1x3 and 1x3 spiral corrugations (>48" span), substrate less than 100% coverage through pipe or invert depth less than 20% culvert rise.	Culvert gradient less than 0.5%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75.	Culvert gradient between 0.5 to 2.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 2.0%, greater than 4" perch, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5.
5	Circular CMPs with 1x3 or smaller annular corrugations (all spans) and 1x3 spiral corrugations (>48" span), 100% substrate coverage through pipe and invert depth greater than 20% of culvert rise.	Culvert gradient less than 1%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75	Culvert gradient 1.0 to 3.0%, perch less than 4 inches, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 3.0%, perch greater than 4 inches, blockage greater than 10%, culvert span to bankfull width ratio less than 0.5.
6	Circular CMPs with 2x6 annular corrugations (all spans), 100% substrate coverage through pipe and invert depth greater than 20% of culvert rise.	Culvert gradient less than 2.0%, no perch, no blockage, culvert span to bankfull width ratio greater than 0.75	Culvert gradient 2.0 to 4.0%, less than 4" perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5.	Culvert gradient greater than 4.0%, greater than 4 inch perch, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5.
7	Special items; log stringer or modular bridge,	No encroachment on bankfull width.	Encroachment on bankfull width (either streambank).	Structural collapse.
8	Baffled structure installations (all culvert sizes and configurations).	No perch, no blockage. Culvert span to bankfull width ratio greater than 0.75. 100% substrate in pipe but baffles protruding.	Outlet with less than 6 inch perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5. Less than 100% substrate.	Perch greater than 6 inches, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5. Less than 100% substrate.
9	Weir installations (all culvert sizes and configurations).	No perch, no blockage. Culvert span to bankfull width ratio greater than 0.75. Weirs provide 6 inch minimum pool depth and no jumps exceed 4 inches.	Outlet with less than 6 inch perch, less than or equal to 10% blockage, culvert span to bankfull width ratio greater than 0.5. Weirs with pool depths less than 6 inches. Jumps over weirs greater than 4 inches.	Perch greater than 6 inches, greater than 10% blockage, culvert span to bankfull width ratio less than 0.5. Weirs without pools, no resting areas. Weir Jumps> 4 inches
10	Concrete Box Culverts	Culvert backwatered or mostly backwatered w/100% substrate. Culvert span to bankfull width ratio greater than 0.75. No blockage.	Culvert gradient up to 2%. Outlet with less than 4 inch perch. 100% substrate in pipe. Culvert span to bankfull ratio greater than 0.5.	Perch greater than 4 inches. Culvert span to bankfull ratio less than 0.5. Laminar flow. Less than 100% substrate in pipe.
11	Circular concrete and smooth wall ABS culverts.	100% substrate in pipe. Slope less than .5%. No Perch	Less than 100% substrate in pipe. Slope .5-1%. Perch less than 4 inches	No substrate. Slope greater than 1% Perch greater than 4 inches.

Note: 1) For culverts containing baffles but are entirely covered with substrate, evaluate using the criteria for structures 2-8, as appropriate. 2) If culvert does not fit well on this CSF run Fish-Xing. 3) This CSF works well for culverts on public lands, not always well for private landowner culverts due to large variations in construction materials and types of installations.

This model was derived from a US Forest Service model.

Appendix C

Wildlife Habitat Assessment Form

Wildlife Habitat Assessment

Unit	No.	Location	Area	Score

Comments:

