Dairy-McKay Fish Passage Assessment and Prioritization

Washington County, Oregon
Department of Land Use and Transportation,
Operations and Maintenance Division

Authors:
Scott Griebling, Inspection Technician
Janet Oatney, Sr. Environmental Resource Specialist
Stephen Cruise, Environmental Resource Specialist
Washington County Department of Land Use and Transportation
Operations Division - Environmental Services
1400 SW Walnut Street
Hillsboro, Oregon, 97123
503-846-7652

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Abstract

During the summer of 2006, Washington County conducted a fish passage inventory of the culverts acting as road-stream crossings in the Dairy-McKay watershed. The inventory has established a foundation for future fish passage inventories in the County's other watersheds. Field inspections were conducted on 302 culverts, 164 of which were surveyed and prioritized to identify structures that were barriers to migratory fish species. The remaining culverts were determined non-fish bearing structures. Twenty of the culverts surveyed were deemed high priority barriers and were organized in groupings based on geographic location, stream connectivity, and ease of construction.

Objectives

- Assess fish passage status within Washington County road system in the Dairy-McKay watershed.
- Identify which road-stream crossings act as fish passage barriers (referred to simply as barriers from here on) through field surveys.
- Prioritize and group the barriers by December 2006 to set the groundwork for future replacement.
- Develop a method for incorporating barrier removal into overall project selection, rather than simply incorporating fish passage design into maintenance projects.
- Develop fish passage assessment and prioritization protocol for use throughout the County and by local watershed councils and other transportation entities.
- Foster partnerships to speed replacement of high priority barriers and improve migratory fish access to high quality habitat.

I. Introduction

Overview

Washington County surveyed the fish bearing culverts within the Dairy-McKay watershed in order to identify and prioritize the barriers to migratory fish. A prioritization scheme ranked the barriers and identified the highest priority culverts for replacement within the watershed. Finally, the high priority barriers were placed into groups based on geographical proximity, stream connectivity potential, and construction logistics.

Background

Washington County has incorporated fish passage design elements within the culvert replacement program for many years. However, project selection continues to focus on structurally deficient culverts with limited consideration of the ecological benefits. Barriers to high quality habitat are unlikely to be addressed until the culverts become structurally inadequate. An inventory of barriers in the Dairy-McKay watershed will help the County integrate environmental benefits into the current maintenance and replacement strategy if additional funding becomes available.

An additional requirement to inventory barriers comes from Oregon House Bill 3002, which requires all artificial obstructions on streams with current or past migratory fish

populations to provide upstream and downstream passage if certain "triggering" events occur. The bill also requires the Oregon Department of Fish and Wildlife (ODFW) to complete and maintain a statewide inventory of all artificial obstructions. The County's inventory would support ODFW's efforts to complete the statewide inventory.

Partners Involved

The project was undertaken in collaboration with the Bureau of Land Management (BLM), the Oregon Department of Fish and Wildlife (ODFW), and Tualatin River Watershed Council (TRWC). Because the nature of this project does not fall within the direct realm of road maintenance, Washington County sought additional funding to complete this project. The BLM used Title II of the Secure Rural Schools and Community Self-Determination Act to help fund the project with the desire to provide migratory fish access to streams running through BLM land and gain a more complete inventory of State fish passage barriers. Twenty-two culverts on federal lands within the Dairy-McKay watershed were surveyed in addition to the County owned structures (see map in Appendix A).

The fish passage assessment aids the TRWC in achieving priority action items in the Tualatin River Watershed Action Plan: *"Action Item 1 – Assess watershed conditions to help prioritize restoration activities"* and *"Action Item 2 - Conserve and improve fish and wildlife habitat (focusing on anadromous fish)"*. The information gathered from the County's assessment will be provided to the TRWC.

The County participates in the Fish Passage Task Force as a technical advisor in developing a consistent statewide methodology for assessing and prioritizing fish passage barriers. An additional goal and benefit of this assessment is the ability for other transportation agencies to utilize this assessment methodology to complete surveys of their potential transportation related fish passage barriers.

Watershed Selection

The Dairy-McKay watershed (HUC 1709001001) is a subbasin of the Tualatin River watershed (HUC 17090010), which is located in northwest Oregon and empties into the Willamette river. The Tualatin River watershed drains 712 square miles of forest, agricultural plains, and urban area. The urban areas, comprising 15% of the watershed, include southwest Portland, Hillsboro, Tigard, and Beaverton and contain some of Oregon's fastest growing urban populations. Forest and agriculture take up 50% and 35% of the remaining area, respectively. (Tualatin River Watershed Council website)

The Dairy-McKay watershed provides an excellent starting point for Washington County's fish passage barrier inventory. This 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, constituting nearly one-third of the basin. From its headwaters in the Tualatin Mountains, the mainstem tributaries flow in a general southerly direction joining the Tualatin River at River Mile 45 near the city of Hillsboro. The Tualatin River serves as rearing and migration habitat for salmon and steelhead, and the Dairy-McKay watershed also contains 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 lies almost entirely within Washington County, with small upper reaches crossing into Columbia County to the north and Multnomah County to the east. The watershed includes mountainous regions, foothills, and plains, resulting in several different stream reaches and habitat types. The variety in terrain results in a wide array of culvert sites to be surveyed, allowing the inventory methodology to be tested under different conditions.

Figure 1 Tualatin River Watershed (Hawksworth, J.T.)