COMPONENT		DEGREE	SCORE *	**	COMMENTS
WATER	Quantity & Seasonality	None 0 … Seasonal 4 … Perennial 8			
	Quality	Stagnant 0 … Seasonally Flushed 3 … Continually Flushed 6			
	Proximity to Cover	None 0 … Nearby 4 … Immediately Adjacent 8			
	Diversity (Ponds/Streams/ Wetlands)	One Present 2 … Two Present 4 … Three Present 8			
FOOD	Variety	Low 0 … Medium 4 … High 8			
	Quantity & Seasonality	None 0 … Limited 4 … Year Round 8			
	Proximity to Cover	None 0 … Nearby 4 … Immediately Adjacent 8			
COVER	Structural Diversity	Low 0 … Medium 4 … High 8			
	Variety	Low 0 … Medium 4 … High 8			
	Nesting	Low 0 … Medium 2 … High 4			
	Escape	Low 0 … Medium 2 … High 4			
	Seasonality	None 0 … Limited 2 … Year Round 4			
ADDITIONAL VALUE					
DISTURBANCE	Physical	Permanent 0 … Temporary 2 … Undisturbed 4			
	Human	High 0 … Medium 2 … Low 4			
INTERSPERSION		Low 0 … Medium 3 … High 6			
UNIQUE FEATURES 0-4		Wildlife ___ Rarity of Habitat Type Flora ___ Scenic ___ Educational Potential ___			

*Existing **Enhancement Potential

Adopted from a form created by: Mike Houck – Audubon Society
Dennis Peters – US Fish & Wildlife Service
Gene Herb – Oregon Dept. of Fish & Wildlife
Ralph Rogers – US Army Corps of Engineers
Diana Hwang – US Fish & Wildlife Service
Jack Broome – Wetlands Conservancy

Appendix D

High Priority Barrier Raw Data

Appendix D – High Priority Raw Data

Table 1 – Culvert Prioritization Criteria

Basin	Report Culvert ID Number	Stream Name	Habitat Length (0-4 range)	Habitat Quality (0-4 range)	Barrier Severity	ESH	Total Score (0-4 range plus ESH)	Rank (0-4 range)
McKay	1	McKay Creek	4	4	2	1.00	11.00	1
West Fork	2	Kuder Creek	4	4	2	0.84	10.84	2
East Fork	3	Rock Creek	4	4	2	0.49	10.49	3
West Fork	4	Sadd Creek	4	3	2	1.00	10.00	4
East Fork	5	Plentywater Creek	3	4	2	0.52	9.52	5
West Fork	6	Sadd Creek	4	3	1	1.00	9.00	6
West Fork	7	Cougar Creek	4	2	2	1.00	9.00	6
McKay	8	Neil Creek	4	3	1	0.91	8.91	8
East Fork	9	Roundy Creek	4	3	1	0.54	8.54	9
West Fork	10	Tributary of Whitcher Creek	3	3	1	0.84	7.84	10
East Fork	11	Murtaugh Creek	1	3	2	1.00	7.00	11
West Fork	12	Burgholzer Creek	1	3	1	1.00	6.00	12
East Fork	13	Tributary of EFDC	1	3	1	0.99	5.99	13
East Fork	14	Tributary of EFDC	1	3	1	0.99	5.99	14
East Fork	15	Tributary of EFDC	1	3	1	0.97	5.97	15
East Fork	16	Tributary of EFDC	1	3	1	0.94	5.94	16
West Fork	17	Tibutary of Mendenhall Creek	1	3	1	0.86	5.86	17
East Fork	18	Rock Creek Tributary	1	3	1	0.45	5.45	18
East Fork	19	Tributary of EFDC	1	2	1	0.99	4.99	19
East Fork	20	Tributary of EFDC	1	2	1	0.93	4.93	20
West Fork	21	Tributary of Mendenhall Creek	1			0.83	1.83	21
West Fork	22	Mendenhall Creek	4	4	0	1.00	9.00	6
East Fork	23	Rock Creek	4	4	0	0.00	8.00	#N/A
West Fork	24	Mendenhall Creek	4	3	0	1.00	8.00	#N/A

Appendix D – High Priority Raw Data

Table 2 – Culvert location and information

Basin	Report Culvert ID Number	Stream Name	GPS Lat	GPS Long	# of barrels	Length (ft)	Width (in)	Heigth (in)	Slope	Upstream Habitat Length (mi)	Distance to ESH (mi)	Perch Height (in)	% Blockage	Bankfull width (ft)	Stream Gradient
McKay	1	McKay Creek	45°43.446'N	123°01.228'W	1	40.17	35	39	-12.70%	3.04	0.00	26	0%	3.68	0.075
West Fork	2	Kuder Creek	45°39'33.4938"N	123°9'55.9692"W	2	31.4167	39	39	-7.79%	3.85	0.45	6	0%	10.573	2%
East Fork	3	Rock Creek	45°44'33.576"N	123°2'56.184"W	1	71.167	84	86	-0.76%	2.98	1.41	30	0%	15.33	9%
West Fork	4	Sadd Creek	45°36'56.6532"N	123°10'13.3674"W	1	66.46	80	64	6.24%	5.03	0	0	0%	10.54185	0%
East Fork	5	Plentywater Creek	45°42.713'N	123°02.325'W	1	62	42	42	-6.00%	1.27	1.33	7.5	10%	4.56	0.04
West Fork	6	Sadd Creek	45°37'31.3386"N	123°10'49.8684"W	1	25	84	56	0.40%	3.86	0	0	0%	10.9795	1.5%
West Fork	7	Cougar Creek	45°40'21.99"N	123°10'12.291"W	1	18.7575	94	80	-2.40%	4.53	0	2	20%	19.5002	2%
McKay	8	Neil Creek	45°39'31.32"N	122°58'56.3334"W	1	40.854	42	42	-1.81%	2.41	0.24	0	10%	8.3117	2.75%
East Fork	9	Roundy Creek	45°44'59.4954"N	123°5'51.108"W	1	52.25	79.5	66.75	-1.67%	2.17	1.27	0	0%	14.8875	8%
West Fork	10	Tributary of Whitcher Ck	45°41.461'N	123°10.174'W	1	36.42	41	32.5	1.70%	1.01	0.44	0	5%	3.7	0.02
East Fork	11	Murtaugh Creek	45°41'42.0318"N	123°5'4.2"W	1	39.33	80.5	99.25	-3.23%	0	0.01	9.5	0%	15.41065	2.5%
West Fork	12	Burgholzer Creek	45°42.220'N	123°15.450'W	2	40	18	18	-20.20%	0.45	0.00	0	0%	8.7	0.08
East Fork	13	Tributary of EFDC	45°39.733'N	123°03.691'W	1	32.667	38	38	-0.94%	0.1	0.02	9	0	2.5	5.5
East Fork	14	Tributary of EFDC	45°39.680'N	123°03.509'W	1	20	48	48	0.80%	0.1	0.04	0	0	4.388916667	0.00535
East Fork	15	Tributary of EFDC	45°39.838'N	123°03.745'W	1	47.0833	30	30	-2.38%	0.1	0.09	0	0	4.222	2
East Fork	16	Tributary of EFDC	45°39.894'N	123°03.795'W	1	32.417	24	24	-3.97%	0.1	0.16	0	0	3.375	4
West Fork	17	Tibutary of Mendenhall Ck	45°42.318'N	123°10.416'W	1	41.16	37.5	33.5	-3.35%	0.38	0.38	0	10%	8.7	0.035
East Fork	18	Rock Creek Tributary	45°44'41.6"N	123°03'01.4"W	1	42.14583	36	36	-1.28%	0.1	1.52	0	0%	11.08	9.5%
East Fork	19	Tributary of EFDC	45°39.654'N	123°03.517'W	1	10.333	42	42	-1.26%	0.1	0.02	0	0	3.583	-0.0037
East Fork	20	Tributary of EFDC	45°39.901'N	123°03.815'W	1	35.167	27	27	-2.70%	0.1	0.18	3	0	2.75	5.5
West Fork	21	Tributary of Mendenhall Ck	45°42.263'N	123°10.025'W	1				n/a	0.47	0.48	n/a	n/a	n/a	n/a
West Fork	22	Mendenhall Creek	45°42.532'N	123°09.467'W	1	70.583	183	127	-2.62%	3.58	0.00	0	0	11.14575	4
East Fork	23	Rock Creek	45°44.656'N	123°02.277'W	1	45	7'	7.08'	-1.40%	5.33	2.76	0	0%	11.05	0.055
West Fork	24	Mendenhall Creek	45°42.471'N	123°09.458'W	1	67	15'	9.4'	3.00%	3.05	0.00	0	2%	11.27	0.045