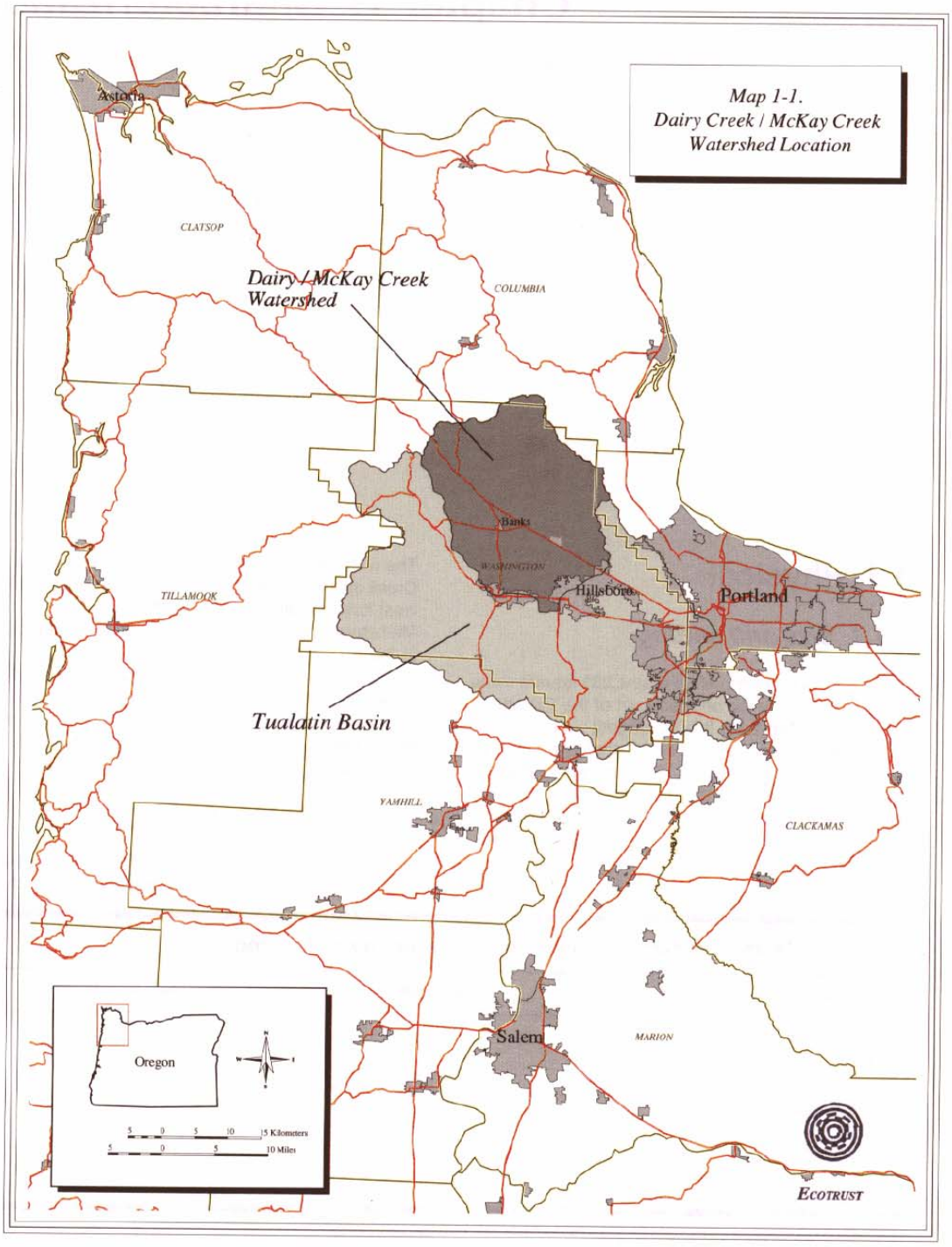
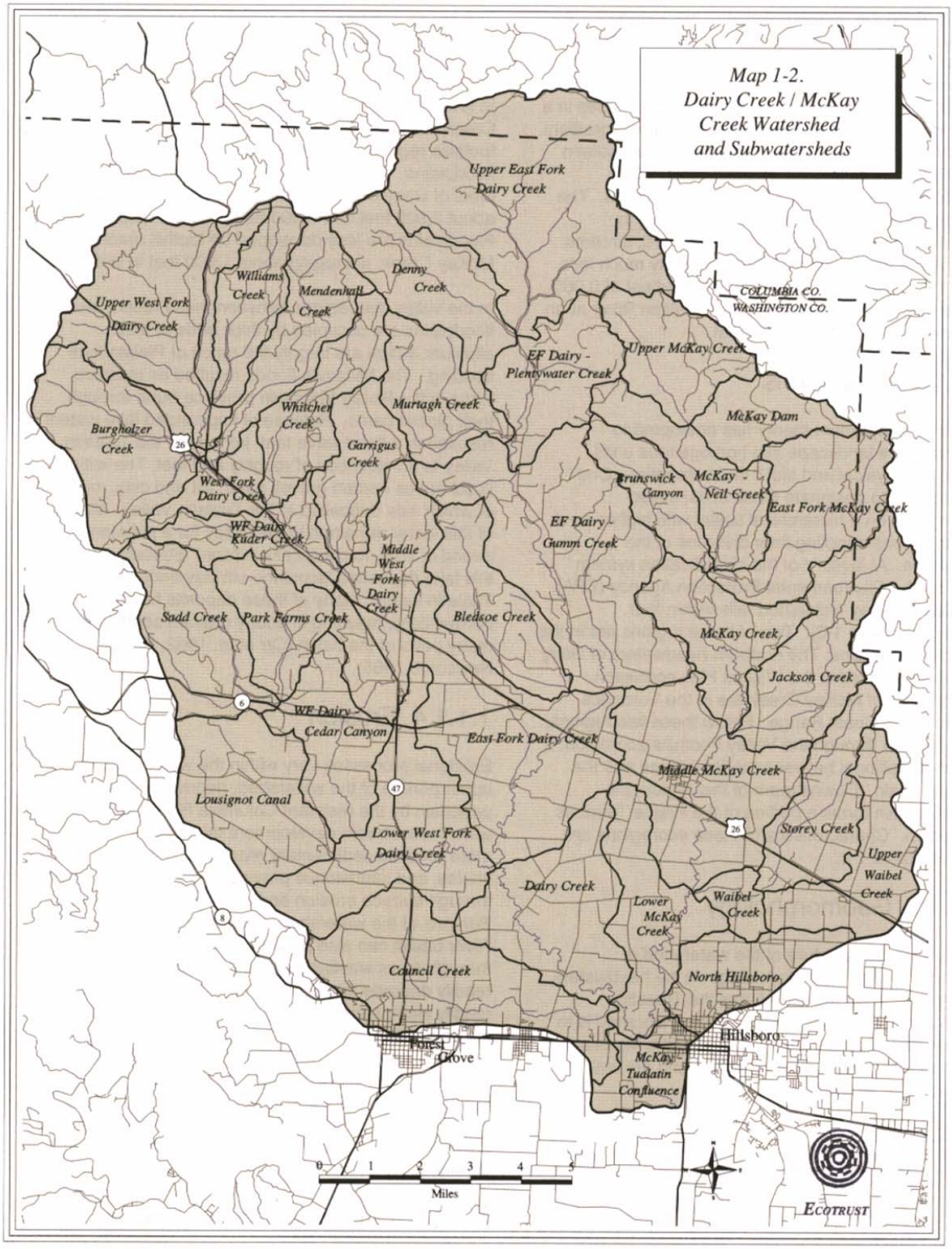


Figure 2. Dairy-McKay Watershed



Species of Concern

The fish species of concern include winter steelhead (*Oncorhynchus mykiss*), currently listed as threatened under the Endangered Species Act, and all migratory fish species, as directed by the Oregon Department of Fish and Wildlife Fish Passage Task Force. Juvenile cutthroat trout (*O. clarkii*) will be used as a design species because they represent the weakest species and life history of anticipated migratory fisheries within this watershed. Coho salmon (*O. kisutch*) are not native to the watershed but have acclimated to the basin, exist well with other species, and have value as game fish. While not the species of concern, the assessment will account for Coho presence in the scoring scheme by incorporating proximity to Essential Salmonid Habitat (ESH) streams.

Survey Scope

Fish passage assessments range from detailed data collections to simplified measurements of surrogate barrier indicators. While a detailed data collection and hydraulic analysis of each culvert provides a specific description of a culvert's barrier level, the effort and time required to collect that level of detail for each culvert is excessive based on Washington County's needs. Instead, the high priority barriers in the watershed were identified relative to one another, allowing them to adopt a more simplified approach to the culvert surveys. A more detailed survey and assessment of culvert finalists will be completed before replacement.

II. Inventory

Culvert Selection

The first step in the culvert inventory involved identifying County culverts on or adjacent to fish bearing waterways in the Dairy-McKay watershed. Based on ODFW input, 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. The Integrated Road Information System (IRIS) provided a list of culverts associated with streams or named bodies of water in the watershed. Some culverts identified by IRIS as spanning ditches held perennial or intermittent streams. To include these culverts in the survey, road-stream crossings were located using Geographic Information System (GIS) mapping and matched with the IRIS data. The survey team confirmed the carrying type (named body, stream, or ditch) in the field before eliminating questionable culverts. If no stream features were present at a culvert site, it was identified as a drainage culvert and was eliminated from the inventory. When identifying non-fish bearing culverts, care was taken to ensure culverts providing high water refuge habitat via occupied floodplains, wetlands, and side channels were not ruled out.

To emphasize stream reaches most likely to have fish presence and to keep the project's scale manageable, culverts smaller than 15 inches in diameter were excluded from the inventory, as they generally serve as drainage cross tiles, rarely carry perennial or intermittent streams, and offer minimal upstream habitat. Additionally, culverts carrying streams with gradients over 15% were excluded from the inventory because that gradient typically represents the upper limit of fish use. Stream gradient was measured in the field using a clinometer upstream and downstream of each culvert.

A total of 302 culverts greater than 15 inches were identified as potential fish bearing culverts in the Dairy-McKay watershed. Further inspection ruled out 138 culverts, most of which lacked channel bed and bank features or had gradients greater than 15%. Of the 138 culverts ruled out, 13 had recently been replaced to ensure fish passage and were not surveyed. A complete survey was performed on the remaining 164 culverts, seven of which were found to pass migratory fish based on surrogate indicators.

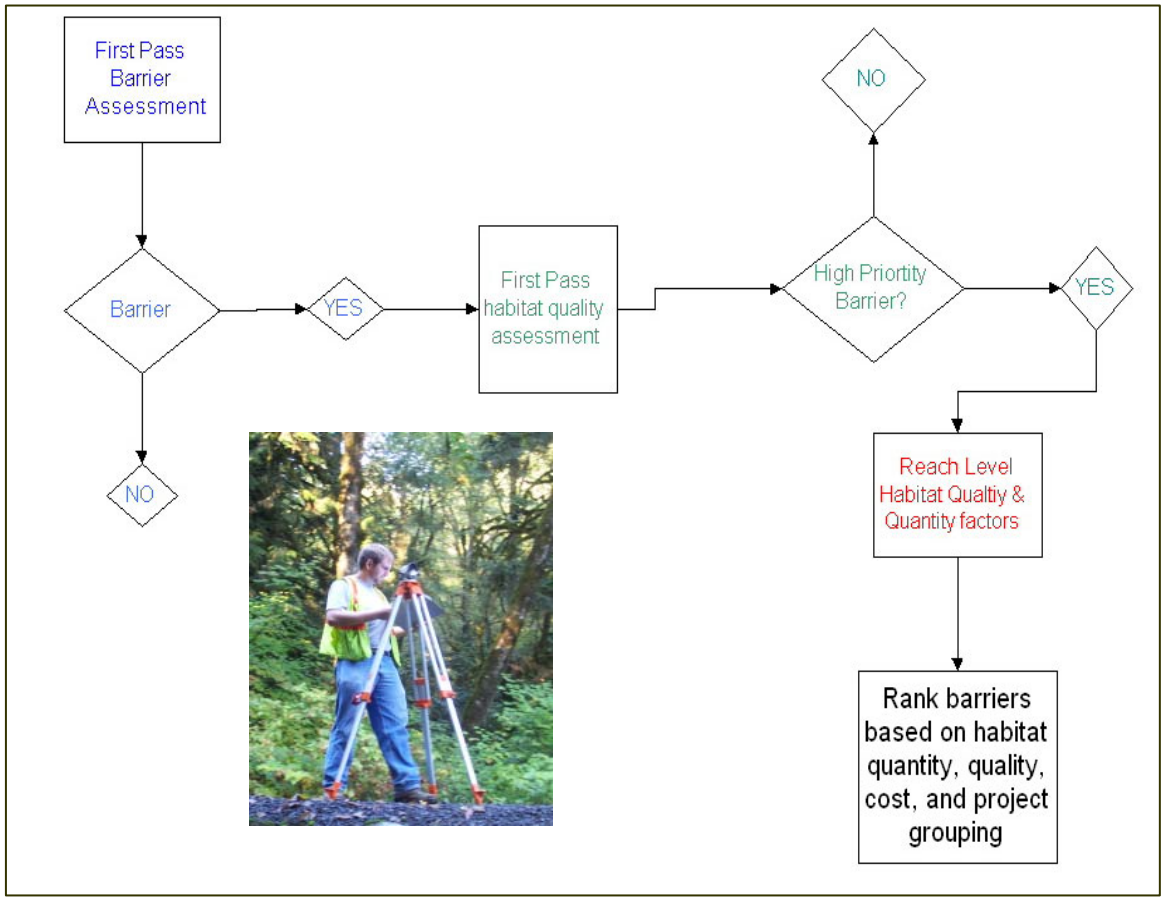
Assessment Methodology

Multiple assessment methods were evaluated prior to data collection. Observational methods such as fish sampling were ruled out as not only time consuming, but time specific, in that sampling efforts must be timed to correspond with the life histories of multiple fish species to reach conclusive evidence of fish passage at a specific crossing. Hydraulic modeling programs such as FishXing, HY-8, HEC-RAS and others require detailed stream information to determine barrier presence and severity. The measurements of surrogates indicative of hydraulic performance as introduced by the US Forest Service were evaluated and determined appropriate both for the amount of site data collected, and the ability to compare and rank multiple barriers within the watershed (Clarkin, Kim et al).

The survey method selected was based on the BLM's *Fish Passage Through Road Crossing Assessment* (Appendix B). Several parameters collected by the BLM were omitted due to existing county records or lack of applicability to county needs. The goal of the survey method was not to establish an in-depth determination of fish passability, but to capture sufficient information to rank barriers relative to other County barriers surveyed. Appendix C contains the County's Culvert Assessment.

Field determination of culvert slope

Figure 3. Fish Passage Flow Chart



The culvert survey measured four surrogate indicators to determine a culvert's ability to pass fish: culvert gradient, stream bankfull width, inlet blockage, and outlet perch. These surrogates were chosen based on the understanding that functional fish passage culverts closely resemble the stream channel they carry. Sediment retention also indicates a culvert's ability to pass fish, but as only a small percentage of county culverts retain sediment, it was not used as a barrier indicator.

Table 1. Surrogate Indicators

Surrogate Indicator	Culvert Attribute Described	Biological Attributes Described
Culvert Gradient	Flow velocity, similarity to carried body	Maximum swim velocity
Stream Bankfull Width	Flow velocity, similarity to carried body, undersized culverts	Maximum swim velocity
Inlet Blockage	Hydraulic conditions at inlet, ability to pass material	Maximum jump height / maximum swim velocity
Outlet Perch	Hydraulic conditions at inlet, undersized culverts	Maximum jump height

III. Barrier Prioritization

Prioritization Methodology

Once inventoried, the culverts were ranked to identify which barriers prevented access to high quality habitat areas. Four main criteria were developed to rank each culvert: barrier severity, habitat quality, habitat length and proximity to Essential Salmonid Habitat (ESH).

Barrier Severity

Barrier severity determination was based on the *BLM Coarse Screen Filter Version 2.2* (Appendix D). 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 BLM land in the Dairy-McKay watershed. The model evaluated culverts based on the surrogate indicator data collected in the culvert inventory. The surrogates were analyzed to determine whether a culvert presented a barrier to 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 bankfull width was considered a barrier; a ten percent of a blockage of a culvert's inlet constituted a barrier, and jumps or perched outlets greater than six inches were identified as barriers. After each barrier type was evaluated for compliance, the number of barrier violations were added 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 (Appendix E). 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 higher scores indicating better habitat.

Habitat Length

USGS topographic maps and Terrain Navigator Pro (Maptech) were used to measure habitat length. Stream and tributary lengths above each culvert were added together to determine the total habitat length. A few culverts showed no streams on the maps but had water present when surveyed, while others indicated stream presence on the maps, but lacked flow. A base habitat length of 0.1 miles was assigned to culverts without measurable stream lengths. Habitat length was scored on a 1-4 scale as well, with a high score indicating greater habitat length.

Proximity to Essential Salmonid Habitat (ESH) (as identified by Oregon Department of State Lands)

Streams designated as ESH provide habitat for a variety of salmonid species including Chinook (*O. tshawytscha*), chum (*O. keta*), Coho salmon and steelhead trout. ESH streams in the Dairy-McKay watershed are generally used by winter steelhead, but other salmonid species, with the exception of chum salmon, may be present in the Tualatin

Basin. These streams are indicative of overall stream health and importance in the watershed. The distance to the nearest ESH stream was measured using USGS topographic maps and Terrain Navigator Pro (Maptech). Culverts were ranked based on proximity to ESH with the scores ranging from 0-1. Because the maximum points available is less than the other scoring factors, proximity to ESH streams did not weigh as heavily in the total score.

Table 2. Ranking Scores

Barrier Prioritization	**Score**	**Scoring Explanation**
Barrier Severity	0-4	One point is given per barrier type present. Barrier types are Jump, Velocity, Blockage, and Gradient.
Habitat Quality	1 2 3 4	Average rating is <2.5 Average rating is between 2.5 and 5 Average rating is between 5 and 7.5 Average rating is greater than 7.5
Upstream Habitat Length	1 2 3 4	Available upstream habitat is <0.5 mi. Available upstream habitat is between 0.5 and 1 mi. Available upstream habitat is between 1 and 1.5 mi Available upstream habitat is >1.5 mi.
Proximity to ESH	0-1	Barrier distances to ESH were normalized within the database. One point indicates the barrier is in an ESH stream. The barrier furthest from an ESH stream received no points.
TOTAL SCORE	**2-13**	Barrier prioritization scores were added together to determine barrier final scores and rankings.

Example of barrier proximity to ESH. Culverts such as this block access to high quality refuge habitat and limit spawning and rearing access.

Total Score

Adding the barrier severity, habitat length, habitat quality, and proximity to ESH scores provided a first pass score from 2-13 for each culvert. High scores represented culverts with several barrier types, large amounts of high quality upstream habitat, in close proximity to ESH streams. Twenty culverts were designated high priority barriers and will be the focus of the Action Plan. The remaining barriers will receive attention at a later time.

Table 3. High Priority Culverts

Road	Milepost	Asset #	Stream Name	Habitat Length	Habitat Quality	Barrier Severity	Prox. To ESH	Total Score	Rank
Fern Flat Rd	2.54	1650	Campbell Creek	4	4	3	1	12	1
Nowakowski Rd	1.319	1849	Trib. of W. Fork Dairy Creek	4	4	3	0.92	11.92	2
Genzer Rd	1.088	1868	Genzer Creek	4	4	3	0.82	11.82	3
Dairy Creek Rd	6.548	1649	Plentywater Creek	4	4	2	1	11	4
Kay Rd	0.228	1902	Neil Creek	4	3	3	0.92	10.92	5
Greener Rd	1.165	1651	Rock Creek	4	4	2	0.88	10.88	6
Greener Rd	1.166	1651	Rock Creek	4	4	2	0.88	10.88	7
Leyman Rd	0.241	1871	Trib. of Whitcher Creek	2	4	4	0.87	10.87	8
Greener Rd	2.659	1898	Panther Creek	4	3	3	0.79	10.79	9
Keller Rd	0.59	1647	Gumm Creek	4	4	2	0.64	10.64	10
Sullivan Rd	0.042	1852	Burgholzer Creek	4	4	1	1	10	11
Dairy Creek Rd	3.827	1646	Trib. of E. Fork Dairy Creek	2	4	3	1	10	12
Strassel Rd	0.592	1658	Poliwaski Canyon Creek	4	4	1	0.98	9.98	13
Leyman Rd	0.584		Whitcher Creek	2	4	3	0.87	9.87	14
Greener Rd	1.425		Whitcher Creek	1	4	4	0.84	9.84	15
Gheen Rd	0.124	1869	Kuder Creek	3	4	2	0.74	9.74	16
Dixie Mountain Rd	3.132		Trib. of Neil Creek	1	4	4	0.66	9.66	17
Hansen Rd	0.519	1903	Trib. of E. Fork McKay Creek	2	4	3	0.65	9.65	18
Hahn Rd	0.328		Wirtz Branch Creek	4	3	2	0.57	9.57	19
Narup Rd	0.837	1818	Sadd Creek	4	3	1	1	9	20