Appendix D – High Priority Raw Data

Table 3 – Culvert Site Habitat Assessment

			Water				Food			Cover					Disturbance		Interspersion	Unique Features	Habitat Score
Basin	Report Culvert ID Number	Stream Name	Quantity & Seasonality (0-8)	Quality (0-6)	Proximity to Cover (0-8)	Diversity (Ponds/Streams/Wetlands) (2-8)	Variety (0-8)	Quantity & Seasonality (0-8)	Proximity to Cover (0-8)	Structural Diversity (0-8)	Variety (0-8)	Nesting (0-4)	Escape (0-4)	Seasonality (0-4)	Physical (0-4)	Human (0-4)	0-6	0-4	
McKay	1	McKay Creek	8	6	8	2	8	6	8	8	6	3	4	3	2	4	5	0	8.1
West Fork	2	Kuder Creek	6	6	8	6	6	7	8	8	8	4	4	3	3	3	5	1	8.6
East Fork	3	Rock Creek	4	6	8	6	6	7	8	8	6	4	4	4	3	2	4	0	8
West Fork	4	Sadd Creek	8	6	8	4	2	6	8	4	2	4	4	2	0	2	4	0	6.4
East Fork	5	Plentywater Creek	8	6	8	2	7	7	8	8	7	2	4	3	3	4	5	0	8.2
West Fork	6	Sadd Creek	6	3	6	2	5	4	8	5	4	4	2	3	4	3	3	0	6.2
West Fork	7	Cougar Creek	4	4	6	2	2	3	8	1	1	2	1	1	2	1	3	0	4.1
McKay	8	Neil Creek	8	6	5	2	4	4	4	5	4	2	1	1	4	2	3	0	5.5
East Fork	9	Roundy Creek	5	5	8	2	3	3	8	4	6	1	4	1	3	3	2	0	5.8
West Fork	10	Tributary of Whitcher Creek	7	4	8	2	6	5	7	4	4	2	4	2	1	2	3	0	6.1
East Fork	11	Murtaugh Creek	6	5	4	6	5	6	8	8	7	4	4	3	1	2	0	2	7.1
West Fork	12	Burgholzer Creek	6	3	5	4	3	4	4	6	4	3	3	2	1	1	2	0	5.1
East Fork	13	Tributary of EFDC	7	4	8	0	6	6	8	6	6	3	4	3	4	3	4	0	7.2
East Fork	14	Tributary of EFDC	7	5	6	4	5	4	6	5	5	3	2	2	4	3	3	0	6.4
East Fork	15	Tributary of EFDC	7	5	8	2	6	6	8	5	6	3	4	2	4	4	3	0	7.3
East Fork	16	Tributary of EFDC	7	5	7	2	6	6	7	4	4	2	4	3	4	3	4	0	6.8
West Fork	17	Tibutary of Mendenhall Ck	8	6	7	2	5	5	8	5	6	2	4	2	2	2	4	0	6.8
East Fork	18	Rock Creek Tributary	3	4	4	2	6	6	7	2	2	1	2	1	3	3	5	0	5.1
East Fork	19	Tributary of EFDC	7	5	4	4	3	3	4	2	2	2	1	2	4	3	3	0	4.9
East Fork	20	Tributary of EFDC	7	5	5	2	2	4	4	2	4	2	3	2	4	1	2	0	4.9
West Fork	21	Tributary of Mendenhall Ck	n/a																
West Fork	22	Mendenhall Creek	8	6	7	2	6	6	8	6	6	4	4	3	4	4	4	1	7.9
East Fork	23	Rock Creek	8	6	8	2	6	6	8	8	7	3	4	2	0	3	5	0	7.6
West Fork	24	Mendenhall Creek	8	6	7	4	4	5	8	7	6	3	4	2	3	3	4	0	7.4