Examples of high priority barriers

Campbell Creek

Panther Creek

IV. Barrier Grouping

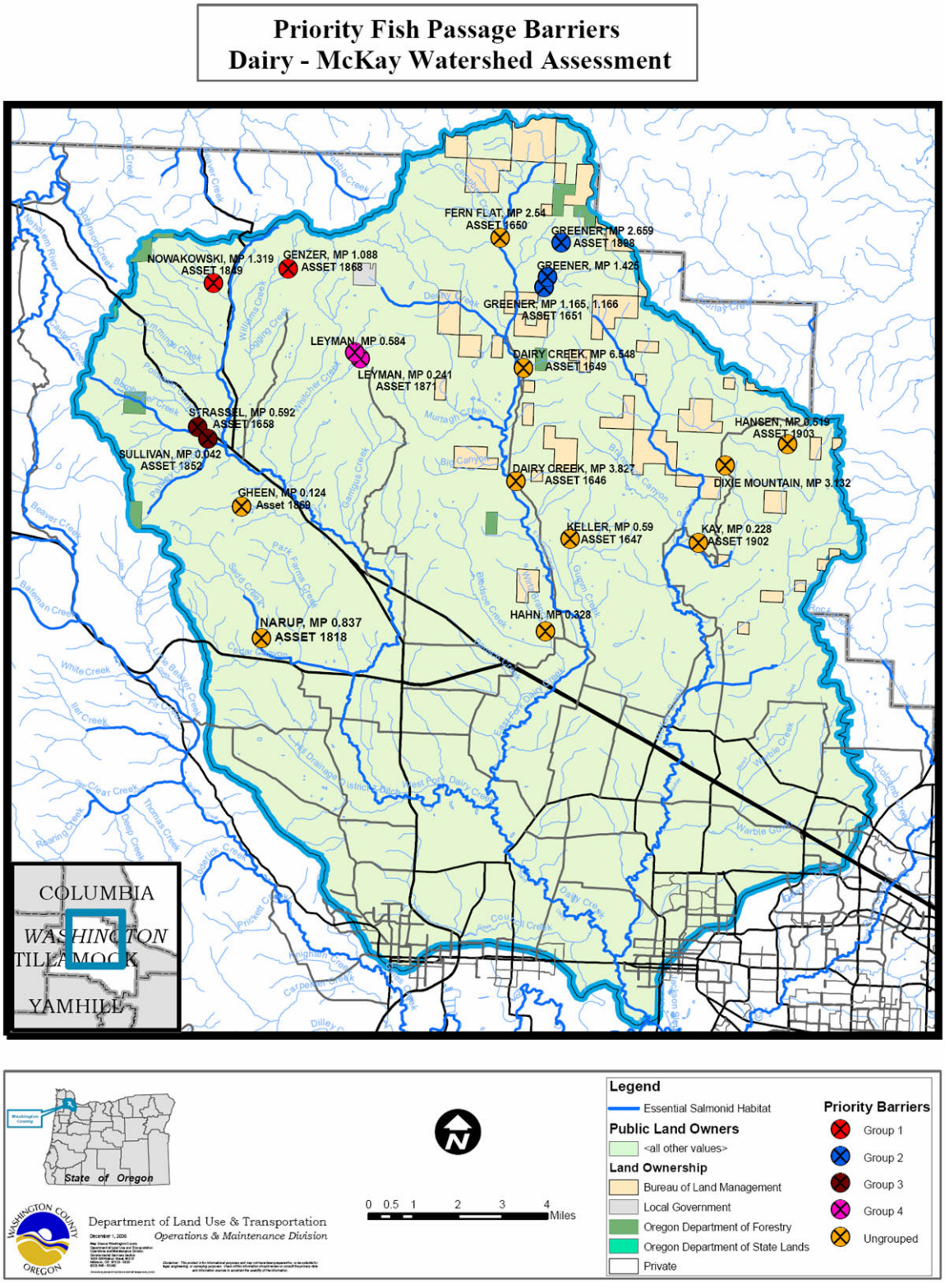
Methodology

To optimize the results of the Fish Passage Assessment, the high priority barriers were placed in groups based on geographic location, stream connectivity, and construction logistics Ten barriers were placed into four groups and the ungrouped culverts were considered stand alone projects. The grouping order does not reflect the priority of the barriers within a group (i.e. group 1 is not necessarily a higher priority than group 3).

Table 4. Culvert Groupings

Road	Milepost	Score	Rank	Upstream Habitat (mi)
Group 1				
Nowakowski Rd	1.319	11.92	2	3.7
Genzer Rd	1.088	11.82	3	1.8
Group 2				
Greener Rd	1.165 & 1.166	10.88	6	4.7
Greener Rd	2.659	10.79	9	2.9
Greener Rd	1.425	9.84	15	0.2
Group 3				
Sullivan Rd	0.042	10	11	7.8
Strassel Rd	0.592	9.98	13	2.0
Group 2				
Leyman Rd	0.241	10.87	8	0.6
Leyman Rd	0.584	9.87	14	0.9
Ungrouped Culverts				
Fern Flat Rd	2.54	12	1	5.2
Kay Rd	0.228	10.92	5	2.1
Keller Rd	0.59	10.64	10	1.9
Gheen Rd	0.124	9.74	16	1.3
Dixie Mountain Rd	3.132	9.66	17	0.2
Hansen Rd	0.519	9.65	18	0.6
Hahn Rd	0.328	9.57	19	2.1
Narup Rd	0.837	9	20	6.2
Culverts in the planning phase				
Dairy Creek Rd	6.548	11	4	4.7
Culverts scheduled to be replaced in 2007				
Dairy Creek Rd	3.827	10	12	1.0

Figure 3. High Priority Culverts



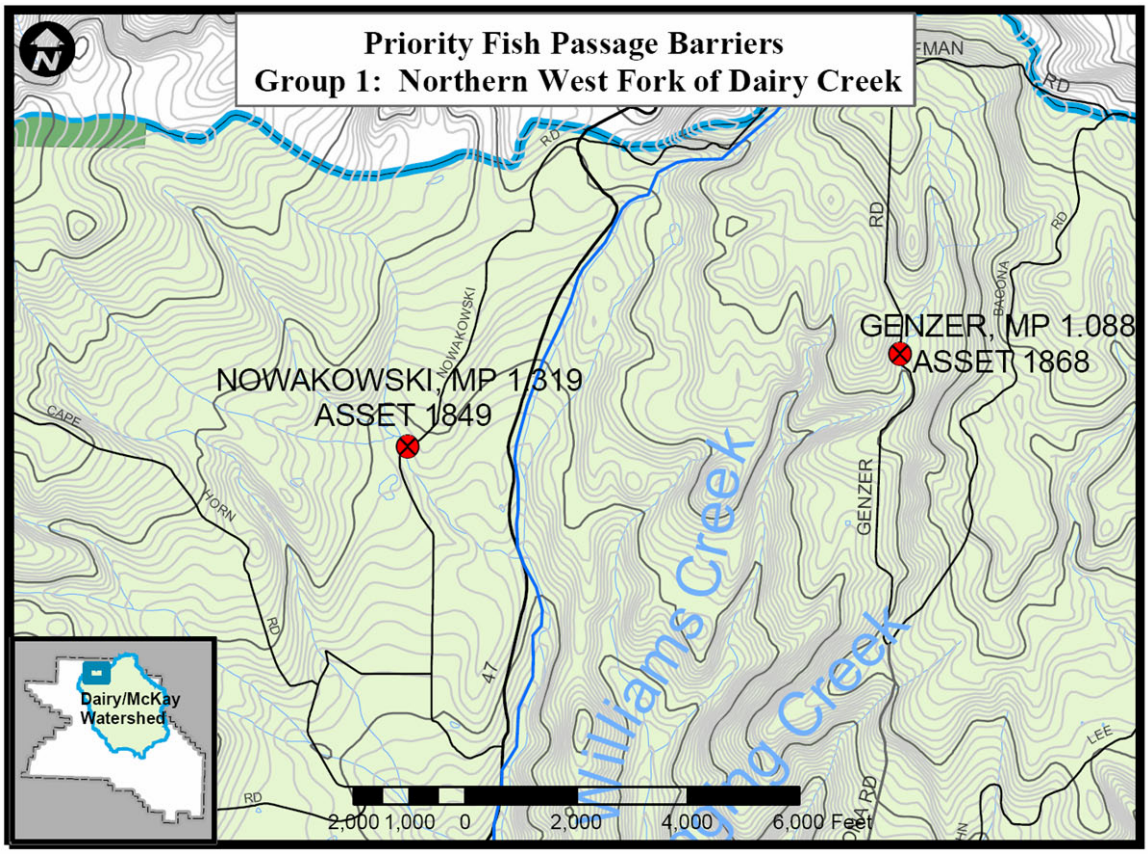
Group 1: Northern West Fork of Dairy Creek

Group 1 includes two high-ranking culverts in the northwestern portion of the watershed. Nowakowski Road milepost 1.319 and Genzer Road milepost 1.088, scoring second and third overall, carry high quality streams which flow into the West Fork of Dairy Creek. While not on the same road, these culverts were grouped together because they are present in the same system and could be replaced together in one construction season. If replaced, these culverts would provide access to 5.5 miles of high quality habitat.

Table 5. Northern West Fork of Dairy Creek group

Road	Milepost	Score	Rank	Upstream Habitat (mi)
Nowakowski Rd	1.319	11.92	2	3.7
Genzer Rd	1.088	11.82	3	1.8
			Total:	**5.5**

Figure 4 Group 1



Group 1: Northern West Fork of Dairy Creek

Culvert Location	
Road Name	Nowakowski Rd
Mile Post	1.319
Watershed	Dairy McKay
Stream Name	Tributary to West Fork Dairy Creek
Latitude	45deg44.197'N
Longitude	123deg12.195'
Culvert Key #	340015FD3F
County Asset #	1849
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	114
Width (ft)	4
Height (ft)	4
Outlet Perch (ft)	4.7
Slope	2.01%
Channel Information	
Upstream Gradient	3.25%
Bankfull width (ft)	8.00
Prioritization Analysis	
Habitat Length (mi)	1.814
Habitat Quality	8.6
Barrier Severity	3
Ditance to ESH (mi)	0.63
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	3
ESH Points	0.92
Total Points:	**11.92**

Culvert Key #	340015FD3F	Group	1

Group 1: Northern West Fork of Dairy Creek

Culvert Location	
Road Name	Genzer Rd
Mile Post	1.088
Watershed	Dairy McKay
Stream Name	Genzer Creek
Latitude	45deg44.489'N
Longitude	123deg10.394'W
Culvert Key #	340015FEC6
County Asset #	1868
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	39
Width (ft)	4
Height (ft)	4
Outlet Perch (ft)	3
Slope	2.95%
Channel Information	
Stream Gradient	3.00%
Bankfull width (ft)	9.5
Prioritization Analysis	
Habitat Length (mi)	3.685
Habitat Quality	8.4
Barrier Severity	3
Ditance to ESH (mi)	1.378
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	3
ESH Points	0.824
Total Points:	**11.82**

Culvert Key #	340015FD3F	Group	1

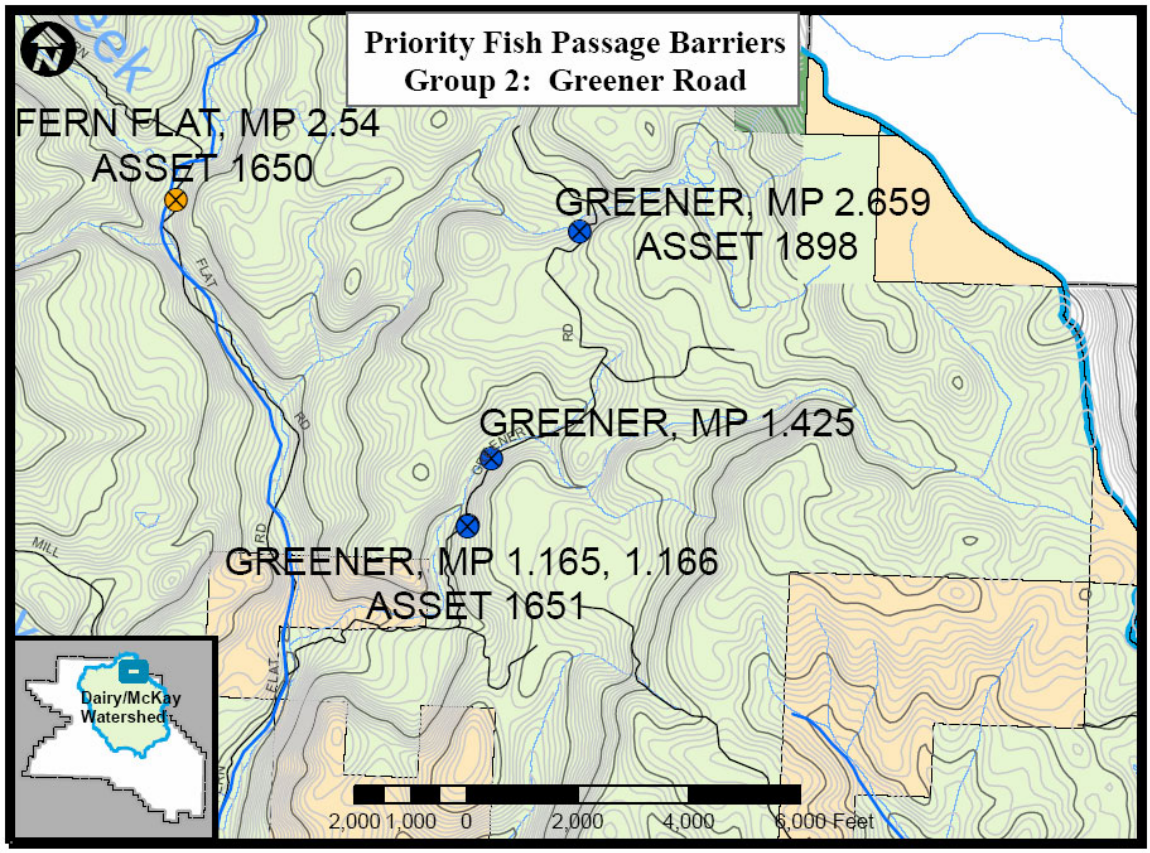
Group 2: Greener Road

Three barriers along Greener Road comprise Group 2 and block access to 7.7 miles of upstream habitat. The dual culverts present at milepost 1.165 carry Rock Creek, a tributary to the East Fork of Dairy Creek, and the culvert at milepost 1.425 carries a small tributary to Rock Creek. The final barrier is further north on Greener road and carries Panther Creek, also a tributary to the East Fork of Dairy Creek. Both Rock Creek and Panther Creek provide high quality fish habitat. Washington County has replaced several fish barriers within the East Fork of Dairy Creek system, and the replacement of these barriers would be a continuation of that work.

Table 6. Greener Road group

Road	Milepost	Score	Rank	Upstream Habitat (mi)
Greener Rd	1.165 & 1.166	10.88	6	4.7
Greener Rd	2.659	10.79	9	2.9
Greener Rd	1.425	9.84	15	0.2
			Total:	**7.7**

Figure 5. Group 2



Group 2: Greener Road

Culvert Location	
Road Name	Greener Rd
Mile Post	1.165, 1.166
Watershed	Dairy McKay
Stream Name	Rock Creek
Latitude	45deg44.392'N
Longitude	123deg03.313'W
Culvert Key #	340016011A
County Asset #	1651
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	30
Width (ft)	4, 3
Height (ft)	4, 3
Outlet Perch (ft)	0, 1.2
Slope	9.17%, 4.65%
Channel Information	
Upstream Gradient	2%
Bankfull width (ft)	12.5
Prioritization Analysis	
Habitat Length (mi)	4.67
Habitat Quality	8
Barrier Severity	2
Ditance to ESH (mi)	0.97
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	2
ESH Points	0.875
Total Points:	**10.88**

Culvert Key #	340016011A	Group	2

Group 2: Greener Road

Culvert Location	
Road Name	Greener Rd
Mile Post	1.425
Watershed	Dairy McKay
Stream Name	Tributary of Rock Creek
Latitude	45deg44.581'N
Longitude	123deg03.155'W
Culvert Key #	340016011D
County Asset #	
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	37
Width (ft)	2
Height (ft)	2
Outlet Perch (ft)	0.5
Slope	7.84%
Channel Information	
Upstream Gradient	11%
Bankfull width (ft)	6.25
Prioritization Analysis	
Habitat Length (mi)	0.17
Habitat Quality	7.6
Barrier Severity	4
Ditance to ESH (mi)	1.2
Habitat Length Points	1
Habitat Quality Points	4
Barrier Points	4
ESH Points	0.84
Total Points:	**9.84**

Culvert Key #	340016011D	Group	2

Group 2: Greener Road

Culvert Location	
Road Name	Greener Rd
Mile Post	2.659
Watershed	Dairy McKay
Stream Name	Panther Creek
Latitude	45deg45.258'N
Longitude	123deg02.779'W
Culvert Key #	340016011E
County Asset #	1898
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	31
Width (ft)	3
Height (ft)	3
Outlet Perch (ft)	0.58
Slope	10.94%
Channel Information	
Upstream Gradient	4%
Bankfull width (ft)	9
Prioritization Analysis	
Habitat Length (mi)	2.873
Habitat Quality	6
Barrier Severity	3
Ditance to ESH (mi)	1.2
Habitat Length Points	4
Habitat Quality Points	3
Barrier Points	3
ESH Points	0.79
Total Points:	**10.79**

Culvert Key #	340016011E	Group	2

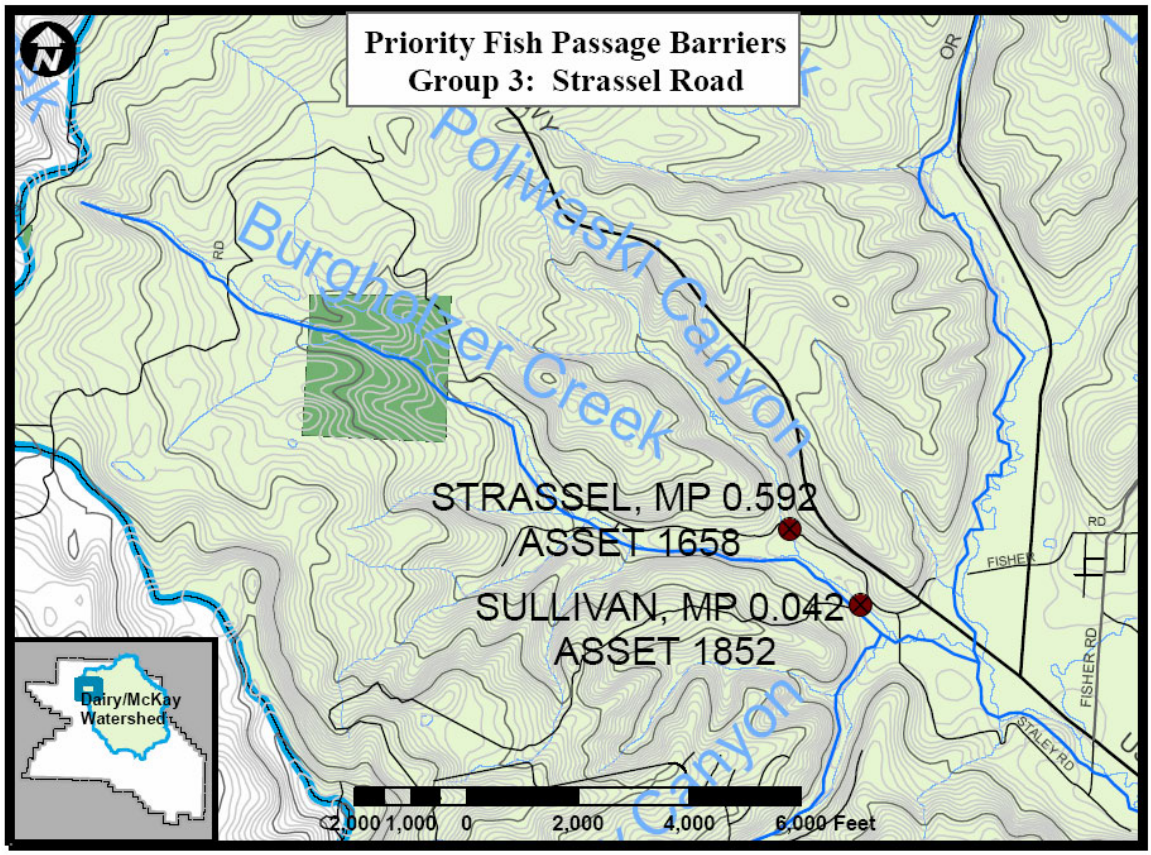
Group 3: Strassel Road

Group 3, comprised of the barriers on Sullivan road at milepost 0.042 and Strassel Road at milepost 0.592, bars access to 9.8 miles of upstream habitat. Sullivan Road crosses Burgholzer Creek, an ESH stream, and Strassel Road crosses Poliwaski Canyon Creek, which feeds into Burgholzer Creek 0.136 miles downstream of the barrier. Both streams provide excellent fish habitat. Washington County has another fish passage barrier on Strassel Road upstream of the Sullivan Road barrier that is scheduled for replacement during the summer of 2008. As that barrier will be replaced in the near future, it is not included in the overall barrier ranking report. Replacing the Strassel Road group will further the County's work to increase the stream connectivity of the Burgholzer Creek system.

Table 7. Strassel Road group

Road	Milepost	Score	Rank	Upstream Habitat (mi)
Sullivan Rd	0.042	10	11	7.8
Strassel Rd	0.592	9.98	13	2.0
			Total:	**9.8**

Figure 6. Group 3



Group 3: Strassel Road

Culvert Location	
Road Name	Sullivan Rd
Mile Post	0.042
Watershed	Dairy McKay
Stream Name	Burgholzer Creek
Latitude	45deg41.175'N
Longitude	123deg12.477'W
Culvert Key #	340015FD7F
County Asset #	1852
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	61
Width (ft)	8.33
Height (ft)	8.33
Outlet Perch (ft)	0.108
Slope	0.11%
Channel Information	
Upstream Gradient	1%
Bankfull width (ft)	13
Prioritization Analysis	
Habitat Length (mi)	7.789
Habitat Quality	7.5
Barrier Severity	1
Ditance to ESH (mi)	0.0
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	1
ESH Points	1.0
Total Points:	**10.0**

Culvert Key #	34001600F7	Group	3

Group 3: Strassel Road

Culvert Location	
Road Name	Strassel Rd
Mile Post	0.592
Watershed	Dairy McKay
Stream Name	Poliwaski Canyon Creek
Latitude	45deg41.391'N
Longitude	123deg12.820'W
Culvert Key #	340015FD59
County Asset #	1658
Culvert Information	
Shape	Circular
Material	Precast Concrete
Length (ft)	44
Width (ft)	4
Height (ft)	4
Outlet Perch (ft)	0
Slope	1.45%
Channel Information	
Upstream Gradient	2%
Bankfull width (ft)	7
Prioritization Analysis	
Habitat Length (mi)	2.006
Habitat Quality	7.5
Barrier Severity	1
Ditance to ESH (mi)	0.1
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	1
ESH Points	0.98
Total Points:	**9.98**

Culvert Key #	340015FD59	Group	3

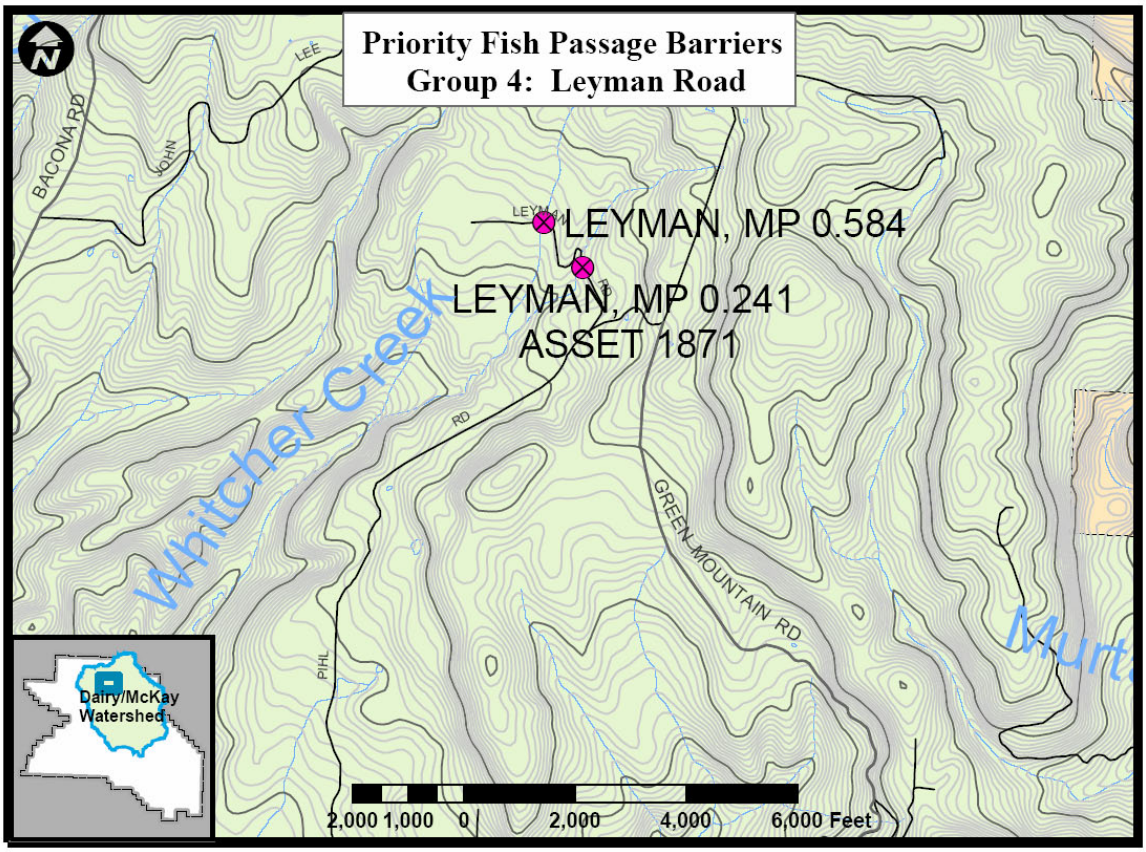
Group 4: Leyman Road

The Leyman Road barriers are close together and would be easy to replace at the same time. Providing access to 1.5 miles of upstream habitat, these two culverts are impassable at all flows.

Table 8. Leyman Road group

Road	Milepost	Score	Rank	Upstream Habitat (mi)
Leyman Rd	0.241	10.87	8	0.6
Leyman Rd	0.584	9.87	14	0.9
			Total:	**1.5**

Figure 7. Group 4



Group 4: Leyman Road

Culvert Location	
Road Name	Leyman Rd
Mile Post	0.241
Watershed	Dairy McKay
Stream Name	Tributary of Whitcher Creek
Latitude	45deg42.846'N
Longitude	123deg08.343'W
Culvert Key #	340015FE4F
County Asset #	1871
Culvert Information	
Shape	Circular
Material	Precast Concrete
Length (ft)	44
Width (ft)	3
Height (ft)	3
Outlet Perch (ft)	0.5
Slope	3.16%
Channel Information	
Upstream Gradient	3%
Bankfull width (ft)	6.25
Prioritization Analysis	
Habitat Length (mi)	0.597
Habitat Quality	8.5
Barrier Severity	4
Ditance to ESH (mi)	1.0
Habitat Length Points	2
Habitat Quality Points	4
Barrier Points	4
ESH Points	0.9
Total Points:	**10.87**

Culvert Key #	340015FE4F	Group	4

Group 4: Leyman Road

Culvert Location	
Road Name	Leyman Rd
Mile Post	0.584
Watershed	Dairy McKay
Stream Name	Whitcher Creek
Latitude	45deg42.951'N
Longitude	123deg08.508'N
Culvert Key #	340015FE51
County Asset #	
Culvert Information	
Shape	Circular
Material	Precast Concrete
Length (ft)	28
Width (ft)	2.5
Height (ft)	2.5
Outlet Perch (ft)	0.75
Slope	4.86%
Channel Information	
Upstream Gradient	8%
Bankfull width (ft)	7
Prioritization Analysis	
Habitat Length (mi)	0.861
Habitat Quality	7.8
Barrier Severity	3
Ditance to ESH (mi)	1.0
Habitat Length Points	2
Habitat Quality Points	4
Barrier Points	3
ESH Points	0.87
Total Points:	**9.87**

Culvert Key #	340015FE51	Group	4

Ungrouped Barriers

Several culverts did not have adjacent high priority barriers or were of significant complexity to warrant a stand alone project and were not included in any groups.

Table 9. Ungrouped barriers

Road	Milepost	Score	Rank	Upstream Habitat (mi)
Fern Flat Rd	2.54	12	1	5.2
Kay Rd	0.228	10.92	5	2.1
Keller Rd	0.59	10.64	10	1.9
Gheen Rd	0.124	9.74	16	1.3
Dixie Mountain Rd	3.132	9.66	17	0.2
Hansen Rd	0.519	9.65	18	0.6
Hahn Rd	0.328	9.57	19	2.1
Narup Rd	0.837	9	20	6.2
Culverts in the planning phase				
Dairy Creek Rd	6.548	11	4	4.7
Culverts scheduled to be replaced in 2007				
Dairy Creek Rd	3.827	10	12	1.0

Typical inaccessible habitat in Dairy-McKay Watershed

Fern Flat Road Culvert

The culvert at milepost 2.54 on Fern Flat Road ranked highest among all the barriers surveyed and provides an excellent opportunity to improve the quality and accessibility of fish habitat. It carries Campbell Creek, a third order stream with 5.2 miles of excellent habitat upstream of the culvert. With a width less than half the stream's bankfull width and a perch of two and a half feet, the culvert bars fish passage at all flows (determined by FishXing—Firor, Susan, et. al). The crossing occurs at Campbell Creek's confluence with the East Fork of Dairy Creek making it especially important because confluence areas provide unique, highly dynamic habitat for fish. Because Fern Flat Road is a narrow dead end road, replacement of this culvert proves especially difficult. A traffic bypass method will be needed, increasing the cost of replacement.

Culvert Location	
Road Name	Fern Flat Rd
Mile Post	2.54
Watershed	Dairy McKay
Stream Name	Campbell Creek
Latitude	45deg45.347'N
Longitude	123deg04.557'W
Culvert Key #	34001600F7
County Asset #	1650
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	61
Width (ft)	7
Height (ft)	7
Outlet Perch (ft)	2.58
Slope	4.13%
Channel Information	
Upstream Gradient	4%
Bankfull width (ft)	18
Prioritization Analysis	
Habitat Length (mi)	5.189
Habitat Quality	9.4
Barrier Severity	3
Ditance to ESH (mi)	0.0
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	3
ESH Points	1.0
Total Points:	**12.0**

Culvert Key #	34001600F7	Group	None

Kay Road Culvert

The Kay Road culvert at milepost 0.228 carries Neil Creek. Replacing this barrier will connect the upper section of Neil Creek to McKay Creek.

Culvert Location	
Road Name	Kay Rd
Mile Post	0.228
Watershed	Dairy McKay
Stream Name	Neil Creek
Latitude	45deg39.549'N
Longitude	122deg58.705'W
Culvert Key #	3400160162
County Asset #	1902
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	60
Width (ft)	3
Height (ft)	3
Outlet Perch (ft)	1.21
Slope	1.55%
Channel Information	
Upstream Gradient	2%
Bankfull width (ft)	7
Prioritization Analysis	
Habitat Length (mi)	2.099
Habitat Quality	6.9
Barrier Severity	3
Ditance to ESH (mi)	0.61
Habitat Length Points	4
Habitat Quality Points	3
Barrier Points	3
ESH Points	0.92
Total Points:	**10.92**

Culvert Key #	3400160162	Group	None

Keller Road Culvert

The culvert at milepost 0.59 on Keller Road carries Gumm Creek which eventually flows into the East Fork of Dairy Creek. Washington County has replaced two culverts downstream on the Gumm Creek system, so replacing the Keller Road culvert would serve to further link the system.

Culvert Location	
Road Name	Keller Rd
Mile Post	0.59
Watershed	Dairy McKay
Stream Name	Gumm Creek
Latitude	45deg39.460'N
Longitude	123deg02.276'W
Culvert Key #	34001600A2
County Asset #	1647
Culvert Information	
Shape	Circular
Material	Precast Concrete
Length (ft)	30
Width (ft)	3.5
Height (ft)	3.5
Outlet Perch (ft)	1.5
Slope	0.00%
Channel Information	
Upstream Gradient	2%
Bankfull width (ft)	5.25
Prioritization Analysis	
Habitat Length (mi)	1.872
Habitat Quality	7.9
Barrier Severity	2
Ditance to ESH (mi)	2.78
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	2
ESH Points	0.64
Total Points:	**10.64**

Culvert Key #	34001600A2	Group	None

Gheen Road Culvert

The culvert at milepost 0.124 on Gheen Road carries Kuder Creek and would provide access to 1.3 miles of habitat if replaced.

Culvert Location	
Road Name	Gheen Rd
Mile Post	0.124
Watershed	Dairy McKay
Stream Name	Kuder Creek
Latitude	45deg39.859'N
Longitude	123deg11.516'W
Culvert Key #	340015FECA
County Asset #	1869
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	40
Width (ft)	3
Height (ft)	3
Outlet Perch (ft)	0
Slope	2.95%
Channel Information	
Upstream Gradient	2%
Bankfull width (ft)	6.75
Prioritization Analysis	
Habitat Length (mi)	1.269
Habitat Quality	7.8
Barrier Severity	2
Ditance to ESH (mi)	2.01
Habitat Length Points	3
Habitat Quality Points	4
Barrier Points	2
ESH Points	0.74
Total Points:	**9.74**

Culvert Key #	340015FECA	Group	None

Dixie Mountain Road Culvert

The culvert at milepost 3.123 on Dixie Mountain Road poses a barrier to fish, provides access to 0.2 miles of habitat, and does not have an easy bypass for traffic during construction. For these reasons, this barrier will not receive immediate attention.

Culvert Location	
Road Name	Dixie Mountain Rd
Mile Post	3.132
Watershed	Dairy McKay
Stream Name	Tributary of Neil Creek
Latitude	45deg41.060'N
Longitude	122deg58.073'W
Culvert Key #	3400160198
County Asset #	
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	72
Width (ft)	2
Height (ft)	2
Outlet Perch (ft)	1
Slope	4.00%
Channel Information	
Upstream Gradient	1%
Bankfull width (ft)	2.5
Prioritization Analysis	
Habitat Length (mi)	0.201
Habitat Quality	7.5
Barrier Severity	4
Ditance to ESH (mi)	2.7
Habitat Length Points	1
Habitat Quality Points	4
Barrier Points	4
ESH Points	0.66
Total Points:	**9.66**

Culvert Key #	3400160198	Group	None

Hansen Road Culvert

The culvert at milepost 0.519 on Hansen Road will not be immediately pursued due to social issues surrounding the area.

Culvert Location	
Road Name	Hansen Rd
Mile Post	0.519
Watershed	Dairy McKay
Stream Name	Tributary of East fork of McKay Creek
Latitude	46deg41.400' N
Longitude	122deg56.355' W
Culvert Key #	340016016B
County Asset #	1903
Culvert Information	
Shape	Circular
Material	Corrugated Aluminum
Length (ft)	40
Width (ft)	4
Height (ft)	4
Outlet Perch (ft)	0.083
Slope	9.52%
Channel Information	
Upstream Gradient	1%
Bankfull width (ft)	5.5
Prioritization Analysis	
Habitat Length (mi)	0.633
Habitat Quality	8.2
Barrier Severity	3
Ditance to ESH (mi)	2.7
Habitat Length Points	2
Habitat Quality Points	4
Barrier Points	3
ESH Points	0.66
Total Points:	**9.66**

Culvert Key #	340016016B	Group	None

Hahn Road Culvert

The culvert at milepost 0.328 on Hahn Road is in very poor structural condition with a remaining design life of approximately 5 years. Washington County replaces all culverts on fish bearing streams to fish passage standards; when replaced the project will provide access to 2.1 miles of upstream habitat.

Culvert Location	
Road Name	Hahn Rd
Mile Post	0.328
Watershed	Dairy McKay
Stream Name	Wirtz Branch Creek
Latitude	45deg37.626'N
Longitude	123deg02.919'W
Culvert Key #	340015FE89
County Asset #	1903
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	34
Width (ft)	2.5
Height (ft)	2.5
Outlet Perch (ft)	0.04
Slope	2..41%
Channel Information	
Upstream Gradient	1%
Bankfull width (ft)	5.5
Prioritization Analysis	
Habitat Length (mi)	2.137
Habitat Quality	5
Barrier Severity	2
Ditance to ESH (mi)	3.3
Habitat Length Points	4
Habitat Quality Points	3
Barrier Points	2
ESH Points	0.58
Total Points:	**9.58**

Culvert Key #	340015FE89	Group	None

Narup Road Culvert

The culvert at milepost 0.837 on Narup Road carries Sadd Creek, an ESH stream, and would provide access to 6.2 miles of upstream habitat if replaced. Although it is only a partial barrier, replacing this culvert would open up significant fish habitat to multiple species and life histories.

Culvert Location	
Road Name	Narup Rd
Mile Post	0.837
Watershed	Dairy McKay
Stream Name	Sadd Creek
Latitude	45deg37.289'N
Longitude	123deg10.840'N
Culvert Key #	340015FE12
County Asset #	1818
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	62
Width (ft)	4
Height (ft)	4
Outlet Perch (ft)	0
Slope	0.00%
Channel Information	
Upstream Gradient	1%
Bankfull width (ft)	8.5
Prioritization Analysis	
Habitat Length (mi)	6.243
Habitat Quality	5.9
Barrier Severity	1
Ditance to ESH (mi)	0.0
Habitat Length Points	4
Habitat Quality Points	3
Barrier Points	1
ESH Points	1.0
Total Points:	**9.0**

Culvert Key #	340015FE12	Group	None

Dairy Creek Road Culvert, milepost 6.548

The Dairy Creek Road culvert at milepost 6.548 is currently in the preliminary design phase of replacement and the site may require a bridge rather than a culvert. When completed, the replacement will reopen 4.7 miles of historical salmonid habitat on Plentywater Creek. A previous ODFW assessment designated the culvert as a high priority barrier, adding to the County's desire to remove the barrier.

Culvert Location	
Road Name	Dairy Creek Rd
Mile Post	6.548
Watershed	Dairy McKay
Stream Name	Plentywater Creek
Latitude	45deg42.734'N
Longitude	123deg03.755'W
Culvert Key #	3400160154
County Asset #	1649
Culvert Information	
Shape	Arch
Material	Cast-in-Place Concrete
Length (ft)	54
Width (ft)	4
Height (ft)	6
Outlet Perch (ft)	0.67
Slope	2.22%
Channel Information	
Upstream Gradient	3%
Bankfull width (ft)	10.5
Prioritization Analysis	
Habitat Length (mi)	4.67
Habitat Quality	8.2
Barrier Severity	2
Ditance to ESH (mi)	0.0
Habitat Length Points	4
Habitat Quality Points	4
Barrier Points	2
ESH Points	1.0
Total Points:	**11.0**

Culvert Key #	3400160154	Group	None

Dairy Creek Road Culvert, milepost 3.827

The culvert at milepost 3.827 is scheduled for replacement during the 2007 construction season and will provide 1.0 mile of upstream habitat. The replacement of both Dairy Creek Road culverts will serve to increase stream connectivity and refuge habitat along the East Fork of Dairy Creek.

Culvert Location	
Road Name	Dairy Creek Rd
Mile Post	3.827
Watershed	Dairy McKay
Stream Name	Tributary of East Fork Dairy Creek
Latitude	45deg40.525'N
Longitude	123deg03.906'W
Culvert Key #	3400160148
County Asset #	1646
Culvert Information	
Shape	Circular
Material	Corrugated Steel
Length (ft)	70
Width (ft)	3
Height (ft)	3
Outlet Perch (ft)	2
Slope	2.71%
Channel Information	
Upstream Gradient	1%
Bankfull width (ft)	7.5
Prioritization Analysis	
Habitat Length (mi)	0.997
Habitat Quality	7.5
Barrier Severity	3
Ditance to ESH (mi)	0.0
Habitat Length Points	2
Habitat Quality Points	4
Barrier Points	3
ESH Points	0.998
Total Points:	**9.998**

Culvert Key #	3400160148	Group	None

V. Conclusion

The fish passage assessment of the Dairy-McKay watershed indentifies the existing barriers and establishes a foundation for future assessments throughout Washington County. Of the 164 surveyed culverts, 96% are full or partial barriers to fish passage. The inventory and prioritization reveals that many of the high priority barriers are located in the upper reaches of the watershed. The survey indicates many of the culverts maintained by Washington County may pose barriers to fish at certain flows, affirming the County's decision to install fish passable culverts on all fish bearing streams. Because of limited resources, replacement of all barriers owned by Washington County will take decades. Barriers will be considered for replacement with a better understanding of their priority relative to the other barriers in the watershed. Ultimately, Washington County intends to inventory and prioritize all of its barriers to better focus resources on the most important ones. The Diary-McKay fish passage assessment provides the needed framework to systematically approach barrier replacement and underscores the need for partnerships with other organizations to achieve greater connectivity and access key habitat within the Tualatin River watershed.

Fern Flat culvert at confluence of E Fork Dairy Creek & Campbell Creek

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Appendices

A. Map of BLM culverts surveyed
B. Fish Passage Through Road Crossing Assessment
C. County Fish Passage Assessment Form
D. BLM. Coarse Screen Filter—Juvenile salmonid passage evaluation criteria Version 2.2.
E. Wildlife Habitat Assessment
F. High Priority Barrier Raw Data